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Clinical and Neuropsychological Features of Suicide Attempters in Tehran, Iran: A Comparative Study

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Abstract

Background: Identifying suicide risk factors and understanding the variations among different clinical groups can play a crucial role in preventing suicide. The objective of this study is to examine the distinctions in clinical and neuropsychological features among suicidal attempters, who have attempted in the last four weeks.

Methods: The design of the study was a case–control study. This study consisted of 62 participants who were assigned to the suicide attempters group (SA+MDD), non-suicidal depressed group (MDD), and healthy control group (HC). Clinical and neuropsychological evaluations were conducted for all participants. The Kolmogorov-Smirnov test was used to evaluate the normality of distribution. To compare the quantitative variables among the three groups, we employed Analysis of Variance (ANOVA), and Kruskal-Wallis. Post hoc analysis was conducted using Dunnett's test. A correlation analysis was conducted between clinical and neuropsychological variables.

Results: The results showed that there was no significant difference in neuropsychological functions among the three groups except Scaled Score Similarities (P=0.007). However, there were significant mean differences observed across the SA+MDD and HC groups for BHS (P<0.001), SSI (P<0.001), RFL (P<0.001), BPAQ (P=0.037), Anxiety-springer-1 (P<0.001), Anxiety-springer-2 (P<0.001), and BDI (P<0.001). Specifically, this difference was significant just for SSI (P<0.001), and RFL (P<0.001) when comparing the SA+MDD and MDD groups. Some significant correlations were seen between clinical and neuropsychological features among suicide attempters. Among neuropsychological features, Motor screening with BIS (P<0.001), Gambling test with SIS (P=0.04), Digit span with BPAQ (P=0.04), anxiety-springer-1 (P=0.07), and BDI (P=0.005), arithmetic task with SIS (P=0.004), BPAQ (P=0.004), anxiety-springer-1 (P=0.03), and anxiety-springer-2 (P=0.008), block design task with SIS (P=0.002), and BPAQ (P=0.03), Rapid Visual Information with BIS (P=0.01), anxiety-springer-2 (P=0.04), and BDI (P=0.003), digital symbol task with BIS (P=0.02), and BDI (P=0.008), and the Picture Completion task with BHS (P= 0.04), had more negative/positive correlation with clinical features.

Conclusion: Some clinical features such as hopelessness should be deemed serious among individuals with suicide attempt particularly among those who were discharged recently. neuropsychological findings revealed functional disturbances in the frontal, parietal and temporal areas of the subjects who are at risk of suicide attempt. The findings can inform the design and implementation of suicide prevention programs. Targeted interventions can be developed to address the identified risk factors and protective factors associated with suicide, such as increasing reasons for living, improving social connectedness, and building resilience.

Keywords: Suicide, Neuropsychology, Clinical Feature, Major Depressive Disorder

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↑What is "already known" in this topic:
MDD patients with a history of suicide attempts exhibit significant differences in cognitive and clinical characteristics compared to MDD patients without suicide attempts and to healthy individuals.

→What this article adds:
Further research is needed to better understand cognitive function in suicidal individuals and how it differs from other groups. However, clinical characteristics serve as a significant factor in distinguishing suicidal individuals from depressed patients without a history of suicide attempts and from healthy individuals.

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Introduction

In recent years, mental and public health experts have been addressing the increasing prevalence of suicidal behavior among different age groups around the world (1). This phenomenon not only affects families but also imposes significant economic and social costs on both developed and developing societies (2). In Iran, suicide behavior is a major issue in terms of mental and public health (3). To gain a better understanding of this issue, more research is needed. However, based on several studies, despite the efforts conducted by the Ministry of Health and other related organizations (4-7), the rate of suicide is still on the rise, making it one of the country's foremost health and social concerns (7).

Suicide has a multifactorial etiology, including social, biological and companied mental disorders factors (8). Major Depressive Disorder (MDD) is the most common psychiatric disorder in suicide attempters. Nevertheless, depression cannot predict progression to suicide, nor can it be said that all depressed people attempt suicide (9, 10). On the other side, previous studies have indicated that there are differences in clinical variables between suicide attempters and non-suicidal patients. Patients with at least one suicide attempt are more frequently diagnosed with personality disorders (18.5% vs 6.5%), have a higher frequency of hospitalization, have a longer duration of untreated illness, and have a history of alcohol abuse. They also miss more work hours and experience more general health problems compared to those without a suicide attempt (11, 12).

