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Executive functions and suicide risk: An analysis of inhibitory control and cognitive flexibility in Colombian adolescents

Funciones ejecutivas y riesgo suicida: un análisis del control inhibitorio y la flexibilidad cognitiva en adolescentes colombianos

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SUMMARY

Background: *This study examined the association between inhibitory control, cognitive flexibility, and suicide risk in 82 Colombian adolescents (53.7 % female; M = 15.91 years, SD = 1.03) from a public school in Cúcuta.*

Material and methods: *A quantitative, non-experimental, correlational design was used. Executive functions were assessed with the Stroop Color–Word Test and the Wisconsin Card Sorting Test (WCST). Suicide risk was evaluated using the Escala de Riesgo Suicida (ERS), validated for Colombian adolescents.*
Results: *Medium to high levels of suicide risk were identified in the sample. Female adolescents showed significantly higher scores in suicidal ideation and intentionality ($U = 523.0$, $p = 0.007$), as well as greater perceived isolation and lack of family support ($p < 0.05$). No significant sex differences were observed in neuropsychological performance, except for a higher number of WCST trials in males ($p = 0.038$). Sex-specific correlational patterns were found. In females, higher suicidal ideation and intentionality were associated with a greater number of WCST trials*

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(ϱ = 0.34, p = 0.025) and lower accuracy in the Stroop word-naming task (ϱ = –0.38, p = 0.011). In males, higher depression and hopelessness were related to poorer performance in word and color naming tasks (ϱ = –0.36 to –0.39, p < 0.05) and lower interference scores.

Conclusions: *The findings indicate sex-specific associations between executive functioning and suicide risk in adolescence, supporting the inclusion of inhibitory control and cognitive flexibility in multidimensional models of adolescent suicide risk.*

Keywords: *Cognitive flexibility, suicidal ideation, adolescent. Inhibition, psychological, executive function.*

RESUMEN

Introducción: *Este estudio examinó la asociación entre el control inhibitorio, la flexibilidad cognitiva y el riesgo suicida en una muestra de 82 adolescentes colombianos (53,7 % mujeres; M = 15,91 años, DE = 1,03) pertenecientes a una institución educativa pública de Cúcuta.*

Materiales y métodos: *Se empleó un diseño cuantitativo, no experimental y correlacional. Las funciones ejecutivas se evaluaron mediante el Stroop Color–Word Test y el Wisconsin Card Sorting Test (WCST). El riesgo suicida se midió mediante la Escala de Riesgo Suicida (ERS), validada para adolescentes colombianos.*

Resultados: *Se identificaron niveles medio–altos de riesgo suicida en la muestra. Las adolescentes presentaron puntuaciones significativamente superiores en ideación e intencionalidad suicida (U = 523,0; p = 0,007), así como en la percepción de aislamiento y en el déficit de apoyo familiar (p < 0,05). No se observaron diferencias significativas por sexo en el rendimiento neuropsicológico, excepto un mayor número de ensayos en el WCST en los hombres (p = 0,038). Los análisis correlacionales evidenciaron patrones diferenciados según el sexo. En mujeres, mayores niveles de ideación e intencionalidad suicida se asociaron con un mayor número de ensayos en el WCST (ϱ = 0,34; p = 0,025) y con una menor precisión en la tarea de denominación de palabras del Stroop (ϱ = –0,38; p = 0,011). En hombres, mayores niveles de depresión y desesperanza se relacionaron con un peor desempeño en las tareas de denominación de palabras y colores (ϱ = –0,36 a –0,39; p < 0,05) y con menores puntuaciones de interferencia.*

Conclusiones: *Los hallazgos indican asociaciones específicas por sexo entre las funciones ejecutivas y el riesgo suicida en la adolescencia, lo que respalda la inclusión del control inhibitorio y de la flexibilidad cognitiva en modelos multidimensionales de riesgo suicida.*

Palabras clave: *Flexibilidad cognitiva, ideación suicida, adolescente, inhibición psicológica, función ejecutiva, Colombia.*

INTRODUCTION

Suicide is a priority public health issue worldwide. It is estimated that more than 720 000 people die each year from this cause, making it the third leading cause of death among young people aged 15 to 29 (1). In the Region of the Americas, suicide mortality has shown worrying trends in the last two decades, with nearly 100 760 deaths reported in 2021 and a predominance of cases in men compared to women (2).

