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The Effect of Computerized Cognitive Remediation on Executive Function and Subjective Well-being in Patients with Chronic Alcohol Dependence

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ABSTRACT

Chronic alcoholism considered as most prevalent neuropsychiatric problem. It is a major medical condition which also implies cognitive impairments disturbing various neuro-psychological functions. Many Empirical studies confirm that people with chronic alcohol dependence have a high rate of cognitive impairments, especially deficits in executive functions. Various innovative computer-based interventions for psychiatric disorders have been developed especially for cognitive remediation. In recent times much interest has been focused on using Posit Science Brain training exercises which is based on the theory of neuroplasticity for enhancement of executive functions. This module emphasizes generalization or extension of benefits beyond the trained task. The overall changes in cognitive functions are to improve the subjective well-being. This study examined this novel computerized intervention to determine its effect on executive functions of patients with chronic alcohol dependence. After the detoxification phase, patients were assigned to cognitive training group (experimental group) and in treatment as usual group (control group). The pre- post assessment results were also noted. The statistical analysis indicated computerized cognitive remediation therapy group presented greater improvements in speed processing, attention, working memory and mental flexibility whereas the control group did not. Moreover, the computerized cognitive remediation group showed a clear improvement in all domains of subjective well-being.

Key Words : Executive function, Patients, Chronic alcoholism, Psychiatric disorders

INTRODUCTION

Alcohol addiction has been considered as one of the major public health problem in our country. Recent National Drug survey 2019 conducted by Ministry of Social Justice and Empowerment, Govt of India reported that alcohol is the most common psychoactive substance used by Indians (M/0 SJ&E, 2019).It also reveals that, nearly one in five alcohol users suffers from alcohol dependence related problems and needs critical treatment. Alcoholism can be simply defined as the state of individuals in which they are unable to resist their urges to consume alcohol and thereby becoming highly dependent on alcohol for their normal daily functioning (WHO, 2018). Chronic alcoholism considered as most prevalent neuropsychiatric problem and it is characterized by elevated state of craving, with obtaining alcohol regardless of devastating impacts on health, interpersonal and occupational functioning and a high vulnerability to relapse after cessation of drinking (Spanagel and Falk, 2008). It has been well documented that, because of alcoholic neurotoxicity, chronic alcoholism leads to harmful effects on central nervous system and its functions (Campanella *et al.*, 2011). In other words, it is connected with impairments in several areas of neurobiological activities. Empirical evidence confirms

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that people with chronic alcohol dependence have a high rate of cognitive impairments especially deficit in executive functions Weiss *et al.* (2014). Executive functions are multifaceted cognitive abilities of frontal-brain that comprise planning, working memory, mental flexibility, inhibitory control, Processing speed, verbal and perceptual skills (Assis Faria *et al.,* 2015). Besides, it has direct impact on emotional processing, motivational and adaptive social skills (Diamond, 2013).

Alcoholism and Neuropsychological issues:

Various studies pointed out that chronic alcoholism especially associated with dysfunction in overall cognitive functions (Durazzo *et al.,* 2007). Frontal executive impairments in these patients include deficits in problem solving, abstraction, planning, organizing and working memory (Bates *et al.,* 2005). Furthermore, as psychomotor performance and short-term memory, verbal recall, visuospatial ability improve or return to normal levels after abstinence. Executive function impairments do persist even after long periods of abstinence (Olivier *et al.,* 2009). According to Ihara's (2000) observations on persons with alcohol dependence, have classified four profiles based on their nature and levels of impairment : (i) Cognitive impairment has been not developed, (ii) Minor executive deficits with no impairment of memory and overall cognitive efficiency, (iii) Dysexecutive syndrome along with memory impairments and preservation of general cognitive efficiency, and (iv) Global impairment, which includes problems in general cognitive efficiency, executive functions and memory. Sofuoglu *et al.* (2013) documented that, response inhibition, working memory and sustained attention of executive functioning are predominantly relevant for chronic substance use disorders.

Like advanced laboratory investigations, a variety of neuropsychological tests that can impart information on the structural unity of brain and its functions. It can provide both general and specific details of current level of cognitive function. Trial Making Test, Digit Forward and Backward Test, Stroop Test, Wisconsin Card Sorting Test are most frequently used for analyzing cognitive function in a very wide verity of neuropsychological and psychiatric disorders in recent years (Assis Faria, 2015).