Further studies have evaluated the neurocognitive mechanisms underlying cognitive impairments in individuals with suicidal behaviors. In line with clinical findings, adult attempters have shown that cognitive impairments can play a significant role in this phenomenon (13-15), which can provide insight into predicting the likelihood of suicidal behavior and also provide appropriate neurocognitive intervention (8). A study (16) using the Cambridge Neuropsychological Test Automated Battery (CANTAB) in youth with and without suicidal behavior and ideation revealed differences in some indicators such as response control, attention, and problem-solving. The exploratory analysis discovered that total commission errors on the Affective Go/No-Go (AGN) test were not significant predictors of future suicide attempts among females, as were higher strategies scores on the Spatial Working Memory (SWM) test for males. Interactions between neuropsychological characteristics and social problems can influence the development of suicide ideation (17). The ability to switch tasks interaction with a negative social interface revealed that distractibility was a significant predictor of suicide ideation development in the future (OR = 3.45). Furthermore, there is a significant difference in executive function (18), impulsivity (19), attention, and decision-making (20-22) between depressed patients with a history of suicide attempts and those with suicide ideations. Making decisions under ambiguity and risk was investigated using the Game of Dice Task (GDT) and the Iowa Gambling Task (IGT). the results showed that suicidal patients made more risky decisions than non-suicidal patients and the healthy group, while no differences were found between groups when it comes to making decisions under ambiguity (22). In a longitudinal study, there was a significant association between impairment in spatial planning and working memory and previous suicide attempts (OR = 8.810), which suggests that the association between these cognitive features and suicidality may persist over a long period of time (23). However, in some contravening studies, there is not any significant difference between the cognitive characteristics of depressed patients with and without suicide attempts and healthy controls (18, 19, 24). These controversies may be related to the proximity of attempting suicide or having a lifetime of suicidal behaviors. Additionally, the differences in the tools used to measure cognitive features can contribute to these differences in results and findings (22, 25). More studies are needed to clarify the clinical and neurocognitive features of individuals with a history of suicidal behaviors.

This study aims to evaluate the neuropsychological and clinical aspects among individuals with a very recent history of attempted suicide.

Methods

Participants

The study sample included 20 participants with major depressive disorder who attempted suicide (SA+MDD), 21 participants with major depressive disorder (MDD) without suicide attempt, and 21 healthy controls (HC) between ages 18 and 55 years old. The method of sampling was convenient. Based on the calculation of the sample size using G*Power software this sample size will be enough to have 80% Power for comparison of means between these three dependent groups. Participants with SA+MDD were recruited from the poisoning department of the Baharloo Hospital. From 9 January 2021, the patients who were referred by the hospital psychiatrist were selected by the clinical psychologist in terms of inclusion criteria. The inclusion criteria for patients who attempted suicide recently (between 1 to 4 weeks ago) with concurrent diagnosis of a major depressive disorder (MDD) according to the DSM-5 (SCID-5 for DSM-5, research version); and a score of 23 or more in Beck Depression Inventory (BDI). Exclusion criteria were diagnosis of psychotic or bipolar disorders, history of substance, alcohol, or drug abuse, a lifetime history of severe head trauma or central nervous system disorder, scores less than 15 (out of 30) points on the Beck Suicide Intent Scale (BSI). MDD group, the participants were referred by psychiatrists from private or governmental outpatient services. all the patients that met the criteria for current major depressive episodes according to DSM-5 had a score of 23 or more on the Beck Depression Inventory (BDI) and had no personal and family history of suicidal behavior enrolled in the study. Healthy controls required to

have no previous or current psychiatric disorders and also had no personal or family history of a suicide attempt. The control group was selected from individuals who visited the non-psychiatric clinic at Baharlu Hospital in an outpatient setting. They were matched with the suicide group in terms of age, gender, and education. These individuals were not diagnosed with depression and suicidal thoughts through SCID, BDI, and BSSI questionnaires. They also do not have a history of suicide attempts in themselves or their families.

Two clinical psychologists completed questionnaires as part of the study. A PhD in clinical psychology administered the clinical questionnaires, while a clinical psychology expert conducted cognitive tests. After being discharged from the hospital, patients were invited to the clinic on two separate days to complete the questionnaires. The clinical questionnaires were completed on the first day, and the cognitive tests were performed on the second day. A psychiatrist specializing in this field supervised all stages of questionnaire completion.

Measures

The Structured Clinical Interview for DSM-5 (SCID-5): SCID-5 is a semi-structured interview guide for the diagnosis of psychiatric disorders based on DSM-5 criteria and is widely used in clinical settings (26). In one study (27) that assessed the validity and reliability of Structured Clinical Interview for DSM-5 – Clinician Version (SCID-5-CV), this tool has an acceptable positive agreement between the interview and diagnoses (from 73 to 97 percent), and the diagnostic sensitivity and specificity were above 0.70. The Persian version of SCID-5 has an acceptable internal consistency, test-retest reliability, and Kappa reliability as 0.95-0.99, 0.60-0.79, and 0.57-0.72, respectively (28).

