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Relationship Between Executive dysfunction and Suicidal Attempt in Adults Diagnosed with Depression: A Systematic Review

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Abstract

Introduction: Suicide attempt has become a public health problem worldwide. Identifying the different risk factors involved in this behavior can result in prevention and intervention alternatives. This phenomenon is associated with environmental, cognitive, psychological, behavioral, biological, and genetic factors.

Method: The search was carried out on Web of Science and Scopus on March, 2023, using the following search equation: topic= "Suicide" AND "Suicidal behaviour" AND "Executive functioning" AND "mood" AND "intervention" OR "psychological treatment" with a date range from January 2001 to March 2023. The reporting follows the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guideline for systematic reviews and meta-analyses. Once the results were obtained, they were loaded onto the Tree of Science platform.

Results: Quantitative results were organized into three trends: Neurobiological factors associated with the attempt of suicidal behavior in adults diagnosed with depression, cognitive factors associated with suicide attempt in adults diagnosed with depression, and potential intervention alternatives for the treatment of suicidal ideation and suicide attempt in adults diagnosed with depression.

Conclusion: Executive dysfunction results in various changes in patients with depressive disorder and a history of suicidal behavior. It is also related to functional variations in the brain, in neural networks and circuits, as well as neuroendocrine changes. The dorsolateral, ventral, and orbitofrontal prefrontal cortex are implicated in this phenomenon. A multidimensional interpretation of this problem is proposed, and the need to identify and promote effective interventions that can help prevent suicide attempt and avoid future relapses.

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Abbreviations

SI = Suicidal ideation, SA = Suicide attempt, EF= Executive functioning, PFC= Prefrontal cortex, DLPFC = dorsolateral prefrontal cortex, MDD= Major depressive disorder, BD = Bipolar disorder.

1. Introduction

Suicidal behaviour is a public health problem worldwide. Each year, about 703.000 people take their own lives. Furthermore, according to the World Health Organization ([WHO], 2021) for every completed suicide, there are many suicide attempts. Identifying the different risk factors involved in this behavior can result in prevention and intervention alternatives, considering that its etiology is associated with environmental, cognitive, psychological, behavioral, biological, and genetic factors. It was reported that neuropsychological performance has been linked to suicidal behavior in several studies over time (Fernández et al., 2021).

Although death rates from suicidal behavior remain the most visible data, it is necessary to consider the concept of suicide in its different expressions, such as suicidal ideation (SI), planning, and suicide attempt (SA), many of which do not end in death. Various studies have reflected that for every completed suicide, there are 10 to 20 or more suicide attempts (WHO, 2013).

A suicide attempt is a self-inflicted behavior, initiated and carried out by an individual using different methods, without the intervention of others, and without a fatal outcome. Longitudinal studies show that 40% of people who attempt suicide have had previous attempts. It is also known that the risk of suicide increases during the first six months and even during the first year after the attempt (Ministerio de Salud, 2022).

Around 79% of suicides in the Americas region occur in men. The age-adjusted suicide rate among males is over three times higher than that among females (WHO, 2021). According to a recent study, sex influences deficits in the cognitive domain in SA, specifically in executive functioning (EF), which are slightly better in women. The results of the research suggest that higher scores on impulsivity have been related to men, which implies a tendency to think and behave in a less planned way in males, generating a higher risk of maladaptive decision-making in demanding situations, which may include risky behaviors, self-injury, or suicidal behavior (Fernández et al., 2021).

Regarding associated clinical diagnoses, depression is the most related syndrome to SI and completed suicide. It is known that major depressive disorder (MDD) and other associated disorders, including Bipolar disorder (BD), have implications for cognitive dysfunction, specifically in executive performance. Likewise, evidence suggests that MDD involves deficits in functionality along prefrontal cortex (PFC) receptors, specifically in the dorsolateral prefrontal region. Thus, it is vital to identify both the factors that increase the risk of suicide in adults with depression but also, the limitations in validity and reliability associated with this

diagnosis (Gómez-Tabares et al., 2022; Dalgleish et al., 2020). Although the link between suicide and mental disorders (particularly depression and alcohol consumption) is well documented in high-income countries, many people who carry out impulsive suicidal behavior are in situations where their ability to cope with the daily life tensions (economic difficulties, couple breakups, losses, pains, or chronic illnesses) is diminished (WHO, 2021).

On the other hand, some of the factors that were associated with the risk of SI or SA include: genetic aspects, physiological and neurobiological variables, failures in executive functioning, and contextual circumstances. Regarding genetic variables, it has been suggested that neurocognitive alterations associated with the risk of SA and SI and pathological personality traits are highly heritable factors (Tolsá & Malas, 2022; Hoehne et al., 2015; Somma et al., 2020).

Among the deficits in EF commonly associated with SI or SA are difficulties in attention control, memory, cognitive flexibility, decision-making, inhibitory control, emotional regulation, and problem-solving (Gómez et al., 2023; Hildebrand et al., 2023; Marzuk et al., 2005; Keilp et al., 2013; Jollant et al., 2011; Richard et al., 2014; Saffer & Klonsky, 2018; Fernández et al., 2021; Gorlyn et al., 2013; Huber et al., 2019; Hoehne et al., 2015; Perrain et al., 2021; Raust et al., 2007). EF deficits can lead to deficiencies in the regulation of thoughts, emotions, and behaviors, making it possible for self-injurious ideas or behaviors to emerge. Consequently, individuals at high risk of SA have a limited repertoire of behavioral responses to stress, and these responses are usually associated with maladaptive behaviors (Bredemeier & Miller, 2015).

From this perspective, deficits in EF are associated with alterations in different neurophysiological variables. The literature has described the relationship between decision-making deficits and serotonergic regulation in the orbitofrontal cortex in people with SA (Hildebrand et al., 2023). Some studies have described the influence of these alterations in the serotonergic system in specific brain areas of the PFC and the dorsal and median raphe nuclei (Raust et al., 2007; Somma et al., 2020).

Recent studies established that cognitive risk factors in SI and SA include deficits in neurocognitive functioning as well as negative thought contents and patterns, such as rumination and cognitive distortions (Diaz et al., 2022). These psychological variables are related to contextual or environmental factors that influence SI or SA. The interpersonal psychological theory of suicide (IPTS) proposes that psychosocial stressors generate alterations in the individual's subjective experience, individual coping strategies are put into play, determined by adequate executive functioning in aspects of planning, organization, attention, and prospective memory (Lennon, 2019).

Therefore, it is crucial to propose possible intervention alternatives that integrate different spheres of the human being, from the neurobiological, cognitive, psychological, affective, and social perspectives. The aim is to reduce risk factors for SI and SA, and to enhance protective factors that prevent SA and promote mental health. The literature has reported promising results from contextual therapy interventions to prevent and reduce SI and SA in individuals with depression (D'Anci et al., 2019; Barredo et al., 2021).

In general terms, although deficits in EF that have been associated with SI or SA have included alterations in attention, memory, behavioral inhibition, cognitive flexibility, and decision-making. Therefore, a systematic review is needed to evaluate the consistency and magnitude of such deficits, thus enabling a comprehensive understanding of suicide and implementing effective treatment alternatives in patients with a diagnosis of depression, which includes direct intervention in the most affected executive functions, the underlying factors of depression, SI, and SA. For this reason, the present review aimed to assess the existing literature to identify the relationship between executive dysfunction and suicide attempt in adults diagnosed with depression.

2. Methods

To write the article, tools were employed to examine the relationship between executive dysfunction and suicide attempt in adults with depression. The first tool used was the Web of Science (WoS) indexed database to identify articles related to executive functioning impairments and suicide attempts in adults with depression. The following search equation (SE) was used: Topic="Suicide" AND "Executive functioning" with a date range from January 2001 to March 2023. The search produced a total of 73 studies that met the criteria related to: adult population, depression diagnosis, mixed symptomatology, history of SI and SA and impairment in cognitive functions. However, no articles were manually removed to improve the accuracy of the analyzed results.

Once the results were obtained, they were loaded onto the Tree of Science (ToS) web platform (Robledo et al., 2014). This tool enables the construction and practical understanding of the theoretical framework and state of the art based on the initial search in WoS. The Tree of Science algorithm is based on graph theory, where articles are represented as nodes and citations between them are represented as links. Therefore, each node represents a unit of knowledge located within the network. The most important nodes are identified based on their position, which is determined according to the links that connect them to other nodes (Hirsch, 2005). In this regard, the studies located at the root are the seed references on executive functioning

impairments and suicide attempt in adults with a depression diagnosis, and those in the trunk are the structural articles. Finally, the leaves are articles that determine current perspectives or trends on the topic.