In Colombia, the most recent records report 3 066 deaths from self-inflicted injuries in 2024, corresponding to a national rate of 5.8 per 100 000 inhabitants, slightly lower than that in 2023, which was 6.3 per 100 000 inhabitants (3). At the territorial level, significant gaps persist between departments and age groups, with adolescents and young adults particularly vulnerable. Likewise, morbidity data show a high incidence of suicide attempts, predominantly among females, while fatal outcomes are more frequent among males (4).

Cognitive neuroscience recognizes that executive functions such as cognitive flexibility and inhibitory control play an essential role in emotional and behavioral self-regulation by facilitating adaptation to changing environmental demands (5). Impaired functioning of these processes can limit the ability to modulate impulsive responses or generate alternative strategies for coping with stress, factors that have been linked to greater vulnerability to suicide risk, particularly during adolescence. Similarly, neuroimaging studies have shown alterations in the activity of the dorsolateral prefrontal cortex and anterior cingulate cortex, regions involved in inhibition and consequence evaluation, in individuals who have attempted suicide (6,7). These observations support the hypothesis that deficits in cognitive flexibility and inhibitory control could constitute neuropsychological

mechanisms mediating between emotional dysfunction and suicidal behavior.

In this context, the present study seeks to analyze the relationship between cognitive flexibility, inhibitory control, and suicide risk in school-aged adolescents in the municipality of Cúcuta, providing recent empirical evidence on a phenomenon of growing relevance in the Colombian psychological and educational fields.

Executive functions

Within the neuropsychological framework of emotional self-regulation and suicidal vulnerability, executive functions (EF) are understood as the set of cognitive operations that enable the planning, control, and regulation of behavior in response to internal or external demands (8,9). These functions enable the organization of thought and action toward goals, integrating components such as working memory, cognitive flexibility, and inhibitory control, which are fundamental to decision-making and impulse modulation (10,11).

From a neuropsychological perspective, EF is closely related to the functioning of the prefrontal cortex and its interactions with subcortical and limbic structures that coordinate cognitive and emotional self-regulation processes (12). Its proper maturation promotes adaptation and behavioral adjustment. At the same time, its alteration has been associated with greater impulsivity and difficulty in inhibiting automatic responses, aspects of interest when analyzing the relationship between executive processing and suicide risk.

Cognitive flexibility

Cognitive flexibility is defined as the ability to modify thoughts, strategies, or behaviors in response to changing environmental demands, thereby enabling more effective responses to new or problematic situations (10,13). This process requires self-regulation and conscious control, enabling the switch between tasks, generating alternative solutions, and adjusting behavior without losing sight of the initial goal. Within executive functions, cognitive control is an essential component that promotes adaptation to novelty and conflict resolution.

From a neuropsychological perspective, cognitive flexibility is associated with the functioning of the dorsolateral prefrontal cortex and frontoparietal networks, areas involved in planning and working memory (14,15). It is measured using tasks that require changes in rules or classification strategies, including the Wisconsin Card Sorting Test (WCST), which assesses the ability to abandon ineffective response patterns, modify criteria, and maintain goal orientation (16). This function develops progressively throughout childhood and adolescence and is sensitive to contextual, educational, and emotional factors.

Several studies have demonstrated the importance of cognitive flexibility in academic performance, emotional regulation, and social adaptation (17,18). Its impairment has been linked to cognitive rigidity, perseveration of errors, and difficulty reevaluating alternatives, which can affect decision-making and coping with stressful situations. Such limitations represent a psychological vulnerability factor that contributes to the understanding of self-regulation and suicide risk, along with other executive functions such as inhibitory control.

