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**Articles**

# The mediating effect of anxiety and depression on the association between adverse experiences and executive functioning in young adults

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## Abstract

*Introduction:* Adverse childhood experiences (ACEs) are associated with signs of anxiety and depression, but their relationship with executive functioning (EF) impairments is unclear.

*Objective:* To analyze the mediating effect of anxiety and depression on the association between adverse childhood experiences and executive functioning in a sample of young adults.

*Methods:* The researchers employed an analytical empirical approach, quantitative type, with a correlational scope through multivariate analysis. In a simple probability cluster sampling, 200 young adults from the city of Manizales (Colombia) were included. The average age was 22 years old, with a SD of 2.72, 77% were women. EF of working memory (WAIS-IV Working Memory Index), shifting (Wisconsin Card Sorting Test - WSCT), inhibitory control (Test of Colors and Words - STROOP), anxiety (Trait-State Anxiety Inventory - IDARE), depression (Beck Depression Inventory-II) and ACEs (Fellity ACEs Questionnaire) were measured.

*Results:* ACEs have strong and direct effects on anxiety and depression, moderate effects on executive functioning, and emotional variables have a weak impact on executive functioning. The indirect effects of ACEs on EF, mediated by anxiety and depression, were not significant. It was found that shifting was directly correlated with early exposure to living with people with depression, the working memory variable was inversely associated with sexual abuse, and the inhibitory control variable was inversely correlated with early exposure to living with substance abusers and living with people in conflict with the law.

*Conclusion:* ACEs have a direct and prolonged effect on emotional well-being, however, emotional factors alone may not mediate impairments in executive functioning. Therefore, future research is invited to study the mediating effect of coping strategies such as resilience between ACEs and executive functioning.

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## 1. Introduction

Adverse childhood experiences (ACEs) comprise different events of rights violations before the age of 18, this topic has been of interest in psychology and is frequently related to signs of anxiety and depression in adults as mentioned by Sahle et al, (2022), other studies that have sought the relationship between ACEs and executive functioning show ambiguous conclusions and suggest expanding studies to better explain the possible relationship. Therefore, the present research sought to determine the relationship between adverse childhood experiences and adult executive functioning with emotional variables as mediating aspects.

Executive functions are higher order cognitive processes that guide behavior toward achieving goals, because they are top down control processes and they damage is associated with mental and behavior disorders like addiction, depression, anxiety, attention deficit with hyperactivity, also, many studies associate its good functioning with better physical health, quality of life, school and work success, as well as marital harmony and public safety, due to its ability to adapt the behavior to a regulatory environment. (Diamond, 2012).

In this regard, Friedman and Miyake (2017) framed three main functions which are inhibitory control, shifting and working memory. Later, Friedman and Robbins (2022) extended the model to include attentional control, verbal fluency and metacognition. In a more detailed explanation, Diamond, (2012) refers that inhibitory control regulates automatic responses, such as recurrent and intrusive thoughts, mediating emotional and behavioral responses. At the cognitive level, it also influences the control of attentional processes (McKay et al., 2024).

Working memory refers to the retention and manipulation of verbal and visuospatial information for short periods of time, this function can update retained information with new content Friedman and Miyake, (2017). As for shifting, this refers to an executive function that allows flexibility in thinking schemes and behaviors, making strategies more flexible until the goal is achieved (Gustavson et al., 2016).

According to the DSM-5 (American Psychiatric Association, 2013), depressive disorder is a mood disorder characterized by anhedonia, abulia, loss of appetite, apathy, daily insomnia or hyper sleepiness, psychomotor agitation or slowing, fatigue, loss of energy, feelings of worthlessness and thoughts of guilt, diminished thought processes that affect decision making, cognitive and attentional control, and recurrent thoughts of death, symptoms that are not best explained by another disorder, substance or medical condition. Severity varies from mild to severe.

While anxiety is characterized by worry, excessive and persistent fear, causing clinically significant distress, that are accompanied by physiological and cognitive activation according to

American Psychiatric Association (2013), physiological activation is associated with physical agitation, while the cognitive component is related to catastrophic anticipation of the future (Härpfer et al., 2021).

