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Comparative Study

A Study to Compare the Pattern of Neuro-Cognition among Single and Multiple Self Harm Attempters in Adult Population

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ABSTRACT

Introduction: Neurocognitive abilities are a catch-all term that refers to cognitive talents that facilitate perception, reasoning, action, and emotion generation and are believed to be associated with specific brain neuronal pathways and networks. As it is considered that neuro-cognitive abilities operate as a mediator between ideas and actions, they may especially be well adapted to explain the path of suicidal thoughts to the acts of suicide. **Objectives:** To compare the pattern of neuro-cognition among single self-harm attempters and multiple self-harm attempters in adult population. **Materials and Methods:** Hospital based cross sectional comparative study was conducted in Department of Psychiatry and Drug De-addiction Centre, Lady Hardinge Medical College and Smt. S. K. Hospital, New Delhi among the population with self-harm attempt seeking consultation from Psychiatry Department and Drug De-addiction Centre either directly or after referral. **Results:** The mean value for trail time is less in single self-harm attempters then multiple self- harm attempters for e.g., the time score of trails 1 in SSA was 51.1sec whereas 60.2 sec in MSA. Composite index (CI) of higher value means good performance. Among the study population, single harm attempters had a higher mean CI score (32.83) as compared to the multi harm attempters (29.01). **Conclusion:** A significant comparative difference was observed in selective attention, cognitive flexibility and inhibition in relation to the multiple self- harm attempters and single self- harm attempters. Thus, it can be concluded that there is a major involvement of frontal lobe dysfunction in self-harm attempters' population.

Keywords: *Single Self-Harm, Multiple Self-Harm Attempters, CTMT, Neuro-Cognition*

According to Sansone, Weiderman and Sansone, "*self- harm probably exists along a continuum from graphic, self-harm behavior to milder forms of self-sabotaging behavior that might be viewed as self-defeating."* In literature, phrases such as "self-harm" and "self-injury," which may be confusing, are often exchanged (6).

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According to Jo Robinson (2017), self-harm is a core issue that can affect up to 25 percent youngsters and lead to negative repercussions like a recurrence of self-harm, suicide and death, morbidity to psychological health, insufficient level of education, job performance & overall a less costly quality of life (4). In adults under the age of 30, suicide is the second largest cause of death. Candidate susceptibility factors are likely to interact with both stable individual differences ("traits") and temporally dynamic within-person processes, making effective risk detection more difficult (5).

In psychiatric illnesses such as- bipolar disorder, borderline personality disorder, depression, and psychotic illnesses, executive functions seem to be impaired(3). Neurocognitive abilities facilitate perception, reasoning, action, and emotion generation and are believed to be associated with specific brain neuronal pathways and networks. These abilities operate as a mediator between ideas and actions, they may be especially well adapted to explaining the path of suicidal thoughts to acts of suicide (1). Neuroimaging studies have a crucial role to play in connecting structural brain abnormalities with functional and cognitive alterations and therefore leads to a neurobiological hypothesis that is associated with suicidal behavior (2).

A study by Isometsa & Lonnqvist, (1998) revealed that most of the deaths (56%) occurred on the very first attempt (8). Moreover, it was also noted that propensity to use the same technique as the previous survived event in fortunate last suicide try utilizing hanging one own self and gas poisoning (9). There is also reported involvement of executive dysfunction seen in persons with suicide attempts and self-harm.

O'Connor RC, Nock MK. et al (2014), gave description about the psychological of suicidal behavior. They also reported about the regional brain structural abnormalities and accompanying brain function deficits that could serve as objective indicators of the behavior of self-harming, helping to overcome self-reporting biases. As a result, self-harm neuroimaging studies are critical because they allow us to link structural brain abnormalities to functional and cognitive changes, allowing us to develop a related neurobiological theory to suicidal conduct (11).

According to E.T. Jay & HP (2014), there has been a recent surge in a study on possible anatomical and functional disorders of the brain in an individual with a background of self-harm, as well as the accompanying deficits in cognitive abilities (12). These criteria have the potential to serve as objective markers, overcoming the inherent biases in self-reported suicide intent in the past, present, or future. Recent systematic reviews (Glenn CR et al, 2014) of brain anatomical and functional abnormalities linked to self-harm have been published to indicate that the orbitofrontal cortex (OFC), orbitofrontal cortex (OFC), ventromedial prefrontal cortex (VMPFC), anterior cingulate cortex (ACC) are the primary brain regions involved indicating potentially impaired prefrontal network functioning (13).