Another tool used was the Scopus indexed database, with the aim of searching for articles related to executive functioning impairments, suicide attempt in adults with a depression diagnosis, and intervention models. The following search equation (SE) was used: Topic="Suicidal behaviour" AND "Executive functioning" AND "mood" AND "intervention" OR "psychological treatment" with a date range from January 2001 to March 2023. The search produced a total of 145 articles, from which were selected those that met the inclusion criteria related to: adult population, depression diagnosis, mixed symptomatology, history of SI and SA and impairment in cognitive functions. Systematic review studies, studies on adolescent/children and focused exclusively on older adult populations, and studies that did not address SI and SA were excluded. Finally, a total of 20 articles were included.

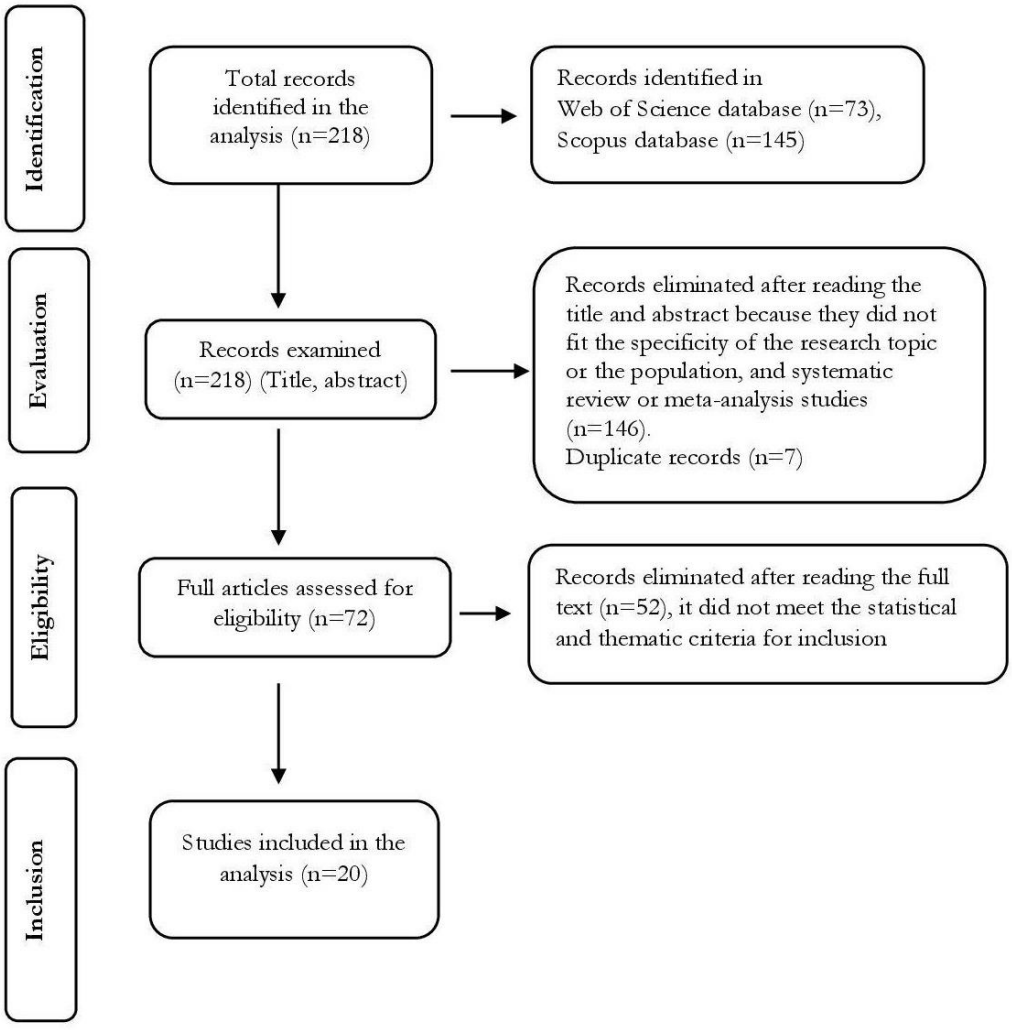

Figure 1. PRISMA flowchart showing selection methodology

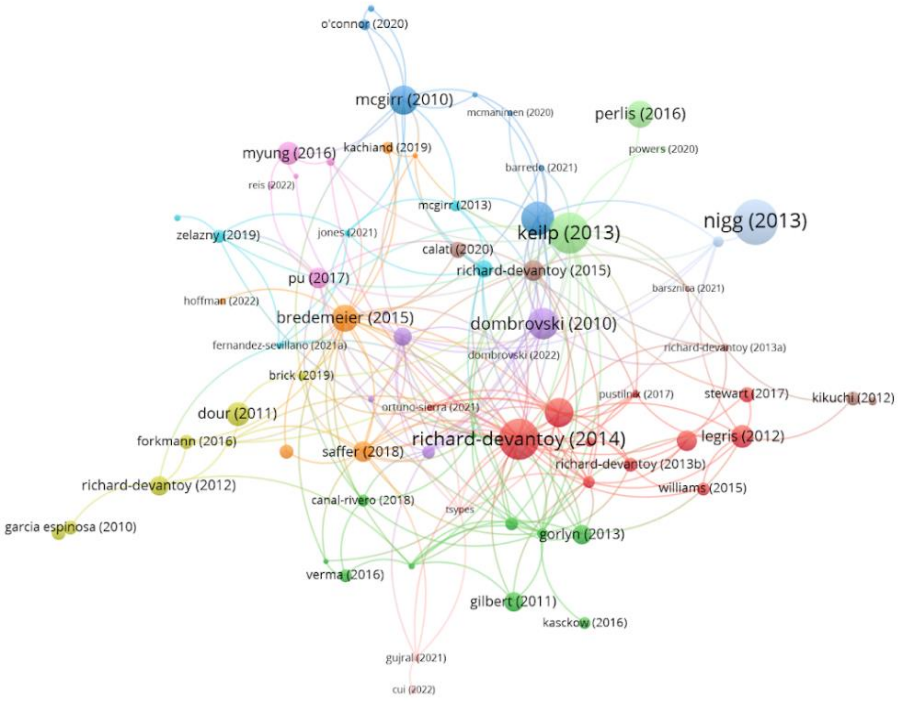

Figure 2. Final Citation Network (Research Communities)

Table 1. Studies included in the systematic review

Study	Population	SI/SA-NO SA	Gender m/f	Age range	Functional /Cognitive impairment	Scales/Inventories applied for dx	Neuropsychological tests applied	Techniques applied
Zhong et al. (2022)	BD II (68) HC (35)	SA (30) NO SA (38)	40/63	18 - 45 Y.O.	SA showed aberrant DFC in the CSTC, SA/SI indicated caudothalamic anomaly.	SCID-P, SCID-NP, HDRS, YMRS, BSSI	TMT-A, BACS-SC, HVLT-R, WMS-III SS, NAB MAZES, MSCEIT, CPT-IP	RMf-ER
Chattun et al. (2020)	MDD (27) HC (25)	SA (14) NO SA (13)	28/24	20 - 50 Y.O.	SA/SI showed disruption of the CSTC loop, caudothalamic dysfunction.	MINI, HDRS, NGASR	N/A	MEG & fMRI
Zheng et al. (2023)	MDD (51) HC (34)	SA (17) NO SA (34)	55/30	18 - 45 Y.O.	SA/SI showed dysfunction in the DLPFC.	MINI, SIOSS, HADS	EAMT, AMT	fNIRS