Authors such as Forrest et al. (2021) differentiate anxiety into two constructs: trait anxiety and state anxiety. The former is a constant integrated into an individual's personality, while the latter refers to transitory feelings of insecurity facing situations perceived as threatening. Anxiety and depression tend to occur together, and although the physiological mechanisms that determine the correlation are unknown, different authors have found comorbidity in more than 70% of people who present either of the two disorders (Coussement et al., 2022; König et al., 2021; ter Meulen et al., 2021), an aspect that is also evident in the population of Colombia (Palomares et al., 2023). Some authors mention that a very high and prolonged anxious response generates changes and damage both in the body and in the brain, functions explained by the overactivation of the Hypothalamic-Pituitary-Adrenal (HPA) axis (Jiang et al., 2019).

The consequences of different adverse experiences on emotions have been widely documented by the scientific community, identifying a relationship between depressive (Mao et al., 2023; Muwanguzi et al., 2023; Amone-P'Olak & Letswai, 2020; Stern & Thayer., 2019) and anxious traits (Jiang et al., 2019; Schellhaas et al., 2022), including also high comorbidity between ACESs with suicidal tendencies and emotional disorders (Sahle et al., 2022). This tendency to affective psychopathology has been demonstrated to be associated with different ACESs, although it is more representative in the most prevalent ones such as physical and emotional neglect (Lund et al., 2020) and sexual abuse (Fergusson et al., 2013).

Other analyses focused on individual experiences, and allowed the identification of specific sequelae, for instance, in sexual abuse an alteration of risk assessment of sexual behavior was evidenced (Fergusson et al., 2013), additionally, child maltreatment was related to internalizing disorders, and antisocial personality in subjects aged 16 to 23 years old (Kent et al., 2022).

Other studies, focused on executive functioning, indicate that adverse experiences may be associated with alterations in the prefrontal cortex, limbic cortex, and hippocampus, generating deficits in memory and executive functions in both adults (Hawkins et al., 2021) and children (Lund et al., 2020). These studies found that neglect, emotional, physical, and sexual abuse, as well as exposure to intimate partner violence, were associated with specific deficits in attention, working memory, shifting, and inhibitory control (Hawkins et al., 2021; Lund et al., 2020), and the relationship is clearer when a particular adverse experience is taken, rather than the total adverse experience (Lund et al., 2020), with neglect being the most strongly related to alterations

in shifting, working memory, inhibitory and cognitive control in the adult (Hawkins et al., 2021; Lynch & Widom, 2022).

On the other hand, authors such as Muwanguzi et al. (2023) investigated 653 Ugandan university students and the relationship between adverse experiences and academic performance, finding that neither the presence of these experiences nor their accumulation affected academic performance. Schellhass et al. (2022) ruled out the relationship between these experiences and working memory impairments. Kent et al. (2022) ruled out that executive functions are affected by maltreatment. Trinidad (2021) found that these experiences do not always generate an impairment in executive functioning because such consequences also depend on protective contextual factors such as socioeconomic status, and ACEs, among others. Although different studies suggest a strong relationship between ACES and domains such as attention, working memory, shifting, and inhibitory control, also suggesting the reduction of the prefrontal cortex, other studies do not find differences (Lund et al., 2020).

These findings suggest that alterations in executive domains may be mediated by an overactivation of the hypothalamic-pituitary-adrenal (HPA) axis and the high levels of stress this generates (Jiang et al., 2019; Zhou et al., 2022). For example, Warren et al. (2021) found that state anxiety and depression affected the executive component of attentional control, whereas anxiety affected shifting executive function. This relationship becomes more evident in longitudinal studies when the emotional experience persists on the subject for a prolonged period, confirming that anxiety and depression predict the affectation of different subdomains of executive functioning (Zainal & Newman, 2022).

Other mediating aspects proposed by Zhou et al. (2022) explain that resilience, working memory and shifting, may mediate the relationship between ACEs and EF by preventing adverse experiences from affecting socioemotional skills. Or, as explained by Lynch and Widom, (2022) brain plasticity plays a fundamental role in the prevention of executive damage, since in cases of abuse and neglect, they found an improvement in these functions 10 years after having experienced the event. This allows us to determine that the alteration or preservation of executive functioning is related to the severity of the emotional response and therefore is more frequent in clinical samples (Jiang et al., 2019).