Inhibitory control

Inhibitory control is the cognitive ability to suppress automatic or impulsive responses and, complementarily, to activate behaviors directed toward specific goals (10,18). This process enables the maintenance of attention, the control of thoughts and emotions, and the modulation of behavior in response to stimuli that could interfere with goal pursuit. In this way, inhibitory control is an essential component of self-regulation, as it supports the ability to consciously choose how to behave or react to a given situation (11).

The development of this process involves interactions among cognitive, emotional, and behavioral functions, as well as the maturation of prefrontal structures that facilitate the regulation of approach and avoidance responses (18). Inhibition allows us to resist immediate temptations and control impulses that, although they may generate short-term pleasure, have

negative long-term consequences (19). In this sense, inhibitory control not only facilitates the suppression of inappropriate responses but also the planning and execution of adaptive behaviors by coordinating sustained attention, motivation, and emotion processing (9,12).

From a neuropsychological perspective, it is considered a central process within executive functions, underpinning working memory, cognitive flexibility, and affective self-regulation (18). A deficit in inhibitory control manifests itself in impulsivity, disinhibition, and difficulty maintaining self-control, conditions that increase emotional vulnerability and the likelihood of maladaptive behaviors. Therefore, its alteration constitutes a predisposing factor for suicide risk, especially in stages of development where the prefrontal cortex has not yet reached full functional maturity (19).

Suicide risk

Suicide risk is defined as the set of actions and cognitions through which a person, through thoughts or behaviors, seeks their own death (20). This concept integrates personal, psychological, biological, and social factors that interact dynamically, shaping the likelihood that an individual will attempt to take their own life. This interaction is influenced by psychopathological history, mental health conditions, and stressors to which the individual is exposed.

Several studies have identified depression as one of the most relevant risk factors, especially because of its association with suicidal ideation. In the Colombian context, a higher frequency of ideation has been described in women, related to psychopathological antecedents such as dissocial behavior disorder. However, suicide should be understood as a multifactorial phenomenon, where biological, neurological, family, and social factors converge (21).

Gender differences are another important aspect in understanding suicide risk. A higher incidence of completed suicides has been observed in men, which is associated with their greater impulsivity, lower tolerance for chronic suffering, and less seeking of help for emotional distress. In addition, men tend to be more affected by addictive disorders, experience greater work-related stress, and have more difficulties expressing their emotions (22). In contrast, women more frequently attempt suicide, which is often mediated by impulsive responses such as drug ingestion, in response to emotional situations that overwhelm their coping resources (23).

Understanding suicide risk from this multidimensional perspective is essential for analyzing its link to the processes of self-regulation, cognitive flexibility, and inhibitory control. These executive functions, by intervening in emotional modulation and decision-making, allow us to understand the cognitive mechanisms that mediate between psychological vulnerability and suicidal behavior, providing theoretical foundations for the present study.

MATERIALS AND METHODS

The study employed a quantitative, correlational, non-experimental design (24). This type of design allows analysis of the relationship among inhibitory control, cognitive flexibility, and suicide risk without manipulating variables, thereby evaluating these variables at a single point in time.

Participants

The population consisted of 230 secondary school students from an educational institution in Cúcuta, Colombia. The sample, selected through targeted non-probability sampling, consisted of 82 participants, of whom 53.66 % (n = 44) were female, and 46.34 % (n = 38) were male. Ages ranged from 14 to 18 years (M = 15.91; SD = 1.03; CV = 6.47 %). The inclusion criteria were: a) informed consent from parents; b) assent from the participant; c) belonging to the grades where the instruments were applied.

Instruments

The following instruments were used for data collection:

***1. Cognitive flexibility and executive control*:** The Wisconsin Card Sorting Test (WCST, 25)

was used. This instrument assesses the ability to modify classification strategies, respond to feedback, and suppress inappropriate responses when stimulus rules change. Normative data and psychometric validation for the Spanish-speaking population have been established in Latin America (26), confirming adequate internal consistency (Cronbach's $\alpha = 0.78–0.85$ across key indices such as perseverative errors and categories completed) and strong construct validity in nonclinical samples.