Ai et al. (2018)	MDD (103) HC (26)	SA (18) SI (31) NO SA (54)	52/77	18 - 40	SA showed hypoactivation in the DLPFC, SA/SI showed impaired neuronal functioning during executive processing.	CIDI, BSSI, QSA, IDS, BAI,, NEMESIS	FACES TASK, TOL	fMRI
Forkmann et al. (2016)	NS (37)	NO SA (37)	10/27	18 - 34	SI showed lower resting vagal tone in relation to impaired inhibitory control.	DESC-I	N/A	ECG
O'Connor et al. (2021)	MDD (24) BD (1) GAD (11) PTSD (2) OTHER (57) HC (47)	SA (49) SI (46)	43/99	18 - 63	SI/SA showed that the cortisol awakening response is inversely related to feelings of hopelessness and defeat.	SITBI, BRS, ESSI, PSWQ, MPS, BIS	N/A	SALIVETTES, GENEACTIV
Reis et al. (2022)	MDD (25)	SA (3) NOT CURRENT SI (10) NO SA (22)	9/16	19 - 59	SI showed reduced functional connectivity and decreased integrity of the DMN in MDD.	SCID, HAM-D, HAM-A, PSS-10, BSSI	MMSE	IRMF
Malhi et al. (2020)	MDP (79) BD (43) MDD (36) HC (66)	SA (25)	73/72	18 - 65	MDP showed DMN dysfunction, supporting SA.	CSSRS, STAI, HAM-D	N/A	IRMF
Qiu et al. (2021)	N (600)	201/191-208	299 /296	P: 26	Avoidant and dependent decision-making style.	YRBS UPPS-SF DASS MSI-BPD UP3 INQ	FrSBe GDMS	N/A
Brokke et al. (2020)	N (98)	31/61-6	45/53	18 - 65	Deficits in cognitive control, attention, and working memory.	CSHF MADRS D-KEFS BRIEF	ACS CSQ Stroop Color Word Test, Wisconsin Card Sorting Test	N/A
Hoffman et al. (2022)	N (38507)	NA/ 689-37,818	31,966 / 6541	p:20,97	Deficits in verbal memory, visual-spatial memory, sustained attention, and cognitive flexibility.	STARRS-LS SLNB	PCET ER40 PFMT PCPT GNG	N/A

Mansueto et al. (2022)	N (395)	189-NA	149/ 246	p: 36, 4	Metacognitive beliefs and repetitive negative thinking.	Symptom Checklist-90 YMRS HAM-D PSR	DERS MCQ-3 CANTAB SOC SSP	N/A
MacPherson et al. (2022)	BD (93)	NA	NA	18- 30	Deficits in cognitive flexibility.	YMRS HAM-D	ID/ED SOC SSP IPANAT	N/A
Dekker et al. (2018)	N (160) MDD (60) HC (100)	60-100	NA	P=22,23	Impulsivity and deficits in cognitive inhibition.	IDD-L IDS-SR30 Word Naming Task, SCID, Emotion-Eliciting Film Clips, Three-Factor Impulsivity Scale	WAIS PUM	N/A
Miranda et al. (2012)	NS (45)	10/13-32	35/10	18-22	Deficits in cognitive flexibility.	C-DISC-IV BDI-II BHS BSS	WCST	N/A
Gilbert et al. (2011)	BD(67)	NA	NA	18-60	Deficits in attention, verbal memory, and decision-making.	BIS-11 CTQ SSI HDRS WAIS-R	WCST IGT Stroop Color and Word Test	N/A
Pu et.al. (2017)	MDD (233)	138/NA-95	111/122	16-76	Deficits in verbal memory, working memory, and motor speed.	HAM-D BACS	BACS Tower of London Test	N/A
Aadahl et al. (2021)	D-PERSONALITY (7) D-AFFECTIVE (12) SCZ (2) ED (1) NS (5)	SA (21) N SA (3) NS (3)	9/18	18 - 35 Y. O.	N/A	ESM, BDI, BSSI, BHS, Defeat Scale, Entrapment Scale, MCQ-30	N/A	N/A
Lapidos et al. (2019)	NS (490)	SA (490)	NS	18	N/A	BSSI, CSSR-S, SEASA, BHS, Q-LES-Q-SF, SF-12, MDPSS, PHQ-9, INQ, ASRS, MLQ	N/A	N/A
Chesin et al. (2016)	MDD (9) Dysthymia (1)	SA (10)	45140	18 - 64 Y. O.	N/A	SCID O MINI, BDI, BSSI, LEIDS-R, FFMQ, SCS, RRS-B	COMPUTERIZED STROOP TASK, CPT, TRVS, TRVB	N/A

Note: SA= Suicide Attempt; SI =Suicidal Ideation; NO SA= No Suicide Attempt; HC= Healthy Controls; BD II= Bipolar Disorder Type 2; MDD= Major Depressive Disorder; CSTC= Cortico-Striato-Thalamo-Cortical Circuit; DFC= Dynamic Functional Connectivity; SCID-P/NP= Structured Clinical Interview for DSM-IV Axis I Disorders, Patient Edition/Non-Patient Edition; HDRS or HAM-D= Hamilton Depression Rating Scale; YMRS= Young Mania Rating Scale; BSSI= Beck Scale for Suicide Intent; TMT-A= Trail Making Test Part A; BACS= Brief Assessment of Cognition in Schizophrenia; HVLT-R= Hopkins Verbal Learning Test-Revised; WMS-III SS= Wechsler Memory Scale; NAB MAZES= Mazes subtest of the

Neuropsychological Assessment Battery; MSCEIT= Mayer-Salovey-Caruso Emotional Intelligence Test; CPT-IP= Continuous Performance Test-Identical Pairs; MRI-RS= Resting-State Functional Magnetic Resonance Imaging; MINI= Mini International Neuropsychiatric Interview; NGASR= Nurses Global Assessment of Suicide Risk; DLPFC= Dorsolateral Prefrontal Cortex; SIOSS= Self-Idea of Suicide Scale; AEMT= Autobiographical Emotional Memory Test, HADS= Hospital Anxiety and Depression Scale; MEG= Magnetoencephalography; fMRI= functional magnetic resonance imaging; fNIRS= functional near-infrared spectroscopy; CIDI= Composite International Diagnostic Interview; QSA= Question about Suicide Attempts; IDS= Inventory of Depressive Symptomatology; BAI=Beck Anxiety Inventory; DESC-I= Rasch-based Depression Screening version 1; SITBI= Self-Injurious Thoughts and Behaviors Interview; BRS= Brief Resilience Scale; ESSI= ENRICHD Social Support Inventory; GAD= Generalized Anxiety Disorder; PTSD= Posttraumatic Stress Disorder ; HPA=Hypothalamic-Pituitary-Adrenal Axis; PSWQ= Penn State Worry Questionnaire; MPS= Multidimensional Perfectionism Scale; BIS= Barratt Impulsiveness Scale; HAM-A= Hamilton Anxiety Rating Scale; PSS= Perceived Stress Scale; C-SSRS= Columbia-Suicide Severity Rating Scale; STAI= State-Trait Anxiety Inventory; DMN= Default Mode Network; DASS= Depression, Anxiety and Stress Scale; MSI-BPD= McLean Screening Instrument for Borderline Personality Disorder; UP3= Beck Hopelessness Scale Short; INQ= Interpersonal Needs Questionnaire; FrSBe= Frontal Systems Behavior Scale; GDMS= General Decision-Making Style Test; CSHF= Columbia Suicide History Form; MADRS= Montgomery-Asberg Depression Rating Scale; D-KEFS= Delis-Kaplan Executive Function System Test; BRIEF= Behavior Rating Inventory of Executive Function; ACS= Attentional Control Scale; CSQ= Cognitive Change Questionnaire; STARRS-LS= The Study to Assess Risk and Resilience in Servicemembers - Longitudinal Study; SLNB= Short Letter N-Back; PCET= Penn Conditional Exclusion Test; ER40= Penn Emotion Recognition Test; PFMT= Penn Face Memory Test; PCPT= Penn Continuous Performance Test; GNG= Go/No-Go Test; PSR= Psychiatric Status Rating Scales; ID/ED= intra-dimensional/extra-dimensional; SSP= Spatial Span; IPANAT=Implicit Positive and Negative Affect Test; WAIS= Wechsler Adult Intelligence Scale; PUM= Positive Urgency Measure; C-DISC-IV= Computerized Diagnostic Interview Schedule for Children Version IV for children and young adults ; BDI= Beck Depression Inventory ; BHS=Beck Hopelessness Scale ; WCST= Wisconsin Card Sorting Test; CTQ= Childhood Trauma Questionnaire; IGT= Iowa Gambling Task; CANTAB= Cambridge Neuropsychological Test Automated Battery; SOC= Stockings of Cambridge task; MCQ= Metacognitions Questionnaire-30; CSSR-S= Columbia–Suicide Severity Rating Scale; SEASA= Self-Efficacy to Avoid Suicidal Action; Q-Les-Q-SF= Quality of Life Enjoyment and Satisfaction Questionnaire-Short Form; SF-12= 12-Item Short Form Survey, Health Survey; MSPSS= Multidimensional Scale of Perceived Social Support; PHQ-9= Patient Health Questionnaire; ASRS= Adult Social Relationship Scale; MLQ= Meaning in Life Questionnaire LEIDS-R= Leiden Index of Depression Sensitivity-Revised; FFMQ= Five Facet Mindfulness Questionnaire; SCS= Self-Compassion Scale, RRS-B= Ruminative Response Scale Brooding subscale; DERS= Difficulties in Emotion Regulation Scale; CPT= Continuous Performance Test, SRT= Selective Reminding Test, BVMT-R= Benton Visual Retention Test; IDD-L= Long term Depression Diagnosis; IDS-SR30= Inventory of Depressive Symptomatology Self-Report; ECG=Electrocardiogram; GENEACTIV= cortisol collection test; STROOP= Stroop Color and Word Test; TL=Tower of London test; MMSE=Mini-Mental State Examination