In the case of non-clinical samples, an interference in cognitive control was identified. This was associated with a compensatory increase in response times, indicating a slower processing speed in the absence of threatening stimuli (Adrover-Roig et al., 2023). This does not imply damage, but an interference in function that hinders the task for the individual. These different

relationships have been identified between ACEs, internalizing responses, and risk behaviors (Fergusson et al., 2013; Lund et al., 2020; Sahle et al., 2022).

Authors such as Kalpidou et al. (2021) indicate that it is maladaptive coping strategies that mediate the relationship between ACEs and psychopathology, ruling out the mediating role of executive functioning. On the contrary, authors such as Wei and Lü (2024) found that inhibitory control mediates the manifestation of depressive symptoms in people who were victims of maltreatment and abuse in childhood when they present a high sensitivity in sensory processing.

Regarding the mediating role of emotions, Kalia and Knauft (2020) found that perceived stress mediates the relationship between ACE and the executive function of shifting, affecting it, but when people develop adaptive coping strategies such as cognitive reappraisal, stress levels decrease and this, in turn, prevents the affectation of the executive function of shifting. Also, Jo et al. (2024) found a relation between shifting and resilience, which reinforces the theory of the association between coping strategies and executive functioning. In the same way Wante et al. (2016) also found in adolescents that emotional regulation mediates the manifestation of anxiety and depression and the negative effect that ACEs can have on executive functioning.

On the other hand, different investigations have studied the effect of signs associated with anxiety and depression on executive functions. For example, insomnia has been related to difficulties in attentional control and poorer planning. (Somma et al., 2020). In the same way, Gustavson et al. (2016) explain how euphoria or worry, both sings of trait anxiety, affecting the shifting rather than anxiety *per se*.

In the national context, figures from the National Institute of Legal Medicine and Forensic Sciences (2023) revealed that during the year 2023 in Colombia, 1941 violent deaths occurred in children under 18 years old, where the most affected group was 12 to 17 years old. Regarding non-fatal injuries, 39,381 cases were identified in minors throughout 2022, finding that, for early and second childhood, as well as for adolescence, the most reported adverse experience is sexual abuse. In the population of the city of Manizales (Colombia), where the study was conducted, 158 violent deaths and 1963 cases of non-fatal injuries were reported by 2022. Given this scenario, it is important to know how these adverse childhood experiences can affect the emotional and cognitive quality of life in adult subjects, in the victimizing context reported by Medicina Legal in Colombia, to determine the mediating effect that emotions such as anxiety and depression can have between adverse experiences and executive functioning in a sample of young adults in the city of Manizales, Colombia.

### 1.1 Hypothesis

Based on literature, anxiety and depression can be related as an exogenous variable (Coussement et al., 2022) largely explained by the presence of ACEs in childhood (Jiang et al., 2019), which are also related to behavioral alterations (Kent et al., 2022). Other authors have linked ACEs to deficits in attentional control, working memory, shifting, and inhibitory control affecting brain structure and function in children (Lund et al., 2020) and adults (Hawkins et al., 2021). Although this relationship is well documented, the mediating role of emotions between adverse experiences and executive functioning sequelae is not. Therefore, the present research adopts as its working hypothesis (H1) that anxiety and depression mediate the relationship between adverse experiences and executive functioning, whereas the null hypothesis (H2), is based on the fact that emotions such as anxiety and depression do not mediate the relationship between ACEs and executive functioning. It is also of interest to determine the relationship between the variables assessed.

## 2. Methodology

### 2.1 Design

The present research has an analytical empirical approach, quantitative type, with a correlational scope through multivariate analysis that, according to Bernal (2016) seeks to explain the behavior of two or more variables of a study. For the present research, the variables are: Adverse childhood experiences, trait-state anxiety, depression, and those that conform to executive functioning such as working memory, shifting, and inhibitory control.

### 2.2 Population and sample

A probabilistic cluster sampling methodology was employed to select a sample of 266 young adults from the city of Manizales Colombia. The sample was selected through an open call via email and social networks. The data were gathered throughout 2022, between February and September, at the facilities of the Católica Luis Amigó University, Manizales, specifically in the Gessell chamber at the psychology laboratory and at the university's clinical psychological care offices.