2. Inhibitory control: The Stroop Color-Word Test (27), was applied in its manual, Spanish-language version. This version has been psychometrically validated for the Colombian population across a broad age range (7–80 years; N = 1,332), demonstrating high test–retest reliability (r = 0.884) and robust construct validity (28). In adolescent and young adult Colombian samples, the interference index and word/color naming scores have shown acceptable to good internal consistency (Cronbach's $\alpha = 0.75–0.80$), supporting its use in neuropsychological assessment of inhibitory control

***3. Suicide risk*:** The Suicide Risk Scale (ERS - by its abbreviation in Spanish (29) was employed. This 20-item Likert-type scale was developed and validated specifically for Colombian adolescents, with a four-factor structure: 1) Depression and hopelessness, 2) Suicidal ideation and intent, 3) Isolation and social support, and 4) Lack of family support. The original validation study reported excellent internal consistency for the total scale ($\alpha = 0.934$) and strong factor-level reliability ($\alpha = 0.79–0.88$). In the present sample, the ERS also demonstrated high reliability: $\alpha = 0.91$ for the total score, with subscale alphas ranging from 0.76 (Lack of family support) to 0.85 (Depression and hopelessness).

Procedure

Neuropsychological and psychometric assessments were administered in three sequential group sessions within the participants' educational institution. Each session was conducted in a quiet, controlled classroom environment, with standardized lighting and minimal external distractions. The Stroop Color–Word Test, the Wisconsin Card Sorting Test (WCST), and the Escala de Riesgo Suicida (ERS) were administered in that order, with flexible breaks offered upon participant request to mitigate fatigue.

Assessments were conducted by a trained research team comprising licensed clinical psychologists, a neuropsychologist, and advanced undergraduate psychology students. Before data collection, all student evaluators completed a two-week training protocol that included theoretical instruction in test administration, interpretation, and ethical considerations, followed by supervised practice sessions using the official WCST and Stroop manuals (25, 27). The neuropsychologist provided ongoing oversight of standardization to ensure procedural fidelity. All materials (response cards, manuals, scoring sheets) were administered manually, with identical kits provided to each evaluator.

Data analysis

Given the ordinal nature of the suicide risk scale and the expected non-normal distribution of neuropsychological performance scores in adolescent samples, nonparametric methods were selected as a priori for all inferential analyses. Accordingly, Spearman's rank-order correlation coefficient (ϱ) was used to examine bivariate associations between cognitive flexibility, inhibitory control, and suicide risk dimensions. Sex differences were assessed using the Mann–Whitney U test, as it is robust to non-normality and appropriate for independent group comparisons with ordinal or non-normally distributed continuous data. Descriptive statistics included frequencies and percentages for categorical variables, and means, standard deviations, and coefficients of variation for quantitative variables.

Due to the exploratory nature of this study and the absence of a priori directional hypotheses for most correlations, no correction for multiple comparisons was applied. Nevertheless, all statistically significant findings ($\alpha = 0.05$ and $\alpha = 0.01$) should be interpreted as preliminary and require replication in future confirmatory studies. All analyses were conducted using SPSS version 25 and R-Studio version 3.1.9.3.

Ethical considerations

This study was approved by the Research Ethics Committee of Simón Bolívar University (Act No. [C2060271025], [03/10/2025]) and conducted in accordance with the ethical principles outlined in the Declaration of Helsinki (30) and the International Ethical Guidelines for Health-Related Research involving Humans issued by the Council for International Organizations of Medical Sciences (31). Written informed consent was obtained from parents or legal guardians, and assent was secured from each adolescent participant. All data was anonymized, coded, and stored in an encrypted repository with restricted access granted solely to the research team. No invasive procedures were performed, and no psychological stress was induced during data collection.

RESULTS

The results of the analyses are presented below in tables of direct scores for suicide risk, cognitive flexibility, and inhibitory control, ending with a correlation table.