3. Results

The research databases show an evolution in the number of articles per year available in Web of Science and Scopus on the relationship between executive dysfunction and suicide attempt in adults with depression. From 2019 onwards, there has been an increase in the number of published articles. The following studies laid the foundation for current trends. These studies address specific subtopics on executive functioning impairments and suicide attempt in adults with depression. Based on the studies found, this systematic review identified three trends: i) Neurobiological factors associated to suicide attempt in adults with depression, ii)

Cognitive factors associated to suicide attempt in adults with depression, and iii) Potential intervention alternatives for treating suicidal ideation and suicide attempt in adults with depression.

3.1 Neurobiological factors associated to suicide attempt in adults with depression

The final sample consisted of 8 studies, including a total of 718 participants. Among them, 266 had a diagnosis of MDD, 112 had a diagnosis of BD, 11 had a diagnosis of generalized anxiety disorder (GAD), 2 had a diagnosis of post-traumatic stress disorder (PTSD), 94 participants had a history of SI or SA without a specified clinical diagnosis, and finally, 233 healthy control subjects. 21.72% of the individuals had a history of suicide attempt at some point in their lives. Overall, 56.82% of the participants were women, and their ages ranged from 18 to 65 years.

Among the neurobiological factors associated to suicidal behavior in adults with depression, it was found that deficit in the dorsolateral prefrontal cortex (DLPFC) are related to depression symptoms that progressively lead to SI or SA (Zheng et al., 2023; Ai et al., 2018). In line with this, a study examined the relationship between PFC functioning and depression symptoms using functional near-infrared spectroscopy (FNIRS). The aim of this study was to monitor PFC functioning in 51 patients with MDD with and without SI, while they performed an autobiographical emotional task. The authors found that patients with SI or SA had lower activation in the DLPFC during the proposed task compared to patients with major depression diagnosis without SI (Zheng et al., 2023). In another study, similar results were found using functional magnetic resonance imaging (MRI) to measure brain activity during emotional and executive processing in 103 patients with depression and SI, while they performed the Tower of London task assessing planning and problem-solving, and the Facial Emotion Recognition task assessing brain activation during emotional processing. The results of the study led to the conclusion that patients with SI exhibited reduced PFC activation, indicating potential cognitive control impairments and decision-making deficits (Ai et al., 2018).

According to the results of this review, some studies suggest that different brain circuits are involved in SI and SA (Chattun et al., 2020; Zhong et al., 2022). One study specifically investigated the relationship of the cortico-striatal-thalamic-cortical (CSTC) circuit in patients diagnosed with MDD at risk of suicide, using magnetoencephalography (MEG) on 52 subjects between 20 and 50 years of age, of whom 27 were diagnosed with MDD and 25 were healthy controls. Previously, patients with MDD were assessed using the International Neuropsychiatric Interview (MINI) and the 17-item Hamilton Rating Scale, which allowed identifying that 14 patients were at high suicide risk, while the rest were at low risk. The authors concluded that

depressed patients with high suicidal risk had a caudate-thalamic dysfunction, specifically between the right caudate and the left thalamus (Chattun et al., 2020). Another study proposed that the cortico-striatal circuit is involved in SA, specifically in patients diagnosed with BD. Using functional magnetic resonance imaging (fMRI) on 68 BD patients with and without previous SA, and 35 healthy control subjects, researchers found that deficits in the dynamic functional connectivity of the cortico-striatal circuit are significantly correlated with cognitive dysfunction in patients with bipolar II depression and previous SA (Zhong et al., 2022).

Moreover, deficiencies in brain functional networks are another factor related to SI and SA, and through neuroimaging techniques, it is possible to identify dynamic changes in functional organization. A recent study found that the default mode network (DMN) is one of the altered brain networks. To reach this conclusion, the researchers evaluated the differences in neuronal activity and functional connectivity in 43 individuals with BD in depressive phase, 36 with MDD, and 66 healthy controls, of whom 25 had a history of SA. They found that those with SA had increased DMN activity and decreased basal ganglia activity (BGN), which was associated with recent SA and impaired self-referential thinking. Additionally, the differential co-activation of BGN and DMN suggests altered cognitive flexibility and rumination symptoms (Malhi et al., 2020). Another study reported that SI in MDD patients was related to reduced functional connectivity, indicating a deficit in communication between different brain regions, negatively affecting emotional and cognitive processing. There was also a marked decrease in white matter integrity, leading to difficulty in the quality of neural connections (Reis et al., 2022).

According to this research perspective, SI may be more related to functional alterations in neural circuits than to neuroanatomical alterations (Balcioglu & Kose, 2018), and the influence of physiological factors may contribute to psychiatric problems and SA. One study identified vagal tone as a factor associated with SI. Researchers aimed to determine whether resting vagally-measured heart rate variability (HRV) was related to SI in 37 participants without a history of SA, who were evaluated for active and passive suicidal ideation, and analyzed HRV using electrocardiography (ECG) to determine vagal tone. They concluded that reduced resting HRV was associated with increased self-reported SI, linked to lower resting vagal tone, suggesting a decrease in cognitive control capacity, difficulty in thought and emotion regulation, increasing the risk of SI (Forkmann et al., 2016). Another study analyzed 142 participants, of whom 95 had a history of SA.

3.2 Cognitive Factors Associated to Suicide Attempt in Adults with Depression

This research line was composed by 9 studies, including a total of 40,198 participants, ranging from 18 to 76 years old, with 18.08% being women. Among the study subjects, there were 160 individuals with MDD, 293 with a diagnosis of BD, and 39,640 individuals for whom no information about clinical diagnosis was provided, but who had a history of SI or SA. Finally, 100 healthy control subjects were reported. In total, 4.10% of individuals reported SI or SA at some point in their lives.

In this line of work, it was found that EF is related to SI or SA in adults with depression. Specifically, two studies from the sample concluded that lower cognitive flexibility is associated with greater symptomatology and, consequently, an increase in suicidal thoughts (MacPherson et al., 2022; Miranda et al., 2012). Specifically, one of these studies aimed to predict SI in 45 patients with previous suicide attempts, with a 6-month follow-up using the Wisconsin Card Sorting Test (WCST). The researchers suggest that cognitive inflexibility may increase vulnerability to SI over time among individuals with a history of SA. Similarly, it may be a lasting cognitive factor in childhood-onset BD-I with implications for a good prognosis.

From the same perspective, a study proposes that in addition to difficulties in cognitive flexibility, aspects such as memory and attention impairments are associated with greater vulnerability to SI or SA (Hoffman et al., 2022; Gilbert et al., 2011; Pu et al., 2017). In one of these works, the study population consisted of 38,507 U.S. Army soldiers, among whom 689 had previous SA. They were administered various neuropsychological tests, including some from the Penn Computerized Neurocognitive Battery. The researchers found that neurocognitive impairments, specifically related to cognitive flexibility, verbal memory, visual-spatial memory, and sustained attention, were significantly associated with a history of SA both before and after military service initiation (Hoffman et al., 2022). Consistent with these findings, two studies concluded that deficits in cognitive factors such as attention, verbal memory, working memory, and decision-making were associated with the risk of SA (Gilbert et al., 2011; Pu et al., 2017).

In particular, one of these investigations aimed to predict suicidal behavior in 67 patients with BAD by measuring cognitive factors. The Wisconsin Card Sorting Test (WCST), the Stroop Color-Word Test, and the Iowa Gambling Task were used. The results showed that patients performed poorly on attention and verbal memory tests (Gilbert et al., 2011). Similarly, another study identified that dysfunction in specific cognitive domains, such as verbal memory, working memory, and motor speed, may be associated with SI in patients with MDD (Pu et al., 2017).