Computerized cognitive remediation:

A variety of different approaches to cognitive remediation have been developed and evaluated over the past few decades. Plenty of data proves that 50–80% of patients presenting to alcohol treatment are showing signs of cognitive dysfunctions (Bates *et al.*, 2002). Additional, its pervasiveness and severity disrupt treatment engagement and prognosis (Bates *et al.*, 2006). Enhancing the existing addiction treatment programmes has been suggested to improve commitment and patient outcomes (Bates *et al.*, 2002). Recently updated systematic reviews of evidence based practices of cognitive rehabilitation in patients with brain impairment, recommended that comprehensive brain training could improve executive functions and reduce cognitive and functional disability (Cicerone, 2019). Since a decade many advanced computer-based interventions for psychiatric disorders have been refined and are capable of drug use disorders due to reduced cost and greater availability compared to traditional treatment (Spek *et al.*, 2007). Many literatures on treatment for cognitive impairment in patients with chronic alcohol and other substance users suggests novel computer based cognitive remediation programs are highly effective than traditional methods (Sofuoglu *et al.,* 2014; Hagovaka *et al.,* 2017). Computerized cognitive training is a mode of management makes use of computer-assisted cognitive exercises to raise impaired cognitive functions and subjective well-being of an individual (Chan Joyce *et al.*, 2015). These cognitive interventions are mostly rehearsal based strategies emphasizing visuo-auditory stimulation to target executive function and was meant at improving multiple domains of cognitive performance and subjective well-being (Miotto *et al.*, 2018). Much research evidence shows that cognitive activation through game based exercises and computerized training strategies can be used for cognitive rehabilitation (Hubert-Wallander *et al.*, 2011). Since past few years much interest has been focusing on using Posit Science Brain training exercises which is based on the theory of neuroplasticity for enhancement of mental flexibility, attention, processing speed, memory and problem solving capacities (Posit Science, 2006). This procedure emphasizes generalization or extension of benefits further than the trained task. Present study of patients with chronic alcohol dependence also comprises a model of brain plasticity based cognitive rehabilitation (Bernardin *et al.*, 2014). We also observed that only a few research presently exists for long term rehabilitation of chronic alcohol and related conditions.

Bickel *et al.* (2011) reported that computer delivered cognitive training which emphasizing executive

function resulted in significant reductions in an aspect of impulsivity, delay discounting among stimulant users. Similarly, Fisher *et al.* (2009) investgated that 55 schizophrenic subjects were randomly assigned to either 50 hours of Posit Science-Computerized auditory training, using computer exercises. The relative to the control group, subjects who received active training showed significant gains in global cognition, working memory, verbal learning and memory. Another study by Fisher *et al*. (2014) pointed that using Posit Signs neuroplasticity-based auditory module training of 40 hours via laptop computer, demonstrated significant improvement in global cognition, verbal memory and problem solving compared with control subjects. Another study also documented that neuroplasticity based computerized rehabilitation of Posit Science over four weeks shown significant improvement in executive function of geriatric depressive patients (Morimoto *et al.*, 2016). Likewise, in accordance with a previous posit science study by Barnes *et al.* (2009), present study has been given cognitive retraining for 60 Minutes of two sessions per day. This procedure emphasizes global changes in cognitive functions are to improve the quality of life and subjective well-being (Posit Science, 2006; Wolinsky *et al.,* 2009).

Subjective wellness :

Subjective well-being refers to individual's satisfaction with their lives as a whole or with the individual domains of their lives (Cummins *et al.*, 2004). It also constitute person's cognitive and emotional appraisal. It was observed that individuals with alcohol and other substance dependence have lower subjective well-being than do those in the general population. Moreover, poorer health and interpersonal relationships in substance addictives are linked with lower subjective well being (Miller *et al.*, 2014). Studies have brought forth that cognitive training has a positive effect on cognitive function as well as, preservation of cognitive function is directly linked with enhancement of individual's adaptive skills and better well-being (Bures *et al.*, 2016).

As per the various studies, operational definition of 'chronic alcoholism' according to present study is patients those who consume alcohol actively and dependent for the duration of eight years and above (Kissin and Begleiter, 1972; Vaillant, 1995). There is no doubt on impaired social-vocational functioning and poor subjective well being of life in chronic alcohol dependent patients that generally follow the emergence of various psychopathologies. The present study aims to explore whether computerized cognitive rehabilitation can be of clinical use in reducing the cognitive deficits as well as subjective well being. We also assume that patients who benefit from computerized cognitive training will experience significant improvements in subjective wellness. Therefore, the present study carried following research null hypotheses:

(i) There will be no significant change in the executive functioning of patients with chronic alcohol dependence with and without cognitive remediation.

(ii) There will be no significant change in subjective well-being with and without remediation.