Clark L (2011) elaborated about the difficult decision-making, poor problem-solving abilities, cognitive inhibition is low, and sensitivity to interference is great, memory issues and changed implicit and explicit awareness of emotional cues are among the causes highlighted. While these insights are useful for understanding the principles that underpin intricate behavior, yet it is unclear if we can utilize assessments of these aspects in individuals to predict future self-harm risk. As a result, this systematic study aimed to see if there were any links between neurocognitive factor assessments and self-harm repetition. (14)

According to the meta-analysis by Allen, Bozzay and Edanbaum (2019), the most commonly found individuals with suicidal thoughts are those who are severely impaired in many aspects of cognitive functioning, such as ability to inhibit and make decisions. Neurocognitive impairment is a customary factor among those who die by killing themself, particularly those who suffer from problems with inhibition and managerial decision-making (10).

Previous systematic reviews (Fliege H et al) on self-harm repetition have focused only on (i)particular types of self-harm; (ii) offered scant or no information on possible neurocognitive variables; (iii) focused only on tools related to psychometric in hospitals; and (iv) focused only on admissions of a hospital (15). There has been no comprehensive review of the key neurocognitive variables linked with self-harm repetition, including all types of self-harm and all situations, as far as we are aware. Hence, the study was planned to see and compare the pattern of neuro-cognition in single self-harm attempters and multiple self-harm attempters in adult population

MATERIALS AND METHODS

Objective

To compare the pattern of neuro- cognition in single self-harm attempters and multiple self-harm attempters in adult population

Study design

A cross sectional comparative study was conducted in the Department of Psychiatry and Drug-Deaddiction Centre at Lady Hardinge Medical College, New Delhi. The study population included the participants with self-harm attempt seeking consultation from Psychiatry Department and Drug De-addiction Centre either directly or after referral. A total of 100 participants were recruited in this study using non -probability convenience sampling method.

Inclusion Criteria

- Participants with self-harm attempt seeking consultation from psychiatry department either directly or after referral was assessed by a qualified psychiatrist.
- Participants in age group of 18-60 years.
- Participants willing to participate in study and give written informed consent.
- Participants who can read English.

Exclusion Criteria

- Any acute psychiatric or medical illness due to which neuro-cognition testing is not feasible.
- Participants clinically diagnosed with severe mental disorders as operationalized in National Mental Health Survey (NMHS) 2015-16. This includes bipolar affective disorder, schizophrenia and other psychotic disorders.
- Participants with history suggestive of intellectual disability or pre-existing cognitive decline as assessed by Mini Mental Status Examination (MMSE)
- Persons screened to have color blindness as assessed by Ishihara chart test. Color vision is pre requisite for one of the neuro-cognitive assessment tools being used in study.

Following instruments were used to assess the study participants:

1. Semi structured proforma: to collect socio- demographic details of study participants.
2. Modified kuppuswamy socio-economic status scale: to assess socioeconomic status of study participants
3. Comprehensive Trail Making Test (CTMT): Trails Making Test (Trails) is a neuropsychological test of visual attention and task switching. The usual time taken or the testing is 5 TO 10 minutes. It detects brain compromise and tracking progress in rehabilitation, detection of frontal lobe defects and problems with psychomotor speed and visual search. Performance on TRAIL1, 2 and 3 correspond to TMT-A mostly requires psychomotor speed whereas performance on Trail 4 and 5 is equivalent to TMT-B and requires flexibility in a response set, or set shifting. Although it is reported that TMT-B, a set-shifting task, is more appropriate for measuring Executive functioning.

RESULT

In our population study at a tertiary care centre, a total number of populations of 100 (n) were taken for the study, where a total number of males - 49, females- 50 and one transgender were present. The age range for both groups was 18 – 58 years. The mean ages for groups SSA and MSA were 60.95 ± 2.06 and 33.90 ± 8.50 years respectively.

Table no. 1: The socio demographics of sample population which is grouped in Single Suicide Attempters (SSA) and Multiple Suicide Attempters (MSA) - a comparative analysis.