Spielberger Anxiety State-Trait Inventory (STAI): The STAI consists of 40 items and includes two separate parts, which evaluate state and trait anxiety. 20 items evaluate current (at this moment) anxiety and the other 20 items assess how people “generally feel” about anxiety (29). This inventory is graded on a four-point Likert scale. Abdoli et al. (30) assessed the reliability and validity of the Persian version of the State-Trait Anxiety Inventory Form Y (STAI-Y) and the result showed that Cronbach's alpha for internal consistency was 0.88 and 0.84 for trait and state anxiety. Also, the convergent validity between BAI and STAI-Y for state and trait anxiety was 0.64 and 0.61, respectively.

Beck Depression Inventory (BDI-II): The BDI-II (31) is a widely used tool to assess the severity of depression. It consists of 21 items, and each statement is scored on a four-point Likert scale. The total score ranges from 0 to 63 and shows four degrees of severity such as minimal, mild, moderate, and severe depression. The study (32) examined the psychometric properties of a Persian version of BDI-II and showed that this tool had high internal consistency (Cronbach’s a ¼ 0.87) and acceptable test-retest reliability (r ¼ 0.74) and had a strong correlation with the Automatic Thoughts Questionnaire (ATQ). In this study, we used a cut-off point of 23 to screen patients in terms of the severity of depression.

Buss Perry Aggression Questionnaire (BPAQ): The BPAQ developed by Arnold H. Buss and Mark Perry (33) has 29 items and is scored on a five-point Likert scale. This questionnaire evaluates a global measure of aggression and four subscales of Physical Aggression, Verbal Aggression, Anger, and Hostility. The psychometric properties of the Persian version of BPAQ were assessed by Samani (34), and the results showed appropriate test-retest reliability (0.78). Also, all items except item 29 had a significant correlation with the total score (range of 0.25 to 0.52). So, these results confirm the efficiency of this questionnaire in the Iranian sample.

Barratt’s Impulsivity Scale (BIS-11): The BIS-11 is a self-report questionnaire of the personality/behavioral construct of impulsiveness initially developed by Barratt (35) in 1990. This scale consists of 30 items rated on a four-point Likert scale, and the total score ranges from 30 to 120. In one study (36) that investigated psychometric properties of the Iranian version of the Barratt Impulsiveness Scale-11, the findings showed three factors of non-planning impulsivity, motor impulsivity, and cognitive impulsivity were significantly correlated to the total score including 32 percent of the total variance. Also, in the evaluation of reliability, Cronbach's alpha and test-retest were 0.81 and 0.77, respectively. So, this study confirms that the BIS-11 scale is usable for the Iranian sample.

Beck Scale for Suicidal Ideation (BSSI): The Self-reporting edition of BSSI (37) is a 19-item instrument that assesses the severity of suicidal thoughts. The total score ranges from 0 to 38, and a higher score indicates a greater risk of suicide. In Iran (38), Cronbach's alpha coefficient of the whole scale was 0.837, which showed high internal consistency. Additionally, this scale had a positive correlation with some indexes of SCL-90-R, such as depression and Global Severity. So, the psychometric properties of the Persian version of BSSI are approved for use in research settings.

Beck Hopelessness Scale (BHS): The Beck Hopelessness Scale is a self-report questionnaire Beck (39), assesses three aspects of hopelessness, including loss of motivation, expectations, and feelings about the future. This scale is composed of 20 true-false items and the total score ranges from 0 to 20. Psychometric properties of the Persian version of the Beck Hopelessness Scale (40) have relatively high reliability (r=0.70). In addition, Cronbach's alpha coefficient of the scale was 0.71, indicating high internal consistency.

Reasons for Living Inventory (RFL): The RFL is a 48-item inventory developed by Linehan et al. (41) that evaluates factors that protect against the risk of suicide attempts. This scale consists of 6 subscales, including Survival and Coping Beliefs, Child-Related Concerns, Responsibility to Family, Fear of Social Disapproval, Fear of Suicide, and Moral Objections. Each reason is scored on a 6-point scale. The Persian version of the RFL was standardized by Mahmoudi et al. using an Iranian sample. The findings showed that the test-retest coefficient and Cronbach's alpha were 0.93 and 0.95, respectively (42).

The Beck Suicide Intent Scale (SIS): The Beck Suicide

Intent Scale (SIS) is a 15-item scale developed to assess the severity of suicidal intention (43). Studies support the reliability of the scale, particularly the subscale that assesses self-reported intention (versus circumstantial indicators) (44).

Wechsler Adult Intelligence Scale (WAIS-R): The WAIS-III (45) is a test of general intelligence and consists of 11 core subtests. Six of these subscales measure verbal abilities, and five of them measure nonverbal mental abilities. The scores include verbal, performance, and full-scale IQ. In the Iranian study (46), all subscales showed test-retest reliability from 0.69 to 0.87, and their internal consistency ranges from 0.77 to 0.88. In this study, we used a seven-subtest short form (SF) conducted by Ward (1999). The included subtests were Block Design (BD), Similarities (SI), Digit Span (DS), Arithmetic (AR), Information (IN), Coding (CD), and Picture Completion (PC).