METHODOLOGY

Sample:

This was a hospital based Case Control Study conducted at the SS. Raju Centre for Addiction Psychiatry, C.I.P, Ranchi. Total sample size was 50, consisting of two groups of 25 individuals with alcohol dependence syndrome according to ICD-10- DCR. After the detoxification phase, patients who were given concern and fulfilled the inclusion and exclusion criteria were taken up for the study. By using randomization method, patients were assigned to cognitive training group (Experimental group) or in treatment as usual group (Control group). Baseline assessments were done with SAD-Q, CIWA-R, HAM-A, SUBI, ESDST, S.C.W.T, W.C.S.T and TMT. The patients selected for cognitive remediation were given cognitive retraining in Behavior Therapy Room. Trainings were given twice a day i.e. morning and evening for 6 days in a week. Each session took 45-60 minutes and it was continued for 20 days for each patients. Post assessment was done by using measures of SUBI, ESDST, S.C.W.T, W.C.S.T and T.M.T. In the same way, baseline assessment was done in Control group as in Experimental group. After 20 days, the post assessment was done like in Experimental group.

(SAD-Q- Severity of Alcohol Dependence Questionnaire, CIWA-R- Clinical Institute Withdrawal Assessment of Alcohol Scale-Revised, HAM-A Hamilton Anxiety Rating Scale, SUBI-Subjective Well Being Inventory, ESDST-Eysenck's Series of Digit Span Test, SCWT- Stroop Color Word Test, WCST- Wisconsin Card Sorting Test and TMT- Trial Making Test)

Inclusion criteria:

1. Patient fulfilling criteria for alcohol dependence

syndrome as per ICD-10 DCR.
2. Alcohol dependence pattern should be 8 or above years.
3. Clinical Institute Withdrawal Assessment of Alcohol Scale-Revised (CIWA-R) Score below 10.
4. Age range between 18 to 55 years.
5. Male Gender.
6. Education more than 8th standard.

Exclusion criteria:

1. Mental retardation and Co-morbid psychiatric conditions.
2. Co-morbid general medical illness (requiring additional treatment).
3. History of other substances used except nicotine and caffeine.
4. Education below 8th standard.
5. HAM-A score above 18.

Tools:

Social demographic and clinical datasheet:

Age, Duration of dependence, Education, Marital status, Occupation, Religion, Socio-eco status and Habitat were collected from patients.

Severity of Alcohol Dependence Questionnaire (SAD-Q):

The SAD-Q is a 20 item questionnaire designed to measure the severity of dependence on alcohol which has demonstrated high reliability and validity. The 20 items of SAD-Q are all scored as follows: 0=never or almost never, 1= sometimes 2= often,3= nearly always.

Clinical Institute Withdrawal Assessment of Alcohol Scale-Revised (CIWA-R)

CIWAR-R scale is the most widely used instrument for assessing alcohol withdrawal. It is a 10 item scale for the quantification of the severity of alcohol withdrawal. A score of 15 or above is considered a cut off point for increased risk of severe alcohol withdrawal effects. Score of < 8 indicates mild withdrawal, score 8 – 14 indicate moderate withdrawal and score less than 10 do not usually require use of medication for treatment.

Hamilton Anxiety Rating Scale (HAM-A):

Hamilton developed this rating scale to assess the severity of symptoms in anxious individuals. The scale consists of 14 items and is a semi structured interview measure. In this scale, interviewer rates the individual on a five point scale of severity of the items. These ratings summed up for a total score, which can range from 0 to 56 with higher scare indicating greater anxiety.

The Subjective Well Being Inventory (SUBI):

SUBI has been designed to measure the extent of well-being or ill-being experienced by an individual or a group of individuals in various day to day life. There are 40 items and has 11 sub domains in it. Each item is to be rated on a three points scale

The Eysenck's Series of Digit Span Test:

The test is a part of PGI battery of brain dysfunction. It consist two parts digit forward and digit backward. It measures attention and concentration. For digit span forward, the examiner reads a sequence of digits and asks examinee to report the digits in the same sequence. For digit span backward, the examiner reads sequences of digits and asks examinee to repeat the same digits but in the reverse order. Sequences of increasing length are administered in both conditions. In the scoring, count the number of digits separately, both for digit forward and digit backward, reproduced correctly on the longest item. The connection between Working Memory and Digit Span is based in part on a relationship between Working Memory and prefrontal cortex activities.

The Stroop Color Word Test (SCWT):

The stroop color word test was developed by stroop it was used to measure the relative speed of reading words, naming colors and used to print an incongruous color name. The stroop test has traditionally been viewed as measures of executive functioning in response inhibition. It consists of three pages word, color and color-word. Each page has 100 items. In the word page it is written as XXXX, printed either in Red, Green or Blue ink and ask the subject to name the color quickly and the color-word page consists of the words from the word page printed in the colors from the color page. The two pages were blended to each cards and the examinee ask to name the color of the ink the words printed in, ignoring the word that is printed for each item. The subject should allow 45 seconds for each page.