The inclusion criteria were (1) being a young adult between the ages of 18 and 30 years old, (2) being cognitively able to respond to the evaluation, (3) voluntarily agreeing to participate by signing an informed consent form and (4), basic cognitive alterations. From this sample 25 people were discarded because they did not complete the tests of the present study, another 10 people completed them but reported not being completely honest in their answers, and 29 people were excluded because they were over the age range determined for the present study, and two people had scores that were too low compared to the average, suggesting basic

cognitive alterations. In the end, 200 people between the ages of 18 and 30 years old met the inclusion criteria (M=21.83; SD=2.72). 77% of the sample (n=154) were women, and 23% (n=46) were men. In terms of socioeconomic level, 81.5% of the participants belonged to low socioeconomic strata as follows: (1.5%) low strata, (28%) lower-middle, and (52%) middle socioeconomic strata. Of the remaining 18.5%, (12.5%) belonged to the upper-middle socioeconomic strata, (2.5%) to high, and (3.5%) to very high socioeconomic strata.

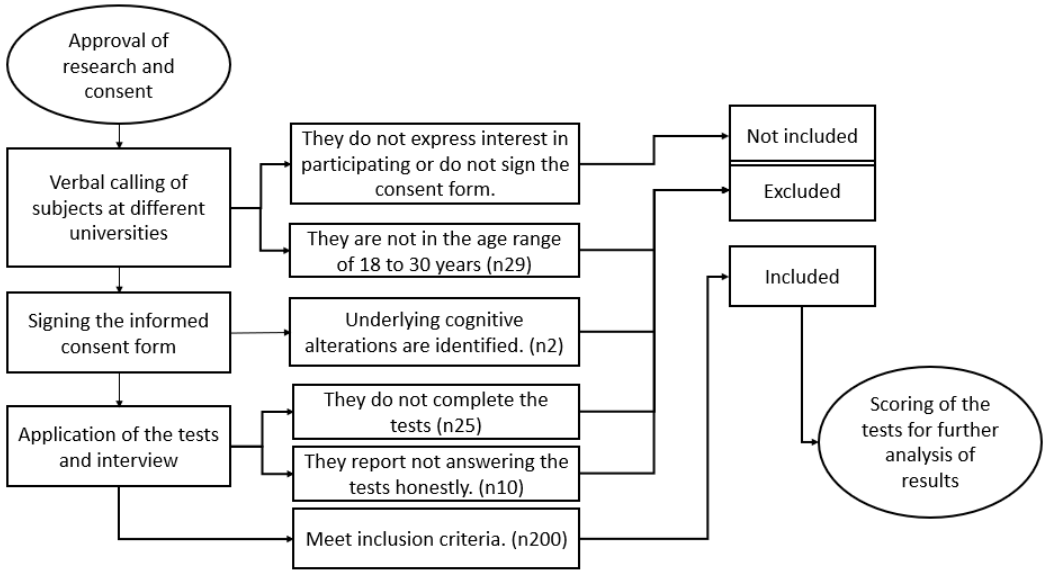


**Figure 1.** Flowchart of recruitment method using

### 2.3 Instruments

*WAIS-IV Working Memory Index*. This is one of the 5 indices that make up the Wechsler Intelligence Scale for Adults and is composed of the digit retention and arithmetic subtests, which together, allow measuring working memory. The age range for this test is from 16 to 90. It has a mean of 100 points and a standard deviation of 10 points. Its validity for latin american population and reliability is 0.92 and 0.94 respectively calculated by Fisher's Z and by comparison by halves (Wechsler, 2014).

*Wisconsin Card Sorting Test (WSCT) third edition*. Pencil and paper version. It evaluates different subdomains of executive functioning. The percentage of perseverative responses allows us to determine the executive function of shifting, for this, the T score of the percentage of perseverative responses was used, which establishes a mean of 50 and a standard deviation of 10; its reliability is higher than 0.9 calculated by Cronbach's Alpha (Heaton et al., 2009). For the Colombian population, a reliability of more than .70 was found (the validation for the Colombian population was taken from (Puerta-Lopera et al., 2022).

*Test of Colors and Words (STROOP) third edition*. It evaluates the capacity to inhibit an automatic response, being an indicator of inhibitory control. The T score of the interference indicator is

used as a measure, with a mean of 50 and a standard deviation of 10. Its reliability is higher than 0.79 using Cronbach's Alpha (Golden, 2010). For the Colombian population, a reliability of more than .70 determined by Cronbach's alpha (Barreto et al., 2016).