Cambridge Neuropsychological Test Automated Battery (CANTAB): This computerized neuropsychological battery developed by Sahakian and Robbins (47) at the University of Cambridge measures three cognitive domains of: visual memory, attention, and functional components of executive function. In this study, using the Motor Screening Task (MOT) at the beginning of the assessment, we introduced the subtests to participants and ensured the validity of the data by testing their sensorimotor and comprehension abilities.

Procedure

The design of the study was a case–control study. The study was approved by the Iran National Committee for Ethics in Biomedical Research with the id of IR.NIMAD.REC.1398.158. It has been launched from 9 January to November 2022 in Tehran, Iran. All the participants signed an informed consent form before enrolling in the study. Clinical interviews and neuropsychological assessments were conducted by clinical psychologists, and self-report questionnaires were completed by participants. All these clinical procedures were performed under the supervision of a qualified senior psychiatrist.

Statistical analysis

We used mean, standard deviation (SD), and percentages to describe the numeric and categorical variables respectively. All numeric variables were tested with the nonparametric Kolmogorov-Smirnov test to evaluate the normality of distribution. To compare the quantitative variables across three groups, we used Analysis of Variance (ANOVA) for normal distribution variables and Kruskal-Wallis for variables without normal distribution. We used Dunnett as a post hoc test. We used the chi-square test to compare categorical variables across three groups. We also used correlation analysis to evaluate the association between clinical and neuropsychological variables. Statistical analyses were performed by SPSS software (version 24) with a significant level of 0.05.

Results

The demographic characteristics of SA+MDD and MDD/HC groups were summarized in Table 1. There was not any significant difference between the three groups based on demographic characteristics.

Clinical evaluation

Table 2 illustrates the differences in clinical variables across three groups. Kolmogorov-Smirnov test showed normal distribution for all clinical variables. The mean of hopelessness, anxiety (one month and lifetime), aggression, and severity of MDD were worse in SA+MDD than MDD group. The results of the post hoc test are shown in Table 3.

Neuropsychological evaluation

The Kolmogorov-Smirnov test revealed that 10 out of 19 subscales did not have a normal distribution. Therefore, the Kruskal-Wallis one-way analysis of variances was used. The one-way ANOVA test was used to compare the average scores of other neuropsychological tests that revealed a normal distribution among the three groups (Table 4). Only the variable "Scaled Score Similarities" showed a signifi-

Table 1. Demographic characteristics of study subjects

Demographic characteristic		SA+MDD No (%) (n=20)	MDD No (%) (n=21)	HC No (%) (n=21)	*P*. Value
Gender	Female	17 (32.7)	18 (34.6)	17 (32.7)	0.903
	Male	3 (30)	3 (30)	4 (40)	0.903
Education (Years)	<= 12	13 (41.9)	9 (29)	9 (29)	0.265
	>12	7 (22.6)	12 (38.7)	12 (38.7)	0.265
Marital status	Married	12 (33.3)	14 (38.9)	10 (27.8)	0.447
	Unmarried	8 (30.8)	7 (26.9)	11 (42.3)	0.447
Employment status	Employee	4 (16.7)	9 (37.5)	11 (45.8)	0.452
	Housewife	8 (40)	7 (35)	5 (25)	0.452
	Student	3 (60)	1 (20)	1 (20)	0.452
	Unemployed	5 (38.5)	4 (30.8)	4 (30.8)	0.452
Handedness	Right	17 (31.5)	19 (35.2)	18 (33.3)	0.506
	Left	1 (20)	1 (20)	3 (60)	0.506
	Equal	0 (0)	1 (100)	0 (0)	0.506
		SA+MDD Mean (SD)	MDD Mean (SD)	HC Mean (SD)	*P*. Value
Age		34.1 (±10.54)	35.9 (±10.38)	34 (±9.30)	0.791
IQ		84.44 (12.49)	98 (25.07)	91 (21.91)	0.138

*SA+MDD:Suicide Attempt+Major Depressive Disorder, MDD: Major Depressive Disorder, HC:Healthy Control

Table 2. Comparison of clinical variables in three groups of study

Variances/ Groups	SA+MDD M (SD)	MDD M(SD)	HC M(SD)	F	*P*. Value
BHS	14.94 (3.4)	12.7 (4.2)	3.8 (2.9)	55.44	<0.001
BSSI	23.83 (5.51)	7.8 (8.2)	0.43 (1.6)	64.19	<0.001
SIS	55.5 (10.5)	63.8 (9.3)	49.4 (9.8)	*	<0.001
RFL	112.7 (38.1)	183.7 (37.7)	214.5 (22.9)	46.50	<0.001
BPAQ	90.9 (17.3)	86.4 (15.9)	74.2 (22.6)	4.21	<0.001
STAI -1	64.4 (10.7)	61.9 (6.2)	39.5 (10.6)	39.03	<0.001
STAI -2	64.4 (8.4)	61.5 (9.2)	40 (9)	44.93	<0.001
BDI	22.8 (6)	21.1 (4.9)	3.5 (3.3)	101.17	<0.001