The Wisconsin Card Sorting Test (WCST):

The Wisconsin Card Sorting Test (WCST) is a

standard test used to assess working memory and executive functions. The Wisconsin Card Sorting Test (WCST) consists of four stimulus card and 128 response cards that depict figure of varying forms (crosses, circles, triangles, or stars), colours (red, blue, yellow, or green) and number of figures (one, two, three, or four).In this test the patient must sort a sequence of cards according to colour, form or number with correct category without noticing each time the criterion of 10 consecutive correct responses is reached. Over the evidence from studies of children and adults suggests that the WCST is valid measure of executive function in neurologically mild to severe impaired populations from seizures disorders to schizophrenia and chronic substance used disorders find impaired performance levels compared with those of normal adults.

The Trail Making Test (TMT):

The trail making test is an extensively used neuropsychological test to reflect a wide variety of cognitive processes including visual search, sequencing and shifting, psychomotor speed, flexibility and ability to execute and modify a plan of action. The task requires a subject to connect- the – dots of 25consecutive targets on a sheet of paper the test has two parts. Part A in which the targets are all numbers (1, 2, 3, etc.) and B, in which the subjects alternates between numbers and letters (1, A, 2, B, etc.) the goal of the subject is to finish the test as quickly as possible, and the time taken to complete the test is used as the primary performance metric. Part A of the test measures psychomotor speed. The results of part B reflect the ability to shift strategy and assess executive function and visuo-spatial working memory.

Brain fitness training, posit science:

Posit Science is a computerized cognitive training program based on the brain plasticity model. It consist of a set of cognitive workouts intended to improve the speed and accuracy of visuo-auditory as well as executive function, while engaging neuromodulatory systems involved in attention and reward (Posit Science, 2006). The objective of this Neuro-plasticity based cognitive training is to enhance and preserve cognitive abilities through the use of fun mental workouts (Lianne, 2007). This module emphasizes repeated auditory stimulation, which activates brain plasticity by strengthening and remodel neuronal pathways (Posit Science, 2006). In order to comprehend and manipulate the visual or verbal stimuli, the brain must first generate precise and reliable neurological responses that represent the frequency, timing, and complex sequential relationships between speech sounds. This program manually trains attention and retention skills through initiation of 'click the start button' repeatedly, before each workout is aimed to force active attentiveness. Next feature is rewarding by points, correct answer dings and fun animations which motivates and increase the likelihood of learning. In addition, through the novelty features *i.e.* different animations also increases attention and retention process (Posit Science, 2006). At the initial phase of training in all exercises, visuo-auditory stimuli are advanced to increase the rapid temporal transitions within the sound stimuli by mounting their amplitude and stretching them in time. The purpose of this higher cognitive function processing is to augment the effectiveness with which these stimuli engage and drive plastic changes in brain auditory systems in which individuals with cognitive deficits exhibit relatively poor temporal responses (Posit Science, 2006). We have noticed that more beneficial clinical studies have come with auditory model of posit science, so the present study has taken this 40 session of brain exercises programme. During each session, a participant works with six exercises which would monitor by software. Studies indicated that this brain plasticity- based program improved overall cognitive functions, communication skills, memory, self confidence and optimism or general wellness (Posit science, 2006; Desma, 2009).

Statistical analysis:

For the analysis of collected data, IBM SPSS 23.0 windows version was used. Descriptive statistics such as mean and SD were used to summarize the continuous variables and frequency for categorical variables. Group difference for sample characteristics was examined with independent t-test and chi-square test. To compare the overall effect of treatment (Cognitive retraining and Treatment as usual) Paired Samples Statistics was used. In this study, a level of significance of <0.05 (two tailed) will take to consider a result statistically significant.