Similarly, two studies propose that in addition to aspects such as attention and working memory impairments, deficits in cognitive control are a vulnerability factor in SA (Brokke et al., 2020; Dekker & Johnson, 2018). In one of these studies, 98 patients with previous SA were assessed using instruments such as the Attention Control Scale (ACS), the Cognitive Change Questionnaire (CSQ), the Stroop Color Test, and the WCST. The results led to the conclusion that patients with SI and a history of SA present difficulties in attention and working memory. Likewise, it was found that patients with previous SA have lower cognitive control than those with SI but without previous attempts (Brokke et al., 2020). Similarly, a study proposed that individuals with a history of MDD may experience difficulties with impulsivity and cognitive control. For this purpose, research was conducted on 60 patients with MDD and 100 control subjects who were administered different tasks to measure cognitive variables, including the Implicit Positive and Negative Affect Test (IPANAT), the Three-Factor Impulsivity Scale, as well as Word Naming Task and Emotion-Inducing Movie Clips. The study found that individuals diagnosed with MDD throughout their lives were more impulsive in both emotional and non-emotional states than non-depressed individuals. Additionally, there is a link between inhibition deficits and emotion-related impulsivity (Dekker & Johnson, 2018).

In the same line of research, it was found that negative metacognitive beliefs are associated with SI. In a study conducted with 395 individuals aiming to identify the relationship between metacognitive beliefs and emotion regulation, assessment instruments such as the Difficulties in Emotion Regulation Scale (DERS) and the Metacognitions Questionnaire (MCQ-30) were used. The researchers concluded that metacognitive beliefs and repetitive negative thinking and rumination may be associated with SI (Mansueto et al., 2022).

Finally, a study suggested the implication of decision-making difficulties in SA among patients diagnosed with BD (Gilbert et al., 2011). In line with this finding, a more recent study aimed to determine if there are differences in decision-making styles between individuals with SA and those with SI (Qiu & Klonsky, 2021). For this purpose, research was conducted on a group of 600 individuals, including 191 with previous suicidal behavior and 201 with SI. The study's results were analyzed based on data obtained from the General Decision-Making Style Test (GDMS) and the Frontal Systems Behavior Scale (FrSBe) to assess EF, concluding that individuals with SA had significantly higher scores in the avoidant and dependent decision-making style compared to those with SI.

3.3 Potential intervention alternatives for the treatment of suicidal ideation and suicide attempt in adults with depression

In this line of research, a total of 3 studies were found regarding potential intervention alternatives for SI and SA in adults with depression diagnosis, involving a total of 527 participants, aged 18 and above, of which 521 reported a history of SA. In total, 98.86% of individuals presented SI or SA at some point in their lives.

From this perspective, one study describes the Self-Regulatory Executive Function (S-REF) model, specifically focusing on the incidence of Cognitive Attentional Syndrome (CAS) in SA. CAS refers to an individual's tendency to direct most of their attention towards their thoughts and rumination, leading to difficulty in controlling negative thoughts and maladaptive coping strategies (Aadahl et al., 2021). The research aimed to analyze the relationship between S-REF and SI, taking into account the influence of metacognitive beliefs. For this purpose, 27 participants were included, who completed a diary for 6 consecutive days using online Experience Sampling Methodology (ESM). The researchers reported that participants' positive and negative metacognitive beliefs were significantly related to recurrent thoughts associated with recurrent SI.

In the same line of research, another study aimed to determine the effectiveness of Peers for Valued Living (PREVAIL) compared to traditional intervention in reducing SA and SI among adults at high risk of suicide who have been hospitalized in mental health centers (Lapidos et al., 2019). This working model is based on the Interpersonal Theory of Suicide (ITS), which describes the coexistence of four factors that trigger the transition from SI to SA: Hopelessness, thwarted belongingness, burdensomeness, and acquired capability for suicide. For this research, 490 individuals at high risk of SA recruited from two mental health units and 40 peer mentors interested in conducting the intervention participated. Various scales were used to measure the risk of SA and the notions supporting ITS. Additionally, qualitative interviews were conducted to identify implementation barriers and facilitators, and a measure developed during the pilot phase was used to assess peer mentorship sessions. The research suggests that peer mentors can contribute to outcomes by fostering hope and connection, reducing depression, and therefore reducing SI (Lapidos et al., 2019).

Finally, a recent study reported that Mindfulness-Based Cognitive Therapy (MBCT) is a treatment that has been used to prevent relapse in individuals with chronic depression, increasing mindfulness and reducing negative effects of cognitive reactivity (Chesin et al., 2016). Researchers adapted MBCT to address concerns related to SA (MBCT-S), developing a brief

and individual intervention for suicide crisis. For this purpose, 10 participants with a history of SA underwent various scales to assess cognitive reactivity, mindfulness, rumination, and self-compassion. Cognitive tests such as the Stroop Test and Continuous Performance Test were also employed to evaluate executive and sustained attention. After 9 weeks of treatment, the results showed that participants experienced significant reductions in rumination and cognitive reactivity to hopelessness or suicide before and after MBCT-S treatment. Likewise, significant improvements in attention were found (Chesin et al., 2016).

4. Discussion

The aim of this systematic review was to evaluate the existing literature to identify the relationship between executive functioning impairments and suicide attempt in adults with depression. A total of 20 studies that met the inclusion criteria were evaluated. From a neurobiological perspective, it was found that impairments in DLPFC are related to depression symptoms, which progressively leads to SI or SA (Zheng et al., 2023). It has been discussed that symptomatology in MDD involves impairments in functionality between PFC receptors, specifically in the dorsolateral prefrontal region (Marzuk et al., 2005). These impairments are associated with poor decision-making appraisal and inadequate emotional regulation (Raust et al., 2007). Similarly, other studies report hypoactivation in DLPFC in SA, implying impaired cognitive control and decision-making capacity (Ai et al., 2018). Individuals with a history of SA have poorer attentional control, working memory impairment, and lower cognitive control compared to those with SI alone (Brokke et al., 2020). However, other findings indicate that SI is associated with executive impairment, decision-making difficulties, and cognitive rigidity. SI and cognitive rigidity may be partly determined by genetic factors (Westheide et al., 2008). Based on this, other results support the hypothesis that cognitive deficits may be a hereditary factor in suicidal behavior and vulnerability to depression (Hoehne et al., 2015). Therefore, it would be interesting to implement regular assessment strategies such as neuroimaging studies in patients diagnosed with MDD as they may help to predict the risk of SA. Additionally, further research is needed to identify differences in cognitive impairments between SA and SI.

On the other hand, it has been established that one of the brain circuits involved in SA in patients diagnosed with MDD is the CSTC circuit, specifically in the area between the right caudate and the left thalamus (Chattun et al., 2020). Likewise, another study suggests that variability in the dynamic functional connectivity of the corticostriatal circuit is associated with cognitive dysfunction in patients with BD in the depressive phase (Zhong et al., 2022). Furthermore, the default mode network (DMN) has been found to be associated with MDD,

SI, and SA, suggesting that this brain network is activated during rest, which may be involved in the development of rumination and affective dysregulation (Malhi et al., 2020). From this perspective, it has been established that a decrease in white matter integrity leads to deficits in the quality of neural connections, affecting communication between different brain regions and consequently generating difficulties in emotional and cognitive processing (Reis et al., 2022). Various studies also highlight that white matter alterations in the brain are considered potential biomarkers in MDD (Breit et al., 2023; Zhu et al., 2011). Finally, future studies are recommended to evaluate changes in CSTC circuit functioning and the DMN, as well as white matter integrity when patients are in a euthymic state and do not present SI.

As a side note, several studies refer to the influence of physiological factors on the risk of SI or SA. In relation to this, it has been described that deficits in serotonergic regulation trigger impairments in cognitive inhibition, enabling a greater risk of SI and SA. These alterations are related to specific brain areas such as the orbitofrontal cortex and the dorsal and medial raphe nuclei (Raust et al., 2007; Somma et al., 2020). Another study establishes that dysfunction in the HPA axis may be a risk factor for SA in terms of increased cortisol levels and decreased resilience in individuals at high risk of SA (O'Connor et al., 2021). This finding suggests resilience as a protective factor against the risk of SA due to its impact on biological stress responses. However, this finding should be interpreted with caution as this particular study used a cross-sectional design with a relatively small sample size (Merlo et al., 2022).