*Trait-State Anxiety Inventory (IDARE).* It is the Spanish adaptation of the State-Trait Anxiety Inventory (STAI) instrument, which allows evaluating the trait and state dimensions of anxiety in adolescents and adults, it comprises 20 questions for each dimension for a total of 40 questions, and it is scored on an ordinal scale from 1 to 4, some items are direct, others inverse and its rating is composed of a simple sum of the results, determining low anxiety with scores below 30, medium from 30 to 44 points, high from 45 to 58 points and very high above 58 points. The Scale was proposed by Spielberger and Gorsuch (1983). The reliability of the data for Latin American population was 0.90 for state anxiety and 0.88 for trait anxiety determined by Cronbach's alpha (Dominguez Vergara, 2013). The internal consistency analysis for the present study ranged from .939 (Cronbach's alpha) to .940 (Omega) for state anxiety and from .928 (Cronbach's alpha) to .929 (Omega) for trait anxiety. The internal consistency for the total anxiety scale was .958 (Cronbach's alpha).

*Beck Depression Inventory-II.* It is an instrument designed to measure the severity of depression in people aged 13 years and older, according to the criteria for depressive disorders. It is composed of 21 multiple choice questions, allowing to score from 0 to 3 points for each item. The qualification ranges established by the authors of the test define a minimum depression score of 0 to 13 points, mild from 14 to 19 points, moderate from 20 to 28 points, and severe from 29 to 63 points. It has a reliability of 0.93 through Cronbach's alpha and test-retest correlation; its construct validity is 0.93 (Beck et al., 2003). The reliability for a sample of young adults of Manizales-Colombia is 0,92 determined by Alpha of Cronbach (Palomares et al., 2023). Internal consistency for this study was .915 (Cronbach's alpha) and .916 (omega) for total depression.

*Adverse Childhood Experiences Scale:* A self-administered questionnaire that measures the presence of adverse experiences before the age of 18. The scale assesses child abuse and neglect, cohabitation with family members who suffer from depressive disorders, and substance abuse. (Felitti et al., 1998) For present research, a general measure of the presence of adverse childhood experiences was taken. The p-value on most of the assessment items in this test ranges from 0.001 to 0.5 (Finkelhor et al., 2015). The internal consistency with Cronbach's alpha for the present study was .703 for the total scale.

**2.4 Procedure**

The research proposal was theoretical and methodologically designed and submitted for consideration in an internal call to the Católica Luis Amigó University. The institution

authorized and provided financial support for the execution of the research conducted between February and November 2023. A probabilistic sampling by clusters is initiated in 7 universities in the city of Manizales in Colombia and a sample of 266 people is determined. Of these 200 meet the inclusion criteria, these subjects are summoned to the university headquarters and, after signing the informed consent form they are evaluated between February and September 2023 by the principal researcher and the research assistant. Subsequently, the results are analyzed by the first co-investigator, through the statistical program SPSS. v. 25 and the Lavaan package of R Studio, to later contrast them with the theory and construct the discussion and conclusions.

**2.5 Ethical considerations**

The conditions regulated by the Helsinki Declaration deontological and bioethical code of the Psychologist Law 1090 of 2006 decreed by the Congress of the Republic and specified by the Ministry of Social Protection of Colombia were taken into account. Related to the ethical principles in human research, such as the voluntary access of the participant, the professional competence to carry out the evaluation, the adequate use of the evaluation instruments, the guarantee of minimum risk to the participant, and the confidentiality of the information collected. Likewise, the guidelines of the Statutory Law 1581 of 2012, which decrees the general provisions for the protection of personal data, are followed. All participants signed an informed consent form, and the research process was approved by the Ethics Committee of the Católica Luis Amigó University in February of 2022 with the approval number 0330.