RESULTS AND DISCUSSION

The present study was designed to assess the efficacy of Computerized Cognitive Remediation for the management of cognitive deficits and subjective wellness in patients with chronic alcohol dependence. The

statistical analysis shows there were no significant difference between experimental and control group in terms of age (p=.943), duration of dependence (p=.219), education (p=.265), marital Status (p=.478), occupation (p=.734), socio-eco status (p=.534), religion (p=.736) and habitat (p=.935). Like similar demographic profile, there were no significant differences in baseline scores or clinical measures among experimental and control groups. The present study showed there was significant improvement in all cognitive performance measures after the computerized remediation treatment. Even though we noticed overall improvements in the all samples on neuropsychological as well as subjective wellness measurements, participants who received cognitive retraining did show greater increase in scores in all domains. This finding is in agreement with a recent systematic review conducted by Shaoqing *et al.* (2018) observed the effect of advanced computerized intervention on patients with cognitive impairments had significant effect on all domains of cognitive function as well as subjective wellness in majority studies. They have concluded that computerized cognitive remediation is a promising one in managing mild cognitive impairments. The results showed in our study according to ESDST, SCWT, WCST and TMT indicating that computerized cognitive remediation therapy group presented overall improvements ($p<0.01$) in speed of processing, attention, working memory and mental flexibility, while all the tested measures in the control group were not significantly improved. Our within- group paired t- test showed that

Table 1.1 : Socio-demographic characteristics between experimental group and control group (N=50)

Sr. No.	Variables		Experimental group(N=25)	Control group (N=25)	X^2/ Fisher exact test	(df)	p
1.	Education	Inter	12 (24.0)	18(36.0)	3.09#	(2)	.265
		U.G	10(20.0)	6(12.0)			
		P.G and above	3(6.0)	1(2.0)			
2.	Marital	Married	16 (32.2)	20 (40.0)	1.65#	(2)	.478
		Unmarried	7 (14)	(8.0)			
		Sep/Divorced	2 (4.0)	1 (2.0)			
3.	Religion	Hindu	13 (26.0)	10 (20.0)	.904#	(2)	.736
		Muslim	3 (6.0)	3 (6.0)			
		Christian	9 (18.0)	12 (24.0)			
4.	Occupation	Farmer	5 (10.0)	7 (14.0)	.619	(2)	.734
		Business	12 (24.0)	12 (24.0)			
		Service/Professional	8 (16.0)	6 (12.0)			
5.	Socio-economic status	Lower	9 (18.0)	13 (26.0)	.1.49#	(2)	.534
		Middle	14 (28.0)	10 (20.0)			
		Upper	2 (4.0)	2 (4.0)			
6.	Habitat	Rural	11 (22.0)	12 (24.0)	.134	(2)	.935
		Suburban	6 (12.0)	5 (10.0)			
		Urban	8 (16.0)	8 (16.0)			

#=Fisher's exact score

Table 1.2: Comparison of clinical variables (Continuous) of experimental group and control group (N=50)

Variables	Experimental Group (N=25) Mean± S.D	Control Group(N=25) Mean± S.D	t	df	p
Age of the Patient (in years)	37.52± 8.337	37.56 ±7.223	.072	(48)	.943
Duration of Dependence (in years)	12.68 ± 2.641	13.92± 4.22	-1.245	(48)	.219

Table 1.3 : Comparison on clinical scales between experimental and Control group before the intervention (N=50)

Sr. No.	Variables	Experimental Group(N=25) Mean± S.D	Control Group(N=25) Mean± S.D	t	(df)	p
1.	SAD-Q	14.60± 2.661	14.88 ±2.205	-.405	(48)	.687
2.	CIWA-R	6.48 ±1.262	6.20 ± .816	.931	(48)	.356
3.	HAM-A	9.00 ± 2.398	9.44 ± 1.530	-.773	(48)	.443

all four cognitive domains improved significantly after treatment in the experimental group. This echoes with previous finding of Brooks *et al.* (2017) in which they found that computerized cognitive intervention emphasizing on working memory improved executive function and self regulation in patients with chronic Methamphetamine dependence.

Various literatures says executive function is a

Table 2.1 : Comparison of pre and post scores of subjective well being inventory (SUBI)