On the other hand, a finding establishes that low vagal tone, measured at rest, is associated with deficits in inhibitory control and therefore is implicated in SI and SA (Forkmann et al., 2016). In relation to this, some studies have established that high vagal tone is related to the individual's adaptive capacity to environmental demands, adequate executive control, and good emotional regulation skills. Meanwhile, low vagal tone influences the prolongation of negative emotions, hindering emotional regulation and impacting SI (Adolph et al., 2018). Likewise, it has been established that increased vagal tone is associated with the activation of prefrontal areas, which in turn explains the increase in emotional regulation (van Hoorn, 2020). These results indicate that vagal tone should be further studied in the future as a physiological risk factor in SI.

From a cognitive perspective, the literature has established the relationship between EF and SI or SA. Firstly, cognitive flexibility dysfunction has been reported in patients with previous SI or SA (Marzuk et al., 2005; Huber et al., 2019). In connection to this, some findings from the present study establish that failures in cognitive flexibility are associated with greater depressive symptomatology, which is in turn related to difficulties in adapting to environmental demands,

increasing vulnerability to SI that can progressively lead to SA (MacPherson et al., 2022; Miranda et al., 2012).

Secondly, it has been established that memory and attention deficits are associated with a higher vulnerability to SI or SA (Hoffman et al., 2022). As reported in another study, specific deficits in attention, control, memory, and working memory prevail in individuals with MDD and BD, across all types of SA. These impairments are widely related to ventral prefrontal dysfunction (Gorlyn et al., 2013). On the other hand, other studies argue that patients with MDD who had previous SA showed higher executive function deficits compared to those with MDD without SA, although the study did not identify any other specific deficits (Gómez et al., 2023). In contrast, another study reports that no significant differences were found between patients who experienced SA and those who did not in variables such as processing speed, attention, verbal learning, or executive function, specifically in euthymic BD patients (Gilbert et al., 2011). The variability of the results may represent a limitation; therefore, further studies are needed in euthymic patients for a better understanding of the variability and long-term impact on these cognitive functions following SA (Myles, 2021).

On the other hand, metacognitive beliefs and repetitive negative thinking (rumination) are associated with difficulties in emotion regulation (Mansueto et al., 2022). A study proposes the Self-Regulatory Executive Function (S-REF) model, establishing that in SI there is an increase in negative, repetitive, difficult-to-control thoughts and maladaptive coping, which is influenced by metacognition. Emerging evidence suggests that metacognitive beliefs are a general vulnerability factor for psychological distress (Aadahl et al., 2021). It is known that the prefrontal cortex is primarily related to the control of complex cognitive processes such as thinking, language, executive control, among others. The most anterior regions of the prefrontal cortex support the most advanced processes in humans, such as social cognition, mentalization, self-awareness, and metacognition (Flores & Ostroksy, 2008). Finally, it would be interesting to study the effects of interventions focused on metacognitive beliefs and emotional regulation in individuals with SI and SA.

Different studies mention that the Interpersonal Theory of Suicide aims to explain the transition from SI to SA, considering psychological and interpersonal factors. In this regard, studies report that resilience factors have an indirect impact on interpersonal variables and suicide risk (Espinosa et al., 2021). Furthermore, it is proposed that mental disorders, previous SA, social isolation, family conflict, unemployment, and physical illness are risk factors associated with suicide (Trejo et al., 2023). On the other hand, another study showed that individuals at high

risk of SA experience a decrease in psychological factors such as resilience and social support, and an increase in trait worry, perfectionism, and impulsivity. These factors are related to dysfunction in the HPA axis, which is responsible for regulating the stress response (O'Connor et al., 2021). From this perspective, a study proposes an intervention based on TPIS, peer mentoring or PREVAIL, suggesting that peer mentors can contribute to outcomes, foster hope and connection, and reduce depression and SI. However, *the effect size, as measured by Cohen's d, was d = 0.15, indicating a low effect* (Lapidos et al., 2019). In relation to the above, it is suggested to conduct more studies on peer interventions to evaluate their effects.

Over the past years, there has been an evidence base for contextual therapies, aiming to propose possible treatments for SI and SA. Different studies report that interventions such as cognitive-behavioral therapy (CBT) and dialectical behavior therapy (DBT) can be effective in preventing SI and reducing SA (D'Anci et al., 2019). The literature describes neurobiological changes associated with psychotherapy. In patients who received brief CBT for SA, there was a 50% to 60% reduction in the likelihood of presenting SA. Others have reported that Acceptance and Commitment Therapy (ACT) aims to increase psychological flexibility, focusing on experiential avoidance, the tendency to avoid unwanted thoughts or emotions (Tighe et al., 2018). However, the efficacy of ACT in reducing SI or SA requires more evidence, given the limited research reported or low effect sizes (d = 0.10 – 0.25). On the other hand, Mindfulness-based therapies and MBCT have demonstrated efficacy in individuals with chronic depression, showing improvements in executive attention, emotion regulation, cognitive flexibility, and interpersonal effectiveness (d = 0.31 – 0.52) (Barredo et al., 2021; Chesin et al., 2016). The literature also reports promising results, directly observable at different levels: affective, bodily, psychological, and cognitive (Bulzacka et al., 2018). Finally, it is recommended to continue developing studies based on contextual therapies, as there is insufficient literature on their effectiveness in intervening in SI and SA. Therefore, it is convenient to conduct longitudinal studies to evaluate the effect of these interventions on neurobiological, psychological, and cognitive factors in SI and SA among adults diagnosed with depression.

In conclusion, executive dysfunction results in various changes in patients with depressive disorder and a history of suicidal behavior, which are also related to functional variations in the brain, neural networks, and circuits, as well as neuroendocrine changes. Similarly, the dorsolateral, ventral, and orbitofrontal prefrontal cortex are implicated in this phenomenon, yet these underlying processes are not taken into account during interventions. Therefore, a multidimensional interpretation of this issue is proposed, highlighting the need to continue

studying the complexity of this phenomenon, underlying factors, and related disorders, in order to identify and promote effective interventions that can help prevent SA and avoid future relapses.

Conflict of interest statement

The authors have not declared any conflict of interest for this article.

Authors'cContribution

MCA: Data collection, analysis and interpretation of results, all authors reviewed the results and approved the final version of the manuscript.

VGJ: Data collection, analysis and interpretation of results, all authors reviewed the results and approved the final version of the manuscript.

DLM: Draft manuscript preparation, data collection, analysis and interpretation of results, all authors reviewed the results and approved the final version of the manuscript.

References

1. Aadahl, V., Wells, A., Hallard, R., & Pratt, D. (2021). Metacognitive beliefs and suicidal ideation: An experience sampling study. *International Journal of Environmental Research and Public Health, 18*(23). https://doi.org/10.3390/ijerph182312336
2. Ai, H., van Tol, M.-J., Marsman, J.-B. C., Veltman, D. J., Ruhé, H. G., van der Wee, N. J. A., … & Aleman, A. (2018). Differential relations of suicidality in depression to brain activation during emotional and executive processing. *Journal of Psychiatric Research*, *105*, 78–85. https://doi.org/10.1016/j.jpsychires.2018.08.018
3. Adolph, D., Teismann, T., Forkmann, T., Wannemüller, A., & Margraf, J. (2018). High frequency heart rate variability: Evidence for a transdiagnostic association with suicide ideation. *Biological Psychology*, *138*, 165–171. https://doi.org/10.1016/j.biopsycho.2018.09.006
4. Balcioglu, Y. H., & Kose, S. (2018). Neural substrates of suicide and suicidal behaviour: from a neuroimaging perspective. In Psychiatry and Clinical Psychopharmacology (Vol. 28, Issue 3, pp. 314–328). Taylor and Francis Ltd. https://doi.org/10.1080/24750573.2017.1420378
5. Barredo, J., Bozzay, M. L., Primack, J. M., Schatten, H. T., Armey, M. F., Carpenter, L. L., & Philip, N. S. (2021). Translating Interventional Neuroscience to Suicide: It's About Time. *Biological Psychiatry*, *89*(11), 1073–1083. https://doi.org/10.1016/j.biopsych.2021.01.013
6. Bredemeier, K., & Miller, I. W. (2015). Executive function and suicidality: A systematic qualitative review. In Clinical Psychology Review (Vol. 40, pp. 170–183). Elsevier Inc. https://doi.org/10.1016/j.cpr.2015.06.005
7. Breit, S., Mazza, E., Poletti, S., & Benedetti, F. (2023). White matter integrity and pro-inflammatory cytokines as predictors of antidepressant response in MDD. In *Journal of Psychiatric Research* (Vol. 159, pp. 22–32). Elsevier Ltd. https://doi.org/10.1016/j.jpsychires.2022.12.009
8. Brokke, S. S., Landrø, N. I., & Haaland, V. Ø. (2020). Cognitive Control in Suicide Ideators and Suicide Attempters. Frontiers in Psychology, 11. https://doi.org/10.3389/fpsyg.2020.595673
9. Bulzacka, E., Lavault, S., Pelissolo, A., & Bagnis Isnard, C. (2018). Mindful neuropsychology: Mindfulness-based cognitive remediation. *Encephale*, *44*(1), 75–82. https://doi.org/10.1016/j.encep.2017.03.006
10. Chattun, M. R., Zhang, S., Chen, Y., Wang, Q., Amdanee, N., Tian, S., … & Yao, Z. (2020). Caudothalamic dysfunction in drug-free suicidally depressed patients: an MEG study. European Archives of Psychiatry and Clinical Neuroscience, 270(2), 217–227. https://doi.org/10.1007/s00406-018-0968-1
11. Chesin, M. S., Benjamin-Phillips, C. A., Keilp, J., Fertuck, E. A., Brodsky, B. S., & Stanley, B. (2016). Improvements in Executive Attention, Rumination, Cognitive Reactivity, and Mindfulness among High-Suicide Risk Patients Participating in Adjunct Mindfulness-Based Cognitive Therapy: Preliminary Findings. *Journal of Alternative and Complementary Medicine*, *22*(8), 642–649. https://doi.org/10.1089/acm.2015.0351
12. Dalgleish, T., Black, M., Johnston, D., & Bevan, A. (2020). Supplemental Material for Transdiagnostic Approaches to Mental Health Problems: Current Status and Future Directions. *Journal of Consulting and Clinical Psychology*, *88*(3), 179–195. https://doi.org/10.1037/ccp0000482.supp