BHS: Beck Hopelessness Scale, SSI: Suicide Scale Ideation, RFL: Reason for Life, BPAQ: Buss Perry Aggression Questionnaire, STAI -1: Springer for Last Month, STAI -2: Springer for Lifetime, BDI: Beck Depression Inventory.
* impulsivity (BIS) did not have a normal distribution, the P. value of the Kruskal-Wallis one-way analysis of variances was reported

Table 3. Post hoc analysis of clinical variables in three groups of study

Variable	Group		Mean diff.	SE	*P*. Value
BHS	SA+MDD	MDD	2.28	1.22	0.192
		HC	11.18	1.01	<0.001
	HC	MDD	-8.90	1.12	<0.001
BSSI	SA+MDD	MDD	15.99	2.29	<0.001
		HC	23.40	1.37	<0.001
	HC	MDD	-7.41	1.93	0.003
SIS	SA+MDD	MDD	-8.31	3.20	0.041
		HC	6.12	3.27	0.191
	HC	MDD	-14.43	2.95	<0.001
RFL**	SA+MDD	MDD	-70.99	12.19	<0.001
		HC	-101.75	10.28	<0.001
	HC	MDD	30.76	9.63	0.009
BPAQ	SA+MDD	MDD	4.51	5.36	0.784
		HC	16.80	6.41	0.037
	HC	MDD	-12.28	6.04	0.139
Anxiety-springer-1	SA+MDD	MDD	2.48	3.10	0.808
		HC	24.86	3.43	<0.001
	HC	MDD	-22.38	2.93	<0.001
Anxiety-springer-2	SA+MDD	MDD	2.91	2.83	0.665
		HC	24.29	2.79	<0.001
	HC	MDD	-21.38	2.82	<0.001
BDI	SA+MDD	MDD	1.69	1.77	0.716
		HC	19.36	1.60	<0.001
	HC	MDD	-17.67	1.29	<0.001

*SA+MDD:Suicide Attempt+Major Depressive Disorder, MDD: Major Depressive Disorder, HC:Healthy Control
** A higher score indicates a higher level of reason for life

cant difference (*P*=0.007) across the three groups. The results of the Dunnett test showed that there was a significant difference in the "Scaled Score Similarities" between the SA+MDD group and the MDD compared to the HC group (*P*=0.009, *P*=0.003), respectively. There was no significant difference between the MDD group and the HC group.

Correlation of clinical and neuropsychological variables

Significant associations were observed between clinical and neuropsychological characteristics among individuals who had attempted suicide(SA+MDD group). Regarding the neuropsychological features, notable connections were found as follows: Motor screening exhibited a significant correlation with BIS (*P*<0.000), the Gambling test demonstrated a significant correlation with SIS (*P*=0.045), Digit span showed a significant correlation with BPAQ (*P*=0.042), anxiety-springer-1 exhibited a marginally significant correlation (*P*=0.075), and BDI showed a significant correlation (*P*=0.000). The arithmetic task displayed a significant correlation with SIS (*P*=0.004), BPAQ (*P*=0.000), anxiety-springer-1 (*P*=0.033), and anxiety-springer-2 (*P*=0.008). The block design task demonstrated a significant correlation with SIS (*P*=0.002) and BPAQ (*P*=0.030). Rapid Visual Information exhibited a significant correlation with BIS (*P*=0.011), anxiety-springer-2 (*P*=0.042), and BDI (*P*=0.003). The digital symbol task displayed a significant correlation with BIS (*P*=0.029) and BDI (*P*=0.008). Finally, the Picture Completion task exhibited a significant correlation with BHS (*P*=0.042), demonstrating a more negative/positive association with clinical features(The details of the correlation table can be seen in the Appendix).

Discussion

The evaluation of clinical variables among the three groups (SA+MDD, MDD, and HC) revealed significant differences. The results demonstrated that there was no significant difference between the neuropsychological functions of the three groups except the "Scaled Score Similarities" of the SA+MDD, MDD, and HC groups, but the MDD group and the HC group had no significant difference. Correlation results between clinical and neuropsychological scales in the SA+MDD group are discussed below.