Subjective well-being inventory- domains	Phase of assessment	Experimental group (N=25) Mean± S.D	Control group(N=25) Mean± S.D	t	(df)	p
General well- being	Pre-assessment	3.64 ± .700	3.40± .500	1.39	(48)	.169
	Post- assessment	7.00± 1.118	4.28 ± .843	9.71	(48)	.000**
Expectation-	Pre-assessment	3.80± .645	3.72± .614	.449	(48)	.655
achievement	Post- assessment	6.84± 1.313	4.24 ± .663	8.83	(48)	.000**
Confidence in	Pre-assessment	3.96± .841	3.68 ± .557	1.38	(48)	.171
coping	Post- assessment	7.12 ± 1.092	4.36 ± .810	10.14	(48)	.000**
Transcendence	Pre-assessment	3.76± .879	3.64± .700	.534	(48)	.596
	Post- assessment	6.96 ± 1.274	4.40± .913	8.16	(48)	.000**
Family support	Pre-assessment	3.96± .978	3.68 ± .802	1.10	(48)	.274
	Post- assessment	6.96± 1.399	4.36 ± .757	8.17	(48)	.000**
Social support	Pre-assessment	3.80 ±.957	3.68± .748	.494	(48)	.624
	Post- assessment	7.16± 1.519	4.40± 1.080	7.40	(48)	.000**
Primary group concern	Pre-assessment	3.67± .663	3.52 ± .653	1.28	(48)	.204
	Post- assessment	7.36± 2.691	4.44± 1.734	4.56	(48)	.000**
Mental mastery	Pre-assessment	10.76± 1.480	9.84 ± 1.573	2.13	(48)	.138
	Post- assessment	16.40± 2.582	10.20 ±1.870	9.88	(48)	.000**
Perceived ill-health	Pre-assessment	9.44± 1.227	9.00± 1.384	1.18	(48)	.240
	Post- assessment	13.20 ± 2.141	9.84 ± 1.724	6.11	(48)	.000**
Deficiency in social	Pre-assessment	3.88± 1.201	3.08± .277	3.24	(48)	.102
Contacts	Post- assessment	7.08 ± 1.152	4.24 ± .436	11.53	(48)	.000**
Well-being negative	Pre-assessment	3.68± .690	3.44± .506	1.40	(48)	.168
affect	Post- assessment	7.24 ± .970	4.72± 1.137	8.43	(48)	.000**
SUBI Total	Pre-assessment	55.00 ± 5.774	51.76± 3.722	2.35	(48)	.122
	Post- assessment	94.08± 8.391	59.12± 3.833	18.94	(48)	.000**

**indicate0.01 level of significance(p<0.01)

Table 2.2 : Comparison of pre and post scores of Eysenck's Series of Digit Span Test (ESDST) between experimental and control group

	Phase of assessment	Experimental Group (N=25) Mean± S.D	Control Group(N=25) Mean± S.D	t	(df)	p
Eysenck's Series of Digit Span Test	Pre-assessment	7.28 ± .458	8.36 ± .645	-.75	(48)	.452
	Post- assessment	10.28± 1.37	8.36 ± 1.319	5.51	(48)	.000**

**indicate0.01 level of significance(p<0.01)

Table 2.3 : Comparison of pre and post scores of Stroop Color Word Test (SCWT) between experimental and control group

Stroop Color Word Test	Phase of assessment	Experimental group (N=25) Mean± S.D	Control group (N=25) Mean± S.D	t	(df)	p
Stroop Word	Pre-assessment	33.64 ±5.773	30.96± 2.937	2.069	(48)	.144
	Post- assessment	46.20± 9.265	32.44±3.465	6.956	(48)	.000**
Stroop Colour	Pre-assessment	34.68 ± 7.064	34.76±4.245	-049	(48)	.961
	Post- assessment	50.28± 6.154	37.56±6.158	.934	(48)	.000**
Stroop Colour Word	Pre-assessment	38.28± 8.111	40.56±6.014	-1.129	(48)	.265
	Post- assessment	56.28 ± 9.685	41.40± 6.892	.083	(48)	.000**

**indicate0.01 level of significance(p<0.01)

dynamic frontal neural process associated with higher cognitive abilities responsible for adequate cognitive – affective states and people with chronic substance dependence are known to be most susceptible to its dysfunction (Bickel *et al.,* 2014). Like our study, computerized executive function training shown improving cognitive functions and to be an effective strategy to reduce alcohol dependence by increasing control over automatic impulses (Houben *et al.,* 2011). Present finding reiterates the analysis provided by multisite randomized controlled double- blind trial with two groups who received posit science computer training (experimental group) and cognitive stimulation program modeling treatment as usual (control group). They have provided computerized cognitive remediation as 1 hour per day in 5 days per week (Smith *et al.,* 2009). The present study findings also correlate with results of a pilot randomized, controlled trial posit science's active computerized cognitive training in 47 subjects with mild cognitive impairment. They concluded that intensive computer based brain training could improve working memory and processing speed (Barnes *et al.,* 2009).