Demographics	**SSA (n=50) Value/ percentage**	**MSA (n=50) Value/ percentage**	**p value**
Age	60.95±2.06	33.11± 8.50	<0.001
Gender			
Male	22%	27%	0.611
Female	25%	25%	
Education			
School	31%	17%	0.815
Male	N=12	N=6	
Female	N=19	N=11	
Graduate	17%	19%	0.70
Male	N=10	N=10	
Female	N=7	N=9	
Marital status	47%	51%	
Socio economic status	7.2±24.46	3.13±1	<0.001
Religion			
Hindu Muslim Christian Sikh	41% 6% - -	40% 9% 1% 3%	
Self- harm frequency	1.95 ±6.63	2.94 ± 1	<0.001

(p< 0.05= significant)

CTMT trials and composite index score

- Composite index high means good performance.
- Among from single harm attempters the mean CI score was (32.83) compared with Multi harm attempters (29.01)
- The composite index for all trials test is presented in the table 2.

Table 2: Descriptive statistical results for the two Self-harm groups- the CTMT trials and composite index score

CTMT trails	Single harm Mean	SD	Multi harm Mean	SD
Composite Index t-statistic – 2.2 95% CI Significance level:0.0250*	32.83	8.43	29.01	8.35

*P = less than 0.05 is consider significant

CTMT score with different age groups

Table 3. Presented the comparison between both self- harm groups CTMT trial scores. These comparisons have been done using multivariate analysis of variance (MANOVA) in which the CTMT trail scores are continuous served as the dependent variables and single harm, multi harm groups are independent /subjects variable.

Age differences between the single harm and multi harm groups has examined using an ANOVA that included two between-subjects variables (group, age level).

Table 3: CTMT score with different age groups

	Single harm					**Multi harm**				
Age group/CTMT	**15-20**	**21-30**	**31-40**	**41-50**	**51-60**	**15-20**	**21-30**	**31-40**	**41-50**	**51-60**
Trial-1	**28**	**37**	**31**	**39**	**46**	**28**	**34**	**33**	**35**	**41**
Trial -2	**35**	**36**	**33**	**33**	**35**	**56**	**53**	**6**	**72**	**71**
Trial-3	**29**	**38**	**30**	**37**	**38**	**31**	**35**	**29**	**32**	**34**
Trial-4	**29**	**37**	**32**	**30**	**39**	**27**	**32**	**27**	**30**	**33**
Trial-5	**37**	**42**	**44**	**39**	**42**	**30**	**37**	**33**	**39**	**39**
Mean	**31.6**	**38**	**34**	**35.6**	**40**	**34.4**	**38.2**	**25.6**	**41.6**	**43.6**
SD	**4.10**	**2.35**	**5.70**	**3.97**	**4.18**	**12.18**	**8.47**	**11.26**	**17.33**	**15.68**
SE	**1.83**	**1.05**	**2.55**	**1.78**	**1.87**	**5.45**	**3.79**	**5.04**	**7.75**	**7.01**

From the results presented in the table 3:

- There was a significant difference between the single harm and multi harm groups on the CTMT trails, with different age groups (Degree of Freedom =4, Sum of square = 10.2, α= 0.05) which is presented in the table 16
- for 15-20 years (total n =9, Single harm - mean = 31.6, SD = 4.1, SE=1.83, Multi harm mean = 34.4 SD= 12.18, SE= 5.45),
- 21 to 30 years (total n = 39, Single harm - mean =38, SD = 2.35, SE=1.05, Multi harm mean = 38.2, SD=8.47, SE= 3.79),
- 31 to 40 years (total n =35, Single harm - mean =34, SD =5.7, SE= 2.55, Multi harm mean =25.6, SD= 11.26, SE= 5.04),
- 41 to 50 years (total n =12, Single harm - mean=35.6, SD = 3.97, SE=1.78, Multi harm mean =41.6, SD= 17.33, SE= 7.75)
- 51 to 60 years (total n =4, Single harm - mean = 40, SD = 4.18, SE 1.87, Multi harm mean =43.6 SD= 15.68, SE= 7.01)

CTMT trial scores and composite Index differences MANOVA analysis:

- CTMT Trail Scores and Composite Index Differences MANOVA indicated in the table
- By using the Descriptive statistics, 95% confidence intervals for both the groups is analyzed.
- For single harm CTMT score has 95% LCL 31.8 and 95% UCL is 39.7 and t value = 25.06, P value= $1.50 *10^{-5}$.
- For multi harm CTMT score has 95% LCL 34.6 and 95% UCL is 43.3 and t value = 24.91, P value= $1.54 *10^{-5}$.
- The composite Index for both groups are analyzed using the descriptive statistics analysis and the result for:
- Single harm CI 95% LCL= 28.5 and 95% UCL is 38.4 and t value = 18.7, P value= $4.7*10^{-5}$.
- For multi harm CI has 95% LCL is 24.0 and 95% UCL is 29.7 and t value = 25.89, P value= $1.32 *10^{-5}$.