**2.6 Data analysis**

Statistical analyses were performed using SPSS. v. 25 and the Lavaan package of R Studio. A descriptive analysis of the sociodemographic characteristics and social, clinical, and neuropsychological indicators of the participants was performed. The Kruskal-Wallis H-test was used to compare participants' performance on neuropsychological variables with scores on trait and state anxiety, depression, and adverse childhood experiences. Additionally, a Spearman's Rho correlation analysis was performed between the study variables. Finally, structural equation modeling (SEM) was proposed to examine the direct and indirect effects of adverse childhood experiences, anxiety, and depression symptoms on executive functioning (inhibitory control, working memory, and shifting). For SEM analyses, all adverse childhood experiences were included and a latent variable of anxiety and depression was considered to examine their direct and indirect effects on measures of executive functioning. The following indicators were used to assess the fit of the proposed model: Comparative Fit Index (CFI≥ 0.90), Tucker-Lewis Index (TLI≥ 0.90), Bentler-Bonett Non-Normed Fit Index (NNFI≥ 0.90), Relative Non-Centrality Index (RNI≥ 0.90), Bollen Incremental Fit Index (IFI≥ 0.90), Goodness of Fit Index

(GFI≥ 0.90), Adjusted Goodness of Fit Index (AGFI≥ 0.90) and Root Mean Square Residual of Approximation (RMSEA ≤ 0.08) (Byrne, 2016).

## 3. Results

Table 1 shows indicators of participants performance on neuropsychological tasks of executive functioning, the presence of adverse childhood experiences, and the level of severity of symptoms of depression, state anxiety, and trait anxiety.

In terms of cognitive functioning, 76% of participants demonstrate high performance in cognitive flexibility (Shifting), whereas only 7.5% exhibit low performance. 11.5% have high inhibitory control, 79% have average performance, and 9.5% have difficulty inhibiting impulsive responses. In working memory, 59% have low performance and only 4% have high performance. In terms of adverse childhood experiences, 92.5% reported at least one adverse childhood experience. Sixty-six percent of the sample reported between 1 and 4 and 26.5% reported between 5 and 6 adverse childhood experiences. The most recurrent experiences were related to domestic violence, physical violence, psychological violence, and psychological neglect. On the other hand, 54.5% reported high or very high levels of trait anxiety, while 40.5% reported high or very high levels of state anxiety. In addition, 60.5% had mild to severe depressive symptoms (see table 1).

**Table 1.** Indicators of early adverse experiences, symptoms of anxiety, depression

| Variables | Indicator | *n* | *%* |
|---|---|---|---|
| ***Executive functioning*** | | | |
| **Performance in Shifting** | Low | 15 | 7,5 |
| | Average | 33 | 16,5 |
| | High | 152 | 76,0 |
| **Inhibitory control performance** | Low | 19 | 9,5 |
| | Average | 158 | 79,0 |
| | High | 23 | 11,5 |
| **Working memory performance** | Low | 118 | 59,0 |
| | Average | 74 | 37,0 |
| | High | 8 | 4,0 |
| ***Adverse childhood experiences*** | | | |
| **Neglect** | No | 182 | 91,0 |
| | Yes | 18 | 9,0 |
| **Intrafamily problems - abandonment** | No | 135 | 67,5 |
| | Yes | 65 | 32,5 |
| **Living with people who suffer from depression** | No | 150 | 75,0 |
| | Yes | 50 | 25,0 |
| **Living with people who abuse substances** | No | 146 | 73,0 |
| | Yes | 54 | 27,0 |
| **Victim of domestic physical violence** | No | 120 | 60,0 |

| | | | |
|---|---|---|---|
| | Yes | 80 | 40,0 |
| **Living with people in conflict with the law** | No | 184 | 92,0 |
| | Yes | 16 | 8,0 |
| **Psychological domestic violence** | No | 78 | 39,0 |
| | Yes | 122 | 61,0 |
| **Victim of physical domestic violence** | No | 115 | 57,5 |
| | Yes | 85 | 42,5 |
| **Psychological - moral abandonment** | No | 115 | 57,5 |
| | Yes | 85 | 42,5 |
| **Sexual abuse** | No | 156 | 78,0 |
| | Yes | 44 | 22,0 |
| ***Symptoms of anxiety and depression*** | | | |
| **Trait Anxiety** | Low | 23 | 11,5 |
| | Medium | 68 | 34,0 |
| | High | 72 | 36,0 |
| | Very high | 37 | 18,5 |
| **Anxiety Status** | Low | 33 | 16,5 |
| | Medium | 86 | 43,0 |
| | High | 64 | 32,0 |
| | Very high | 17 | 8,5 |
| **Depression** | Minimal | 79 | 39,5 |
| | Mild | 37 | 18,5 |
| | Moderate | 49 | 24,5 |
| | Severe | 35 | 17,5 |