Our rationale for giving attention to subjective well-being is due to studies indicating that individuals with alcohol and other substance dependence have significantly impaired stress coping and subjective wellness which fuels addictive tendencies, and also cause poorer interpersonal adjustments as well as treatment adherence (Miller *et al.,* 2014, Ramachandani *et al.,* 2018). Presently there are only few researches explored the effect of computerized cognitive remediation on subjective well being. A majority of studies observed

Table 2.4 : Comparison of pre and post scores of Wisconsin Card Sorting Test (WCST) between experimental and control group

Wisconsin Card Sorting Test	Phase of assessment	Experimental Group (N=25) Mean± S.D	Control Group(N=25) Mean± S.D	t	(df)	p
Trials correct	Pre-assessment	28.96 ± 9.374	29.84± 7.347	-.360	(48)	.713
	Post- assessment	57.52± 6.941	29.44± 6.771	14.48	(48)	.000**
Total errors	Pre-assessment	30.96 ± 6.846	28.00±3.629	1.910	(48)	.162
	Post- assessment	17.28 ±4.098	27.04 ±6.010	-6.708	(48)	.001**
Perseverative responses	Pre-assessment	18.24 ± 6.200	15.28±2.078	2.264	(48)	.128
	Post- assessment	10.64± 3.303	16.20± 4.301	-5.127	(48)	.000**
Perseverative errors	Pre-assessment	10.52 ± 3.070	8.36± 1.729	3.065	(48)	.140
	Post- assessment	5.44± 2.583	10.08± 4.020	-4.855	(48)	.000**
Non-perseverative errors	Pre-assessment	7.04± 2.354	6.92± 1.778	.203	(48)	.840
	Post- assessment	5.88± 1.833	8.64± 3.451	-3.532	(48)	.001**
Conceptual level responses	Pre-assessment	28.240±10.6077	24.00± 6.271	1.720	(48)	.192
	Post- assessment	54.96± 9.103	20.92± 6.144	15.497	(48)	.000**
Number of categories completed	Pre-assessment	3.64± 1.411	5.68± 2.393	-3.672	(48)	.110
	Post- assessment	9.00 ± 1.472	5.28± 2.731	5.995	(48)	.000**
Trials to complete first categories	Pre-assessment	10.760±3.045	5.320±2.577	6.818	(48	.106
	Post- assessment	5.080±3.2777	6.400±2.3094	-1.646	(48)	.000**
Failure to maintain set	Pre-assessment	4.840± 1.675	4.880 ± 1.615	-.086	(48)	.932
	Post- assessment	1.640 ± .9522	6.280± 2.558	-8.500	(48)	.000**
Learning to learn	Pre-assessment	2.320± 1.519	11.480±3.536	-11.897	(48)	.122
	Post- assessment	14.160±4.766	10.040±3.194	3.590	(48)	.000**

**indicate0.01 level of significance(p<0.01)

Table 2.5 : Comparison of pre and post scores of Trail Making Test (TMT) between experimental and control group

Trail Making Test	Phase of assessment	Experimental Group (N=25) Mean± S.D	Control Group(N=25) Mean± S.D	t	df	p
Trial- A	Pre-assessment	68.600±8.727	53.360±9.411	5.937	(48)	.169
	Post-assessment	40.120±7.378	52.760±10.096	-5.054	(48)	.000**
Trial- B	Pre-assessment	75.040±5.855	68.360±5.670	4.097	(48)	.151
	Post-assessment	52.680±8.952	67.120±7.189	-6.288	(48)	.000**

**indicate0.01 level of significance(p<0.01)

Table 3.1 : Comparison of changes in pre - post scores of subjective well Being inventory (SUBI) of experimental group

Subjective well-being inventory-domains	Pre-assessment (N=25) Mean± S.D	Post-assessment (N=25) Mean± S.D	t	(df-24)	p
General well- being	3.64 ±.700	7.00± 1.118	-13.76	(24)	.000**
Expectation-achievement	3.80 ± .645	6.84± 1.313	-10.64	(24)	.000**
Confidence in coping	3.96 ± .841	7.12 ± 1.092	-13.40	(24)	.000**
Transcendence	3.76 ± .879	6.96 ± 1.274	-11.31	(24)	.000**
Family support	3.96 ± .978	6.96± 1.399	-9.333	(24)	.000**
Social support	3.80 ± .957	7.16± 1.519	-9.456	(24)	.000**
Primary group concern	3.67± .663	7.36± 2.691	-6.763	(24)	.000**
Mental mastery	10.76 ± 1.480	16.40± 2.582	-11.44	(24)	.000**
Perceived ill-health	9.44 ± 1.227	13.20 ± 2.141	-7.940	(24)	.000**
Deficiency in social contacts	3.88± 1.201	7.08 ± 1.152	-8.552	(24)	.000**
Well-being negative affect	3.68± .690	7.24 ± .970	-15.87	(24)	.000**
SUBI Total	55.00 ± 5.774	94.08± 8.391	-22.92	(24)	.000**

**indicate0.01 level of significance (p<0.01)

Table 3.2 : Comparison of changes in pre - post scores of Eysenck's Series of Digit Span Test (ESDST) of experimental group