There have been studies that have pointed to the crucial

Table 4. Comparison of neuropsychological variables in three groups of study

Variables/Groups	SA+MDD Mean (SD)	MDD Mean (SD)	HC Mean (SD)	F	*P.* value
Motor Screening Task Mean latency	783.82 (203.15)	739.24 (168.00)	722.06 (129.02)	*	0.720
Motor Screening Task Mean error	9.90 (2.88)	9.33 (2.34)	10.34 (2.65)	0.790	0.459
Emotion Recognition Task Percent correct	57.71 (8.80)	57.65 (9.86)	63.81 (10.35)		0.64
Emotion Recognition Task Mean overall response latency	2832.72 (977.58)	2859.92 (739.37)	3070.09 (820.05)	0.480	0.621
Cambridge Gambling Task Risk adjustment	0.47 (0.93)	0.34 (0.81)	0.18 (1.36)	0.350	0.706
Cambridge Gambling Task Risk-taking	0.50 (0.12)	0.51 (0.10)	0.47 (0.15)	0.644	0.529
Rapid Visual Information Processing Mean latency	607.63 (178.51)	513.25 (150.44)	579.02 (187.18)	*	0.168
Rapid Visual Information A'	0.85 (0.08)	0.84 (0.05)	0.87 (0.05)	*	0.247
Rapid Visual Information Total hits	11.00 (5.17)	13.90 (6.16)	13.87 (6.44)	1.467	0.239
Rapid Visual Information Total false alarms	4.39 (7.40)	4.48 (6.99)	7.09 (12.16)	*	0.446
Spatial Working Memory Between Errors	35.35 (22.11)	31.95 (22.23)	39.09 (23.26)	*	0.576
Spatial Working Memory Strategy	35.82 (5.88)	35.04 (5.62)	37.09 (4.88)	0.754	0.475
Scaled Score digit span	6.72 (2.37)	7.28 (2.28)	7.33 (2.15)	*	0.723
Scaled Score Arithmetic	7.44 (2.33)	8.23 (2.48)	7.76 (2.11)	0.584	0.561
Scaled Score Block Design	9.00 (2.44)	9.19 (2.71)	8.80 (2.80)	0.107	0.899
Scaled Score Digital Symbol	8.83 (2.30)	9.09 (2.58)	9.47 (2.11)	*	0.646
Scaled Score Similarities	7.68 (1.49)	9.90 (2.68)	10.42 (2.77)	*	0.007
Scaled Score picture completion	6.87 (2.78)	8.76 (2.99)	8.05 (2.65)	2.037	0.141
Scaled Score information	6.87 (2.39)	8.14 (2.08)	8.73 (2.84)	*	0.130

*These subscales did not have a normal distribution, the P. value of the Kruskal-Wallis one-way analysis of variances was reported (Motor screening Task Mean latency, Emotion Recognition Task Percent correct, Rapid Visual Information Processing Mean latency, Rapid Visual Information A' target sensitivity, Rapid Visual Information Total false alarms, Spatial Working Memory Between errors, Scaled Score digit span, Scaled Score Digital Symbol, Scaled Score Similarities, Scaled Score information).

role of hopelessness, anger, and impulsivity in suicide attempts (48-51). However, the results of this study showed just significant differences in RFL between SA/MDD and the other two control groups. Additionally, although hopelessness score, there was significant difference between groups. However, the SA+MDD scores were higher than the other two groups. These may indicate that the suicide attempters in this study rather than impulsive acting out the suicide urge , were more hopeless. Suicide attempts may motivated by impulsive behavior or hopelessness the latest one should be considered more serious for re-attempt (52, 53). Studies have indicated that individuals who engage in non-impulsive suicide attempters experience a greater intensity of suicidal thoughts compared to those who act impulsively (54).in our study, the subjects were recruited from individuals who attempted suicide in the last four weeks and who may have the intention to die or re-attempt. SA+MDD group had a significantly lower score in reason for life compared to the MDD and HC groups. According to the Interpersonal Theory of Suicide, suicidal behavior arises from the combination of two factors: perceived burdensomeness. When individuals experience both perceived burdensomeness and thwarted belongingness, they may lose their reasons for life, which may lead to an increased risk of suicidal ideation and attempts (55, 56). In addition, the RFL scale showed positive associations with certain protective factors of suicide. These factors include control over goal attainment through strategies that involve connecting with others in the social environment, positive family relationships, and community-level resilience factors (57). The lower RFL scale score in the suicide group, may indicate a lack of certain protective factors against suicide, which has led them to attempt suicide.

We also investigated cognitive functions among three groups of people. Unexpectedly , the results for most of the investigated cognitive components did not significantly differ between the three groups, while some studies that used neuropsychological batteries were able to find a significant difference between suicidal and non-suicidal individuals (58, 59). However, for some components, such as the motor screening task mean latency, emotional cognitive recognition and spatial working memory, although the difference is not statistically significant, the difference in the scores of the SA+MDD and MDD groups and HC groups can be considered. Although the IQ of the two groups was largely similar, the lack of differences between the groups in the neuropsychological scales could be attributed to various factors, such as the length of the tests and the fatigue of the participants, and the small sample size.

Nonetheless, there are other hypotheses that could be proposed and investigated in future studies. One hypothesis suggests that individuals in a crisis of suicide attempt may temporarily experience heightened cognitive performance, aiding them in non-efficient planning and attempting suicide. Essentially, they may utilize their cognitive functions, such as planning, instead of addressing solving life problems to alleviate psychological pain and attempt suicide (59). Given that the individuals in the suicide group in our study had attempted suicide recently (one month ago), this hypothesis could be further explored in future studies.