Table 4: Difference between CTMT average score and CI for self-harm groups with age group

	Single harm		**Multi harm**	
Age group	**CTMT tscore**	**CI**	**CTMT tscore**	**CI**
15-20	32	29.25	34.4	24.3
21-30	38	36.3	38.2	26
31-40	34	29.9	37.6	26.1
41-50	35	33.5	41	27.53
51-60	40	38.5	43.6	30.5
Mean	**35.8**	**33.49**	**38.96**	**26.88**
SD	3.19	3.49	3.49	2.32
P value	0.0250	<0.0001	0.0250	<0.0001

(*p value 0.05 considered as significant)

Comprehensive Trial making test result analysis

- Raw scores from each trail can be converted to *T*-scores and percentiles, while the composite index can be represented as for mean trial score.
- Each trial time and t- scores mean, median, standard deviation and standard error are presented along with the table.
- Bigger t score means good function.
- For normal population according to western study was from 50 ± 10

Table 5: Trail test time and scores in both groups

	Statistics	**Trial - 1 time**	**Trail 1 tscore**	**Trial2 Time**	**trail2 tscore**	**trail 3 time**	**trail 3 tscore**	**trail 4 time**	**trail 4 tscore**	**trail5 time**	**trail5 tscore**
Single harm	Mean	**51.1**	34.7	56.3	33.5	60.2	34.2	52.8	35.7	**61.5**	42.8
	SD	17.1	10.7	19.3	9.8	23.4	12.2	25.8	10.5	27.2	12.8
Multi Harm	Mean	**60.02**	31.36	67.15	30.12	70.98	30.28	76.08	25.77	**92.68**	29.17
	SD	22.55	8.67	28.21	8.05	28.00	10.34	23.90	7.78	24.73	7.68

- The above table shows that the mean value for a trial time is less in SSA than MSA for e.g., the time score of trails 1 in SSA was 51.1sec whereas 60.2 sec in MSA.

DISCUSSION

In our study conducted at a tertiary care centre, an equal distribution of gender was noted among the self-harm attempters. While, on assessment of the cognitive functions, there was a difference noted in the TMT between the single and multiple self-harm attempters. We found differences in, trail time scores among the two selected groups that are depicted in table no.5. Pluck et al 2012, assessed neuropsychological aspects of self-harm in schizophrenia and the Trail Making Test. He found that the frontal executive function and the result showed $Z = -1.65$, $P = 0.10$. Pluck failed to find any association between repetition and the TMT (17). Processing speed was assessed in two studies (18) using two measures: the Color-Word Interference Test (CWIT) from the Delis-Kaplan Executive Functions System (D-KEFS) and Part A of the Trail Making Test (TMT) (19). Over-all, attempters performed better than ideators, with a small effect size observed. In contrast, a large effect size difference was observed comparing ideators and non- suicidal individuals, with ideators exhibiting worse performance.

We have used CTMT in this study which was not used previously on similar sample groups. In CTMT Trail 1(Visual search and speed), the visual search speed for single is similar to TMT Part A in which the attempters are tested their visual search and speed i.e using to connect a series of encircled numbers. Trail 2 (scanning) of the CTMT is similar to Trail 1 to do the same procedure followed in Trial-1. However, in Trail 2 the complexity of the task is increased. Trial-3 has increased the participant's ability to complete the task in fast processing i.e. it contains various line drawings. In Trail 4, the complexity further is increased to the participant is asked to connect the test objects which need to test their mental flexibility. Trail 5 of the CTMT is similar to Part B of the original TMT in which the attempters are used to test their executive function. The total of the T-scores from the five trails is transformed into a composite index using the standardization sample.