13. D'Anci, K. E., Uhl, S., Giradi, G., & Martin, C. (2019). Treatments for the prevention and management of suicide. In *Annals of Internal Medicine* (Vol. 171, Issue 5, pp. 334–342). *American College of Physicians*. https://doi.org/10.7326/M19-0869
14. Dekker, M. R., & Johnson, S. L. (2018). Major depressive disorder and emotion-related impulsivity: Are both related to cognitive inhibition? *Cognitive Therapy and Research, 42*(4), 398–407. https://doi.org/10.1007/s10608-017-9885-2
15. Diaz, E., Estric, C., Schandrin, A., & Lopez-Castroman, J. (2022). Neurocognitive functioning and impulsivity in first-episode psychosis with suicidal ideation and behavior: A systematic review. Schizophrenia Research, 241, 130–139. https://doi.org/10.1016/j.schres.2022.01.042
16. Espinosa-Salido, P., Perez Nieto, M. A., Baca-García, E., & Ortega, M. P. (2021). Systematic review of the indirect relationships of thwarted belongingness and perceived burdensomeness in suicide. *Clínica y Salud*, *32*(1), 29–36. https://doi.org/10.5093/CLYSA2020A27
17. Fernández-Sevillano, J., Alberich, S., Zorrilla, I., González-Ortega, I., López, M. P., Pérez, V., ... & Saíz, P. (2021). Cognition in Recent Suicide Attempts: Altered Executive Function. *Frontiers in Psychiatry, 12*. https://doi.org/10.3389/fpsyt.2021.701140
18. Flores-Lázaro, J. & Ostrosky, F. (2008).Neuropsicología de Lóbulos Frontales, Funciones Ejecutivas y Conducta Humana. *Revista Neuropsicología, Neuropsiquiatría yneurociencias*, 8(1), 47-58. https://dialnet.unirioja.es/servlet/articulo?codigo=398748
19. Forkmann, T., Meessen, J., Teismann, T., Sütterlin, S., Gauggel, S., & Mainz, V. (2016). Resting vagal tone is negatively associated with suicide ideation. *Journal of Affective Disorders, 194*, 30–32. https://doi.org/10.1016/j.jad.2016.01.032
20. Gilbert, A. M., Garno, J. L., Braga, R. J., Shaya, Y., Goldberg, T. E., Malhotra, A. K., & Burdick, K. E. (2011). Clinical and cognitive correlates of suicide attempts in bipolar disorder: Is suicide predictable? *Journal of Clinical Psychiatry, 72*(8), 1027–1033. https://doi.org/10.4088/JCP.10m06410
21. Gómez, J. F. P., Grisales, A. M., Gallego, L. M. H., & Lince, J. J. D. (2023). Executive functioning in college students with anxiety and depression: a multivariate analysis. *Mediterranean Journal of Clinical Psychology*, *11*(1). https://doi.org/10.13129/2282-1619/mjcp-3596
22. Gómez-Tabares, A. S., Marín, J. P. C., Vanegas, A. M., Martínez, D. A. L., & Gallego, E. M. M. (2022). The effect of coping strategies on the risk for suicidal ideation and behavior in adolescents. *Mediterranean Journal of Clinical Psychology*, *10*(2). https://doi.org/10.13129/2282-1619/mjcp-3436
23. Gorlyn, M., Keilp, J. G., Oquendo, M. A., Burke, A. K., & John Mann, J. (2013). Iowa Gambling Task performance in currently depressed suicide attempters. *Psychiatry Research, 207*(3), 150–157. https://doi.org/10.1016/j.psychres.2013.01.030
24. Hildebrand, A., Weiss, M., & Stemmler, M. (2023). Life adversities of clients seeking advice for suicidal ideation from an online peer counseling service: Characteristics and associations with outcomes. *Mediterranean Journal of Clinical Psychology*, *11*(2). https://doi.org/10.13129/2282-1619/mjcp-3721
25. Hirsch, J. E. (2005). An index to quantify an individual's scientific research output. *Pnas, 102*(46), 16569-16572. https://doi.org/10.1073/pnas.0507655102

26. Hoehne, A., Richard-Devantoy, S., Ding, Y., Turecki, G., & Jollant, F. (2015). First-degree relatives of suicide completers may have impaired decision-making but functional cognitive control. *Journal of Psychiatric Research, 68*, 192–197. https://doi.org/10.1016/j.jpsychires.2015.07.004
27. Hoffman, S. N., Taylor, C. T., Campbell-Sills, L., Thomas, M. L., Sun, X., Naifeh, J. A. … & Jain, S., & Stein, M. B. (2022). Association between neurocognitive functioning and suicide attempts in U.S. Army Soldiers. *Journal of Psychiatric Research, 145*, 294–301. https://doi.org/10.1016/j.jpsychires.2020.11.012
28. Huber, R. S., Hodgson, R., & Yurgelun-Todd, D. A. (2019). A qualitative systematic review of suicide behavior using the cognitive systems domain of the research domain criteria (RDoC) framework. In Psychiatry Research (Vol. 282*). Elsevier Ireland Ltd.* https://doi.org/10.1016/j.psychres.2019.112589
29. Jollant, F., Lawrence, N. L., Olié, E., Guillaume, S., & Courtet, P. (2011). The suicidal mind and brain: A review of neuropsychological and neuroimaging studies. *The World Journal of Biological Psychiatry, 12*(5), 319–339. https://doi.org/10.3109/15622975.2011.556200
30. Keilp, J. G., Gorlyn, M., Russell, M., Oquendo, M. A., Burke, A. K., Harkavy-Friedman, J., & Mann, J. J. (2013). Neuropsychological function and suicidal behavior: attention control, memory and executive dysfunction in suicide attempt. *Psychological Medicine, 43*(3), 539–551. https://doi.org/10.1017/S0033291712001419
31. Lapidos, A., Abraham, K. M., Jagusch, J., Garlick, J., Walters, H., Kim, H. M., … & Pfeiffer, P. N. (2019). Peer mentorship to reduce suicide attempts among high-risk adults (PREVAIL): Rationale and design of a randomized controlled effectiveness-implementation trial. *Contemporary Clinical Trials, 87*. https://doi.org/10.1016/j.cct.2019.105850
32. Lennon, J. C. (2019). Etiopathogenesis of Suicide: A Conceptual Analysis of Risk and Prevention Within a Comprehensive, Deterministic Model. Frontiers in Psychology, 10(SEP). https://doi.org/10.3389/fpsyg.2019.02087
33. MacPherson, H. A., Kudinova, A. Y., Schettini, E., Jenkins, G. A., Gilbert, A. C., Thomas, S. A., … & Dickstein, D. P. (2022). Relationship between cognitive flexibility and subsequent course of mood symptoms and suicidal ideation in young adults with childhood-onset bipolar disorder. *European Child and Adolescent Psychiatry*, *31*(2), 299–312. https://doi.org/10.1007/s00787-020-01688-0
34. Malhi, G. S., Das, P., Outhred, T., Bryant, R. A., Calhoun, V., & Mann, J. J. (2020). Default mode dysfunction underpins suicidal activity in mood disorders. *Psychological Medicine, 50*(7), 1214–1223. https://doi.org/10.1017/S0033291719001132
35. Mansueto, G., Marino, C., Palmieri, S., Offredi, A., Sarracino, D., Sassaroli, S., Ruggiero, G. M., Spada, M. M., & Caselli, G. (2022). Difficulties in emotion regulation: The role of repetitive negative thinking and metacognitive beliefs. *Journal of Affective Disorders*, *308*, 473–483. https://doi.org/10.1016/j.jad.2022.04.086
36. Marzuk, P. M., Hartwell, N., Leon, A. C., & Portera, L. (2005). Executive functioning in depressed patients with suicidal ideation. *Acta Psychiatrica Scandinavica*, *112*(4), 294–301. https://doi.org/10.1111/j.1600-0447.2005.00585.x