Despite the absence of significant differences in cognitive performance among the three groups (SA+MDD, MDD, and HC), the focus was placed on exploring the correlation between cognitive and clinical factors. This investigation aimed to understand the relationship and mutual influence of these factors. However, there were some interesting points in the correlation between clinical and neuropsychological scales in the suicide group. Results revealed a positive correlation between the Suicidal Ideation Scale (SSI) and Motor Screening Task (MOT). The MOT assesses sensory motor skills as well as impulse control. Additionally, the SSI showed a significant positive relationship with the impulsivity scale (BIS). Therefore, as suicidal thoughts increase in individuals at risk of suicide, impulsive

behaviors also tend to increase. Consistent with our findings, previous studies have also demonstrated a link between suicidal thoughts and impulsivity (60, 61). In addition, there was a significant positive relationship between the Beck Intension Scale (SIS) and the Cambridge gambling task risk-taking. The Cambridge gambling task risk-taking assesses decision-making and risk-taking behavior (62). Therefore, this relationship suggests that individuals with higher levels of suicidal intention are more inclined to take risks, which in turn increases their likelihood of attempting suicide. Risk-taking behavior is related to the ventromedial frontal area and anterior cingulate which are responsible areas for evaluating risk and making decisions (63). Studies have shown that there is an impairment in these areas among suicidal individuals (64).

Additionally, the Symbol Digit subscale exhibited a negative correlation with the levels of aggression and depression. A high score on the Symbol Digit subscale suggests proficient motor speed and attention (65). Our findings indicate that within the suicide group, the severity of depression and aggression is directly proportional to the impairment in motor speed and attention. Shifting attention and motor speed are related to the frontal and the neural circuit of fronto-striato-thalamo cortex, which reveals that malfunction of these circuits may contributed to the neural dysfunction of suicidal cases (66).

Our study sample attempted suicide in the last four weeks and may have the intention to re-attempt, which may be deemed in this result. Individuals who have recently attempted suicide exhibit a greater inclination to engage in risky behaviors (67, 68).

Our results showed that the digit span scale has a significant negative relationship with the BPAQ, the anxiety-springer, and the BDI. Given that the digit span scale assesses working memory and attention (69), this relationship suggests that individuals with higher levels of aggression, anxiety, and depression tend to have lower working memory performance, which is related to frontal lobe function (70). Previous studies have also shown deficits in working memory among suicidal patients (71). Other evidence has shown that working memory acts as a mediator for aggression in individuals who have been raised in an inappropriate environment (72, 73). In addition, working memory is one of the functions of the frontal lobe, and there is ample evidence indicating that this function is impaired in suicidal patients (74, 75). In this direction, within the suicidal group, the arithmetic subscale also exhibits a negative correlation with the suicidal intention scale, the BPAQ, and the anxiety-springer scale. In the sense that the arithmetic subscale assesses numerical reasoning ability, attention, and concentration (76), these results can be considered as confirming the findings mentioned above. On the other hand, the same clinical subscales of aggression, anxiety, and intention to suicide (SIS) exhibit a negative correlation with the Block Design subscale. The Block Design subscale also demonstrates abilities in visual memory, executive function, and processing speed which is more related to parietal function (77, 78). Some studies have indicated that improvement in visual memory among individuals at risk of suicide was associated with a decrease in suicide risk (79). Additionally, these studies discovered that poor performance in processing speed was associated with a higher risk of suicide (79).

In the suicide group, the picture completion scale showed a significant positive correlation with Beck's Hopelessness Scale (BHS). The completion scale assesses the ability to recognize and attend to details (80). Previous studies have indicated that a positive mood is associated with decreased attention to detail and cognitive effort. Therefore, it can be hypothesized that individuals experiencing depression exhibit heightened attention to negative details, which may contribute to a greater sense of hopelessness (81). In addition, the emotion recognition scale showed a significant positive correlation with the clinical scales measuring suicidal thoughts and anxiety. Emotion recognition scales assess two key aspects of the ability to recognize emotions: the accuracy in identifying the types of emotions that compose a person's emotional state and the sensitivity to the intensity of those emotions (82). Therefore, this positive correlation suggests that in suicidal patients, with the increase in suicidal thoughts and anxiety, the sensitivity to the intensity of other people's emotions increases. Some studies have shown that individuals who are depressed and have suicidal thoughts may have a heightened ability to recognize unpleasant emotions, such as fear, compared to depressed individuals without suicidal thoughts (83).