The Kruskal-Wallis test was used to compare performance in the neuropsychological tasks of shifting, working memory, and inhibitory control with the independent variables: adverse experiences, anxiety, and depression. Table 2 shows only those variables that showed statistically significant differences ($p<0.05$). Performance on the working memory tasks showed no differences with the independent variables. Statistically significant differences in shifting performance were found in relation to living with people suffering from depression ($p = 0.015$, $\eta^2 = 0.032$) and experiences of sexual abuse ($p = 0.05$, $\eta^2 = 0.019$). For inhibitory control, significant differences were observed in relation to trait anxiety ($p = 0.045$, $\eta^2 = 0.021$), state anxiety ($p = 0.026$, $\eta^2 = 0.027$), and depression ($p = 0.010$, $\eta^2 = 0.037$).

**Table 2.** Differences between performance on neuropsychological variables and adverse childhood experiences, trait anxiety, state anxiety, and depression variables

| **Performance in shifting** | | **N** | **Average Range** | **H** | **p** | $\eta^2$ |
|---|---|---|---|---|---|---|
| **Living with people who suffer from depression** | Low | 15 | 75,50 | 8,384 | 0,015 | 0,032 |
| | Average | 33 | 90,65 | | | |
| | High | 152 | 105,11 | | | |
| **Sexual abuse** | Low | 15 | 125,17 | 5,798 | 0,05 | 0,019 |
| | Average | 33 | 96,68 | | | |
| | High | 152 | 98,89 | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Performance in Inhibitory control** | | | | | | |
| **Trait Anxiety** | Low | 19 | 69,50 | 6,199 | 0,045 | 0021 |
| | Average | 158 | 104,43 | | | |
| | High | 23 | 99,09 | | | |
| **Anxiety Status** | Low | 19 | 73,87 | 7,315 | 0,026 | 0,027 |
| | Average | 158 | 106,07 | | | |
| | High | 23 | 84,22 | | | |
| **Depression** | Low | 19 | 66,53 | 9,220 | 0,010 | 0.037 |
| | Average | 158 | 106,37 | | | |
| | High | 23 | 88,22 | | | |

Table 3 presents the correlations between adverse childhood experiences and executive functioning in adulthood. Shifting was positively correlated with living with people suffering from depression ($r$ = 0.161, $p$ < 0.05). Working memory showed a significant negative correlation with experiences of sexual abuse ($r$ = -0.186, $p$ < 0.01). Inhibitory control was negatively correlated with living with people who abuse substances ($r$ = -0.157, $p$ < 0.05) and with living with individuals in conflict with the law ($r$ = -0.174, $p$ < 0.05).

**Table 3.** Spearman correlation coefficient (Rho) between adverse childhood experiences and executive functioning in adulthood

| **Correlations** | **Shifting** | **Working Memory** | **Inhibition** |
|---|---|---|---|
| **Neglect** | 0,012 | -0,067 | 0,044 |
| **Family problems - abandonment** | 0,062 | 0,133 | 0,032 |
| **Living with people who suffer from depression** | 0,161* | 0,042 | 0,128 |
| **Living with people who abuse substances** | 0,082 | 0,010 | -0,157* |
| **Victim of physical domestic violence** | -0,037 | -0,139 | -0,133 |
| **Living with someone in conflict with the law** | -0,037 | -0,129 | -0,174* |
| **Psychological domestic violence** | 0,095 | 0,006 | -0,023 |
| **Victim of physical domestic violence** | 0,053 | 0,019 | -0,038 |
| **Psychological-moral abandonment** | 0,075 | -0,071 | 0,042 |
| **Sexual abuse** | -0,039 | -0,186** | -0,021 |
| **Total score for adverse experiences** | 0,097 | -0,050 | -0,059 |

Note: *p< 0,05; **p< 0,01

Table 4 shows the results of the analysis of correlations between state anxiety, trait anxiety, depression, and executive functioning variables. No statistically significant correlations were found between the variables.