37. Merlo, E.M., Myles, L.A.M., Settineri, S. (2022). Editorial: A Call for Greater Specification of Core Beliefs. *Mediterranean Journal of Clinical Psychology 10*(3). https://doi.org/10.13129/2282-1619/mjcp-3618
38. Ministerio de Salud y Protección Social, Instituto Nacional de Salud. Protocolo de Vigilancia en Salud Pública, Intento de suicidio. Bogotá, 2022. Retreived on March 27, 2023 from https://www.ins.gov.co/buscador-eventos/Lineamientos/Pro_Intento%20de%20suicidio.pdf
39. Miranda, R., Gallagher, M., Bauchner, B., Vaysman, R., & Marroquín, B. (2012). Cognitive inflexibility as a prospective predictor of suicidal ideation among young adults with a suicide attempt history. *Depression and Anxiety, 29*(3), 180–186. https://doi.org/10.1002/da.20915
40. Myles, L.A.M. (2021). The Emerging Role of Computational Psychopathology in Clinical Psychology. *Mediterranean Journal of Clinical Psychology, 9*(1). https://doi.org/10.6092/2282-1619/mjcp-2895
41. O'Connor, D. B., Branley-Bell, D., Green, J. A., Ferguson, E., O'Carroll, R. E., & O'Connor, R. C. (2021). Resilience and vulnerability factors influence the cortisol awakening response in individuals vulnerable to suicide. *Journal of Psychiatric Research, 142*, 312–320. https://doi.org/10.1016/j.jpsychires.2021.08.006
42. Perrain, R., Dardennes, R., & Jollant, F. (2021). Risky decision-making in suicide attempters, and the choice of a violent suicidal means: an updated meta-analysis. *Journal of Affective Disorders, 280*, 241–249. https://doi.org/10.1016/j.jad.2020.11.052
43. Pu, S., Setoyama, S., & Noda, T. (2017). Association between cognitive deficits and suicidal ideation in patients with major depressive disorder. *Scientific Reports, 7*(1). https://doi.org/10.1038/s41598-017-12142-8
44. Qiu, T., & Klonsky, E. D. (2021). Deciding to Die: the Relations of Decision-making Styles to Suicide Ideation and Attempts. *International Journal of Cognitive Therapy, 14*(2), 341–361. https://doi.org/10.1007/s41811-021-00107-9
45. Raust, A., Slama, F., Mathieu, F., Roy, I., Chenu, A., Koncke, D., … & Bellivier, F. (2007). Prefrontal cortex dysfunction in patients with suicidal behavior. *Psychological Medicine, 37*(03), 411. https://doi.org/10.1017/S0033291706009111
46. Reis, J. V., Vieira, R., Portugal-Nunes, C., Coelho, A., Magalhães, R., Moreira, P., ... & Bessa, J. M. (2022). Suicidal Ideation Is Associated With Reduced Functional Connectivity and White Matter Integrity in Drug-Naïve Patients With Major Depression. *Frontiers in Psychiatry, 13*. https://doi.org/10.3389/fpsyt.2022.838111
47. Richard-Devantoy, S., Berlim, M. T., & Jollant, F. (2014). A meta-analysis of neuropsychological markers of vulnerability to suicidal behavior in mood disorders. *Psychological Medicine, 44*(8), 1663–1673. https://doi.org/10.1017/S0033291713002304
48. Robledo, S., Osorio, G. A. G., & López, C. (2014). Networking en pequeña empresa: una revisión bibliográfica utilizando la teoría de grafos. *Revista Vínculos, 11*(2), 6–16. https://doi.org/10.14483/2322939X.9664
49. Saffer, B. Y., & Klonsky, E. D. (2018). Do neurocognitive abilities distinguish suicide attempters from suicide ideators? A systematic review of an emerging research area. In Clinical Psychology: Science and Practice (Vol. 25, Issue 1). *Blackwell Publishing Inc*. https://doi.org/10.1111/cpsp.12227
50. Somma, A., Marelli, S., Barranca, M., Gialdi, G., Lucini, C., Castelnuovo, A., ... & Fossati, A. (2020). Executive Functioning and Personality Traits in Insomnia Disorder: A Preliminary Report on the Clinical

Importance of Objective and Subjective Reduction of Total Sleep Time. *Mediterranean Journal of Clinical Psychology*, *8*(1). https://doi.org/10.6092/2282-1619/mjcp-2325

51. Tighe, J., Nicholas, J., Shand, F., & Christensen, H. (2018). Efficacy of acceptance and commitment therapy in reducing suicidal ideation and deliberate self-harm: Systematic review. In *JMIR Mental Health* (Vol. 5, Issue 2). JMIR Publications Inc. https://doi.org/10.2196/10732
52. Tolsá, M. D., & Malas, O. (2022). Re-exploring the connection between Emotional Intelligence, Anxiety, Depression, and Stress in adult population. *Mediterranean Journal of Clinical Psychology*, *10*(1). https://doi.org/10.13129/2282-1619/mjcp-3291
53. Trejo-Cruz, V. H., Betanzos, F. G., & de la Torre, A. E. H. (2023). Teoría psicológica interpersonal del suicidio: relación con intento suicida, impulsividad y desesperanza. *South Florida Journal of Health*, *4*(1), 7–12. https://doi.org/10.46981/sfjhv4n1-002
54. Van Hoorn, A. C. (2020). Could affect regulation via vagal nerve self- stimulation be a maintaining factor in non-suicidal self-harm? *Medical Hypotheses*, *136*. https://doi.org/10.1016/j.mehy.2019.109498
55. Westheide, J., Quednow, B. B., Kuhn, K. U., Hoppe, C., Cooper-Mahkorn, D., Hawellek, B., … & Wagner, M. (2008). Executive performance of depressed suicide attempters: The role of suicidal ideation. *European Archives of Psychiatry and Clinical Neuroscience*, *258*(7), 414–421. https://doi.org/10.1007/s00406-008-0811-1
56. World Health Organization. (2021). *Suicide* http://www.who.int/mediacentre/factsheets/fs398/es/
57. Zheng, M., Da, H., Pan, X., Bian, Y., Li, X., Xiao, Q, … & Zhang, Y. (2023). Dorsolateral prefrontal activation in depressed young adults with and without suicidal ideation during an emotional autobiographical memory task: A fNIRS study. *Journal of Affective Disorders, 326*, 216–224. https://doi.org/10.1016/j.jad.2023.01.115
58. Zhong, S., Chen, P., Lai, S., Chen, G., Zhang, Y., Lv, S., … & Jia, Y. (2022). Aberrant dynamic functional connectivity in corticostriatal circuitry in depressed bipolar II disorder with recent suicide attempt. *Journal of Affective Disorders, 319*, 538–548. https://doi.org/10.1016/j.jad.2022.09.050
59. Zhu, X., Wang, X., Xiao, J., Zhong, M., Liao, J., & Yao, S. (2011). Altered white matter integrity in first-episode, treatment-naive young adults with major depressive disorder: A tract-based spatial statistics study. *Brain Research*, *1369*, 223–229. https://doi.org/10.1016/j.brainres.2010.10.104

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