Conclusion

Neuropsychological findings are inconsistent among studies, which may be attributed to their clinical features and the dominancy of hopelessness or impulsivity. Limited significant differences between SA/MDD and MDD could be the sample size and also recently attempted which, in our studies, the suicidal subjects were recruited from those who attempted in the last four weeks who are at risk of re-attempt again (84, 85). functional impairment of the frontal, parietal, and temporal gyrus could have implications for the brain function of individuals with recent suicide attempts who are at risk of re-attempt.These findings shed light on the complex interplay between clinical variables and cognitive functions in individuals at risk of suicide emphasizing the need for comprehensive evaluations and targeted interventions that can inform the development of tailored treatment approaches.

Authors' Contributions

Mozhgan Taban: Review of statistical analyses, revision and critique of the manuscript, interpretation of results; Seyed Kazem Malakouti: Research study conception and design, organization of study data, review of statistical analyses, revision and critique of the manuscript, interpretation of results; Negar Bastani: Collecting data, critique of the manuscript; Marzieh Nojomi: Statistical analysis, revision; Vahid Sadeghi-Firoozabadi: Critique of the manuscript; Ehsan Rajabi: Research study conception, revision; and Nafee Rasouli: Collecting data, organization of study data, review of statistical analyses, revision and critique of the manuscript, interpretation of results.

Ethical Considerations

The present study will commence after obtaining the code of ethics from the Ethics Committee of the National Institute of Medical Sciences Research Development (NIMAD). Participants were fully informed about all stages of the study, and written consent was obtained before beginning. In the written consent, participants were informed that their personal information would be protected.

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Conflict of Interests

The authors declare that they have no competing interests.

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Appendix. Correlation analysis between clinical and neuropsychological variables in the SA+ MDD group

Group			Motor screening Task Mean latency	Emotion Recognition Task Percent correct	Cambridge Gambling Task Risk-taking	Rapid Visual Information Total false alarms	Scaled Score digit span	Scaled Score Arithmetic	Scaled Score Block Design	Scaled Score Digital Symbol	Scaled Score Similarities	Scaled Score picture completion	Scaled Score information
SA+MDD	SIS	Pearson Correlation	0.329	0.038	.477*	0.148	-0.401	-.642**	-.680**	-0.366	-0.141	0.196	-0.095
		Sig. (2-tailed)	0.183	0.882	0.045	0.557	0.099	0.004	0.002	0.135	0.603	0.467	0.726
	PDI	Pearson Correlation	0.406	-0.040	0.210	-0.156	-0.333	-0.458	-0.188	-0.207	-0.158	-0.034	-0.232
		Sig. (2-tailed)	0.094	0.876	0.404	0.535	0.176	0.056	0.454	0.410	0.560	0.901	0.387
	BHS	Pearson Correlation	0.364	0.166	-0.141	0.301	-0.186	-0.131	-0.093	-0.190	0.013	.513*	-0.258
		Sig. (2-tailed)	0.137	0.509	0.577	0.225	0.460	0.603	0.715	0.449	0.962	0.042	0.336
	BSSI	Pearson Correlation	0.464	0.451	0.139	0.123	-0.440	-0.452	-0.292	-0.229	0.235	-0.180	-0.029
		Sig. (2-tailed)	0.053	0.060	0.582	0.627	0.067	0.060	0.240	0.361	0.381	0.504	0.916
	BIS	Pearson Correlation	.747**	0.012	-0.158	.582*	-0.282	-0.332	-0.153	-.514*	-0.047	-0.063	-0.372
		Sig. (2-tailed)	0.000	0.963	0.532	0.011	0.256	0.179	0.544	0.029	0.862	0.817	0.156
	RFL	Pearson Correlation	-0.253	-0.363	0.026	-0.199	0.329	-0.009	0.008	-0.056	-0.087	-0.021	0.045
		Sig. (2-tailed)	0.310	0.139	0.917	0.428	0.182	0.971	0.974	0.825	0.749	0.938	0.868
	BPAQ	Pearson Correlation	0.376	0.059	0.283	0.305	-.484*	-.638**	-.511*	-0.383	-0.308	-0.433	-0.019
		Sig. (2-tailed)	0.125	0.815	0.254	0.218	0.042	0.004	0.030	0.117	0.246	0.093	0.944
	anxiety-springer-1	Pearson Correlation	0.258	0.466	-0.190	0.417	-0.430	-.503*	-.483*	-0.256	-0.214	0.014	-0.257
		Sig. (2-tailed)	0.301	0.051	0.451	0.085	0.075	0.033	0.042	0.305	0.425	0.958	0.338
	anxiety-springer-2	Pearson Correlation	0.124	0.182	-0.255	.483*	-.575*	-.603**	-0.326	-0.166	-0.065	-0.011	-0.189
		Sig. (2-tailed)	0.623	0.469	0.308	0.042	0.012	0.008	0.187	0.510	0.811	0.969	0.484
	BDI	Pearson Correlation	0.286	-0.078	0.031	.661**	-.633**	-0.283	-0.227	-.602**	-0.250	0.087	-0.226
		Sig. (2-tailed)	0.250	0.759	0.902	0.003	0.005	0.255	0.365	0.008	0.351	0.749	0.400