For all CTMT scores investigated in this study, lower scores imply more severe neuro problems. Most previous studies have reported that patients with a greater number of episodes and longer duration of illness suffer greater cognitive decline. In this study, the time taken for completion of TMT-5 and 4 was more in the MSA group. In our study, trail 1 which is meant to see visual speed the time taken by single harm attempters were came out to 48.77 which less as compared to MSA which is 54.49s. In trail 2 (scanning), the time 53.32 came out which is less as compared to MSA i.e., 60.9 therefore we conclude that visual search speed and scanning in single self-harm attempters are far better than MSA. The score for speed processing (trail 3), mental flexibility (trail 4), and trail 5 executive function all were high in multiple self-harm attempters. These finding is replicative of the fact that executive functions appear impaired in self- harm attempters; as seen in studies by Isometsa & Lonnqvist, (1998) (8) and Fliege H et al, 2009 (15).

Multivariate analysis of variance (MANOVA) was used to compare the Single harm and Multi harm groups in the five CTMT trails. The CTMT composite index was also examined separately using ANOVA CTMT Trail Scores and Composite Index Differences MANOVA indicated that there was a significant difference between the single-harm and multi-harm groups on the CTMT trails, for single harm, CTMT score is 39.7 and t value = 25.06, P value= $1.50 * 10^{-5}$. For multi harm CTMT score is 43.3 and t value = 24.91, P value= 1.54

$*10^{-5}$. The composite Index for both groups is analyzed using descriptive statistics analysis and the result for single harm CI is 38.4 and t value = 18.7, P value= $4.7*10^{-5}$. For multi-harm CI is 29.7 and t value = 25.89, P value= $1.32 *10^{-5}$.

MANOVA indicated significant differences between the groups for the composite index and both groups' scores fell with the composite index score placing them in the mildly to a moderately impaired range of performance on the basis of recommended cutoffs in the test manual (Reynolds, 2002).

In one Indian study- Bhatia T et al (2007), they studied 120 outpatients attending the dermatology department and concluded that they took much more time-75.38 ± 31.81seconds for Task A and 150.69 ± 49.84 seconds for Task B (mean age 30.11 years and mean education 12.13 years) than accepted cutoff value of TMT, which is considered to be 40 seconds for Task A and 91 seconds for Task B (20).

However, we used CTMT but its trail 1 and 5 is almost equal to trail A and trail B and we could observe that the mean trail 1 score in MSA was 60.02 and 92.68 in MSA similarly the SSA group trail 1 mean score was 51 and 61 for trail 5 which is less than above- mentioned study. Even in our study, the same findings have been replicated with significantly poor performance in both part A and part B among the study group. Therefore, a larger study with a bigger sample is needed to replicate cut-offs for this test in the Indian population so that this cut-off can be generalized.

This, also adds to the evidence of frontal lobe dysfunction. They are indicative of the possibility of abnormal frontal lobe morphology as also stated in studies based on neuro-imaging by- O'Connor RC, Nock MK. et al (2014) and E.T. Jay & HP (2014) (11, 12). Hence, we can say that brain morphology and neuro- cognitive functioning play an important role in self- harm behaiour.

CONCLUSION

The current study was carried out to have a better understanding of cognitive functions in individuals with history of self- harm. The cognitive functions studied were executive function and memory. Comprehensive trail making test for executive functioning. Additionally, a detailed assessment of clinical correlates of anxiety, depression and socio-economic profiles of the study population was carried out. The result showed that decreases in neuro- cognition function of the subjects having past history self- harm. This was significant with respect to response speed, visuo- motor coordination, and sustained attention. A significant comparative difference was observed in selective attention, cognitive flexibility and inhibition in relation to the multiple self- harm attempters and single self- harm attempters. The domains like visual scanning, psychomotor speed, attention, cognitive flexibility and set shifting were tested by CTMT which showed impairment more in multiple self- harm attempters.

At this time, neurocognitive variables may be most appropriate for understanding the neural mechanisms underlying self-harm behaviour. However, combining variables may lead to future clinical applications, such as: (i) enhanced risk assessments of self-harm to include bedside tests of specific neurocognitive factors (alongside demographics and clinical factors), and (ii) targeted treatment of individual neurocognitive deficits, potentially using tailored cognitive therapy, targeted neurophysiological techniques (e.g., brain stimulation) or

pharmacotherapy. Early intervention after episodes of self-harm or suicidal ideation in this targeted manner could potentially reduce the risk of these patients repeating self-harm and / or requiring longer term support from mental health services.

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Conflict of Interest
There are no conflicts of interests to disclose.

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