Eysenck's Series of Digit Span Test	Pre- assessment (N=25) Mean± S.D	Post assessment (N=25) Mean± S.D	t	(df-24)	p
	7.28 ± .458	10.28± 1.37	-14.412	(24)	.000**

**indicate0.01 level of significance(p<0.01)

Table 3.3 : Comparison of changes in pre - post scores of Stroop Color Word Test (SCWT) of experimental group

Stroop Color Word Test	Pre- assessment (N=25) Mean± S.D	Post- assessment (N=25) Mean± S.D	t	(df-24)	p
Stroop Word	33.64 ±5.773	46.20± 9.265	-8.948	(24)	.000**
Stroop Colour	34.68 ± 7.064	50.28± 6.154	-13.86	(24)	.000**
Stroop Colour Word	38.28± 8.111	56.28 ± 9.685	-10.10	(24)	.000**

**indicate0.01 level of significance (p<0.01)

Table 3.4 : Comparison of changes in pre - post scores of Wisconsin Card Sorting Test (WCST) of experimental group

Wisconsin Card Sorting Test	Pre- assessment (N=25) Mean± S.D	Post assessment (N=25) Mean± S.D	t	(df-24)	p
Trials correct	28.96 ± 9.374	57.52± 6.941	-13.908	(24)	.000**
Total errors	30.96 ± 6.846	17.28 ±4.098	9.799	(24)	.000**
Perseverative responses	18.24 ± 6.200	10.64± 3.303	5.278	(24)	.000**
Perseverative errors	10.52 ± 3.070	5.44± 2.583	6.691	(24)	.000**
Non-perseverative errors	7.04± 2.354	5.88± 1.833	2.280	(24)	.022*
Conceptual level responses	28.240±10.6077	54.96±9.103	-9.909	(24)	.000**
Number of categories completed	3.64± 1.411	9.00 ± 1.472	-14.52	(24)	.000**
Trials to complete first categories	10.760± 3.0452	5.080±3.2777	-8.954	(24)	.000**
Failure to maintain set	4.840± 1.675	1.640± .9522	-7.542	(24)	.001**
Learning to learn	2.320± 1.519	14.160±4.766	12.133	(24)	.000**

*indicate 0.05 level of significance (p<0.05), **indicate0.01 level of significance(p<0.01)

Table 3.5 : Comparison of changes in pre - post scores of Trail Making Test (TMT) of experimental group

Trail Making Test	Pre- assessment (N=25) Mean± S.D	Post assessment(N=25) Mean± S.D	t	(df-24)	p
Trial- A	68.600 ± 8.727	40.120± 7.378	12.25	(24)	.000**
Trial- B	75.040± 5.855	52.680 ±8.952	13.15	(24)	.000**

**indicate0.01 level of significance (p<0.01)

visuo-auditory model cognitive intervention has positive effect on subjective wellness (Vrani, 2017). Present findings also showed a clear improvement and quality in all domains of subjective well being measurements. Randomized control trials based on posit science's computer remediation in adult population showed significant improvement in overall cognitive functions and subjective wellness, especially depressive symptoms (Wolinsky, 2015). Another Meta analysis of prospective controlled trials review concluded that this novel computerized cognitive remediation programs could significantly enhance productivity, wellness and quality of life in patients with various mental disorders (Chan *et al.*, 2015). In addition, Hofmann et al. (2012) observed that cognitive functions mainly working memory and attention process holds successful self- regulation which influence psycho-social adjustment. Our result provides empirical support for the importance of computerized cognitive remediation as a potential driver of outcome change in patients with chronic alcohol and other substance dependence.

Conclusion:

The present study was designed to test the hypothesis that computerized cognitive remediation would not influence measures of neuropsychological performance and subjective well-being in a group of patients with chronic alcohol dependence were assigned to receive remediation therapy in comparison with 'treatment as usual' control group. The results rejected the null hypothesis. Our results indicating that the neuro-plasticity based computerized cognitive remediation therapy group presented greater improvements in speed processing, attention, working memory and mental flexibility whereas the control group did not. Besides, the computerized cognitive remediation group showed a clear improvement in all domains of subjective well-being. By improving the cognitive function, it might strengthen as well as fortify the self regulation which enables them to control craving and better psycho-social adjustments. Strength of the present study include the evaluation of a novel neuropsychological training module to enhance the cognitive function in patients with chronic alcohol and other substance dependence, who are a vulnerable group with a high risk of relapses as well as severe executive dysfunction. The current study certainly has some limitations which include small sampling size and random sampling method could be applied. We failed to determine whether performance gains are maintained over time or not. More observations are needed to identify whether booster sessions of executive training could aid withhold of the clinical improvements.

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