Table 1. Direct scores and interpretation of suicide risk and its dimensions according to gender

Dimensiones	Female (n=44) M (SD)	Level	Male (n=38) M (SD)	Level	Mann–Whitney U (Z), r, p
Depression and hopelessness	11,10 (4,66)	Medium-high	10,00 (4,06)	Medium-high	749 (–0.98), r = 0.11, p = 0.33
Suicidal ideation and intent	11,00 (6,36)	Medium-high	7,84 (3,10)	Medium-high	523 (–2.72), r = 0.30 , p = 0.007**
Isolation and social support	13,11 (3,55)	Medium-high	11,32 (3,76)	Medium-high	557 (–2.12), r = 0.23, p = 0.034*
Lack of family support	9,63 (5,07)	Medium-high	7,00 (3,40)	Medium-high	561 (–2.07), r = 0.23, p = 0.038*
Suicide risk	44,84 (15,76)	Medium-high	36,16 (9,32)	Medium-high	535 (–2.57), r = 0.28, p = 0.010**

Note. M = mean; SD = standard deviation; U = Mann–Whitney U statistic; Z = standardized test statistic; r = effect size ($r = |Z|/\sqrt{N}$); NS = not significant; * $p < 0.05$; ** $p < 0.01$.

Table 1 shows the direct scores for suicide risk and its dimensions. In general, participants obtained scores indicating a medium-high level, both overall and for each of the evaluated factors. For example, in the depression and hopelessness component, female adolescents scored an average of 11.10 ± 4.66 (CV = 41.98 %), while male students scored 10.00 ± 4.06 (CV = 40.60 %). These figures suggest that both groups, regardless of gender, have moderately high levels of depression and hopelessness.

This pattern was maintained in the other dimensions of suicide risk. However, unlike the first dimension, significant differences were observed in the average ranges across the other factors, with consistently higher scores for female participants, suggesting greater relative vulnerability in these areas.

Cognitive flexibility and inhibitory control were characterized using the Stroop test and the Wisconsin Card Sorting Test. These tests allow evaluation of aspects such as the number of words or colors correctly identified, the number of categories achieved, perseverative errors, and other indicators related to executive functioning. Unlike suicide risk, whose scores were analyzed both directly and transformed, these neuropsychological variables were interpreted

Table 2. Direct scores on cognitive flexibility and inhibitory control measures, overall and by sex

Neuropsychological Measure	Total (n=82) M (DE)	Female (n=44) M (DE)	Male (n=38) M (DE)	Mann–Whitney U (Z), r, p
Stroop				
Stroop	81.57 (15.45)	80.73 (15.42)	82.55 (15.64)	902 (0.59), r = 0.07, p = 0.556
Words	60.59 (13.33)	59.30 (11.50)	62.08 (15.21)	936 (0.93), r = 0.10, p = 0.352
Color	37.54 (10.43)	37.00 (10.25)	38.16 (10.74)	896 (0.54), r = 0.06, p = 0.589
Color-Words	3.13 (9.77)	3.15 (9.38)	3.10 (10.33)	804 (–0.31), r = 0.03, p = 0.756
Wisconsin Test				
Total trials	46.77 (3.52)	45.98 (4.63)	47.68 (0.77)	523 (–2.72), r = 0.30, p = 0.007*
Cat. Completed	3.02 (1.63)	3.05 (1.75)	3.00 (1.51)	818 (–0.18), r = 0.02, p = 0.857
Correct Categories	23.63 (8.80)	23.39 (9.34)	23.92 (8.25)	883 (0.43), r = 0.05, p = 0.667
Perseverative Errors	10.54 (7.28)	10.18 (6.79)	10.95 (7.87)	858 (0.20), r = 0.02, p = 0.841
Total Errors	23.57 (8.99)	24.00 (9.97)	23.08 (7.80)	797 (–0.38), r = 0.04, p = 0.704

Note. M = mean; SD = standard deviation; U = Mann–Whitney U statistic; Z = standardized test statistic; r = effect size ($r = |Z|/\sqrt{N}$); * $p < 0.05$; ** $p < 0.01$.

solely based on the raw scores obtained by the participants.

The corresponding results are presented in Table 2. In general, no significant differences were observed between males and females in neuropsychological performance, with one exception: the number of attempts on the Wisconsin test, where male students scored higher than female participants. The students showed a similar pattern of functioning across the areas assessed, both in the correct recognition of words, colors, and word-color combinations and in the levels of interference observed during the task. The same was true for the indicators associated with inhibition, planning, and flexibility, and reflected in the number of categories, correct categories, perseverance errors, and total errors.

Table 3. Spearman's rho (ϱ) correlations between suicide risk dimensions and neuropsychological variables, by sex

Neuropsych var.	Suicidal risk (female)					Suicidal risk (male)				
	DH	IS&S	I&SS	LFS	T-SR	DH	IS&S	I&SS	LFS	T-SR
Stroop										
Words	-0.048	-0.382*	-0.020	-0.183	-0.232	-0.020	0.150	0.046	0.229	0.160
Color	-0.065	-0.031	-0.005	0.028	-0.032	-0.192	-0.035	0.116	0.056	0.057
Color-Words	-0.082	-0.036	-0.093	-0.086	-0.123	-0.362*	-0.180	-0.015	0.014	0.095
Interference	-0.045	0.022	-0.162	-0.115	-0.132	-0.388*	-0.162	-0.054	-0.050	0.175
Wisconsin test										
Total trials	0.101	0.337*	0.368*	0.332*	0.357*	-0.025	0.319	0.042	-0.081	0.073
Cat. Completed	-0.205	-0.196	-0.327*	-0.032	-0.206	0.055	0.070	0.056	-0.225	0.008
Correct Categories	-0.213	-0.144	-0.255	0.007	-0.136	0.102	0.216	0.138	-0.176	0.093
Perseverative Errors	0.006	0.075	0.248	-0.050	0.028	-0.030	-0.197	-0.245	-0.065	-0.201
Total Errors	0.057	0.049	0.205	-0.069	0.027	-0.018	-0.103	-0.040	0.146	0.008

Note: DH = depression and hopelessness. IS&S = suicidal ideation and intent. I&SS = social support. LFS = lack of family support. T-SR = suicide risk. * = significant correlation at the 0.05 level.

As indicated in the statistical analysis section, the correlation between variables was examined using Spearman's rank correlation coefficient, with the results presented in Table 3. It is important to note that these calculations were performed separately for men and women, given that the suicide risk scale used was designed to capture gender-specific nuances, allowing for a more accurate analysis of each subgroup.

Table 3 shows that, in the case of adolescent girls, several of the neuropsychological subtests showed significant correlations with dimensions such as suicidal ideation, social support, family support, and suicide risk. A relevant finding is the moderate negative correlation between suicidal intent and the number of words correctly identified in the Stroop test. In other words, the greater the presence of suicidal ideation, the lower the accuracy in naming words. This pattern is also seen when relating suicidal ideation to the number of attempts in the Wisconsin Test. As suicidal orientation increases, the number of attempts made by students decreases, suggesting less involvement or ability to adjust to the task. Consistently, the analysis reveals negative associations between scores for ideation, social support, lack of family support, and suicide risk, and performance on indicators such as number of categories, correct categories, and perseveration errors, which shows a systematic link between greater suicide vulnerability and lower executive performance.

For male students, Table 3 shows that significant correlations are observed only for the dimensions of depression and hopelessness, specifically for the number of words and colors correctly identified and for Stroop interference indices. These associations are negative and moderate in magnitude, indicating that greater hopelessness is associated with lower performance on these tasks. Likewise, increased hopelessness is accompanied by lower interference, suggesting a different pattern of attentional processing than that observed in female adolescents.

DISCUSSION

The results of this study show relevant differences between men and women in the dimension of suicidal ideation and intentionality, with significantly higher scores in adolescent girls. This pattern is consistent with previous studies in the Colombian population, which have reported higher levels of suicidal ideation and feelings of loneliness in adolescent women compared to their male peers (28,29). Similarly, other studies have described higher levels of suicidal ideation and depressive symptoms in adolescent girls, which is consistent with the trend observed in this sample (32).

In the dimension of depression and hopelessness, although no statistically significant differences were found between sexes, the medium-high scores in both groups indicate a shared emotional vulnerability. However, the literature has shown that this vulnerability is expressed differently: women tend to make more suicide attempts, while men have a higher proportion of completed suicides, partly due to less expressive coping styles and less help-seeking (23,24,33). Recent research has also pointed out that the neurocognitive and emotional factors associated with suicide risk take different trajectories depending on gender, with greater emotional reactivity in women and greater behavioral impulsivity in men (34).

Regarding executive functions, no significant differences were observed between men and women in indicators of cognitive flexibility and inhibitory control. However, the associations between these functions and suicide risk showed specific patterns. In adolescent girls, a higher number of attempts on the Wisconsin Test, an indicator of difficulties in adjusting cognitive strategies, was related to higher levels of suicidal ideation and intentionality, suggesting that lower cognitive flexibility efficiency could limit the ability to generate adaptive responses in highly emotionally charged situations. Recent evidence supports the role of cognitive rigidity as a factor in suicide vulnerability, linking inflexibility with a higher probability of suicidal ideation in adolescents under chronic stress (35,36).

In the case of men, significant correlations were concentrated in interference on the Stroop test and in levels of depression and hopelessness, indicating that inhibitory control may play a risk-modulating role in this group. Several studies have shown that executive functions

are sensitive to alterations in neurochemical systems involved in the stress response, which affect decision-making and behavioral regulation in contexts of threat or uncertainty (18,35,37). Concurrently, recent research has shown that impaired inhibition and decision-making are associated with recent suicide attempts and more complex risk trajectories (32,38,39).

Notably, while some findings align with established literature and may be considered robust, others should be interpreted as exploratory given the study's methodological constraints. The significantly higher levels of suicidal ideation and intentionality in adolescent girls, consistent with prior Colombian and international studies (28,29,32,34), constitute a solid, replicable result. Similarly, the inverse association between inhibitory control (e.g., word and color naming accuracy) and depression/hopelessness in males reflects a pattern documented in neuropsychological models of emotional regulation (37,38). In contrast, the sex-specific correlations involving WCST performance, particularly the link between the number of trials (NI) and suicidal ideation in females, emerge as preliminary observations. Given the modest sample size (N = 82), the absence of correction for multiple comparisons, and the limited prior evidence linking WCST indices to suicide risk in nonclinical adolescents, these associations require cautious interpretation and replication in larger, prospectively designed studies.

Taken together, the findings of the present study highlight that suicide risk in adolescence does not depend solely on emotional or contextual factors, but also involves cognitive processes related to inhibition and flexibility, whose influence varies according to gender. Recent literature supports the idea that the interaction between executive functions, adverse experiences, and sociocultural context plays a key role in the emergence of suicidal ideation during adolescence (34,35,39-41). These results underscore the need to integrate cognitive processes into explanatory models of adolescent suicidal behavior and into prevention-oriented intervention strategies.

Despite these limitations, the results open up important avenues for future research, including: developing longitudinal studies that explore how executive functions and suicide risk change over time; expanding the number of neuropsychological tasks to obtain a more complete executive profile; incorporating neuroimaging techniques or biomarkers to understand the neurobiological mechanisms involved; and comparing clinical and non-clinical populations to define risk and protective factors more accurately. It is also recommended that gender-differentiated interventions be further investigated, given the specific roles that inhibition and cognitive flexibility appear to play in each group (42-44).

CONCLUSIONS

In this sample of Colombian adolescents, executive functioning and suicide risk showed sex-specific patterns of association. In females, inhibitory control and cognitive flexibility were associated with dimensions of suicide risk: a higher number of WCST trials was associated with greater suicidal ideation and intentionality, and lower word-naming accuracy on the Stroop test was associated with higher suicidal ideation. In males, higher depression and hopelessness were associated with poorer performance in word and color naming and lower interference scores. Additionally, lower perceived social and family support was associated with higher suicide risk across participants, and in females, lower cognitive flexibility was associated with lower perceived social support. These findings support the inclusion of neuropsychological variables, particularly inhibitory control and cognitive flexibility, in comprehensive, sex-sensitive assessments of adolescent suicide risk.

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