**Table 4.** Spearman correlation coefficient (Rho) between symptoms of anxiety, depression, and executive functioning

| Correlations | Shifting | Working Memory | Inhibition |
|---|---|---|---|
| Trait Anxiety | 0,014 | -0,022 | 0,117 |
| Anxiety Status | 0,042 | -0,081 | -0,008 |
| Depression | -0,026 | -0,032 | 0,090 |

A structural equation model was proposed based on the diagonally weighted least squares estimator (Byrne, 2016) to analyze the effects of adverse childhood experiences, depression, state anxiety, and trait anxiety on each of the neuropsychological variables. Given the strong correlations between anxiety and depression measures demonstrated in this study ($r \geq 0.70$, $p<0.001$), a latent variable including depression, trait anxiety, and trait anxiety as observable variables were considered, thus proposing a more parsimonious model. The model obtained good goodness-of-fit indicators (Byrne, 2016) (see Table 5).

**Table 5.** Goodness-of-fit statistics for structural equation models

| ***Goodness-of-fit indices*** | ***Value obtained*** | ***Goodness-of-fit value*** |
|---|---|---|
| Comparative Fit Index (CFI) | 0.933 | ≥0.90 |
| Tucker-Lewis Index (TLI) | 0.920 | ≥0.90 |
| Bentler-Bonett Non-normed Fit Index (NNFI) | 0.920 | ≥0.90 |
| Relative Noncentrality Index (RNI) | 0.933 | ≥0.90 |
| Bollen's Incremental Fit Index (IFI) | 0.935 | ≥0.90 |
| Goodness of Fit Index (GFI) | 0.916 | ≥0.90 |
| Adjusted Goodness of Fit Index (AGFI) | 0.882 | ≥0.90 |
| Root Mean Square Error of Approximation (RMSEA) | 0.045 | ≤ 0.08 |
| CI 95% RMSEA Lower | 0.026 | |
| CI 95% RMSEA Upper | 0.061 | |

Table 6 shows the direct and indirect effects of exogenous latent variables on endogenous variables. Adverse childhood experiences (β= -0.362, CI 95% [-0.655 - -0.0694]), p= 0.031), anxiety and depression (β= 0.149, CI9 5% [-0.085-0.3825]), p= 0.231) were found to contribute direct effects that explained 11% of the performance in executive functioning. However, only the effect of adverse childhood experiences was significant. Adverse childhood experiences (β= 0.411, 95% CI [0.326-0.4957]), p< .001) were also found to explain 17% of the variance in the anxiety and depression construct. When analyzing the indirect effect of adverse childhood experiences on executive functioning through the anxiety and depression construct, it was found that the indirect effect was not significant (β= 0.06, CI95% [-0.038-0.160]), p=0.247).

**Table 6.** Direct and indirect effects of exogenous latent variables on endogenous variables

| ***Endogenous variables*** | ***Exogenous variables*** | ***B*** | ***SE*** | ***95% CI*** | | ***β*** | ***β 95% CI*** | | ***z*** | ***p*** |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | *Lower* | *Upper* | | *Lower* | *Upper* | | |
| ***Direct effects*** | | | | | | | | | | |
| Executive functioning (FE) | ACEs | -0.383 | 0.177 | -0.731 | -0.036 | -0.362 | -0.655 | -0.069 | -2.16 | 0.031 |
| | Anxiety and depression (A&D) | 0.144 | 0.120 | -0.091 | 0.379 | 0.149 | -0.085 | 0.383 | 1.20 | 0.231 |
| $R^2$ = 0.109 | | | | | | | | | | |
| Anxiety and depression | ACEs | 0.450 | 0.057 | 0.338 | 0.563 | 0.411 | 0.326 | 0.496 | 7.87 | <.001 |
| ***$R^2$ =*** 0.169 | | | | | | | | | | |
| **Indirect effects** | | | | | | | | | | |
| ACEs ⇒ A&D ⇒ FE | | 0.065 | 0.056 | -0.045 | 0.174 | 0.061 | -0.038 | 0.160 | 1.157 | 0.247 |

Figure 1 illustrates the SEM model diagram presented in Table 6, which demonstrates the standardized direct effects of adverse childhood experiences and anxiety-depression on executive functioning.

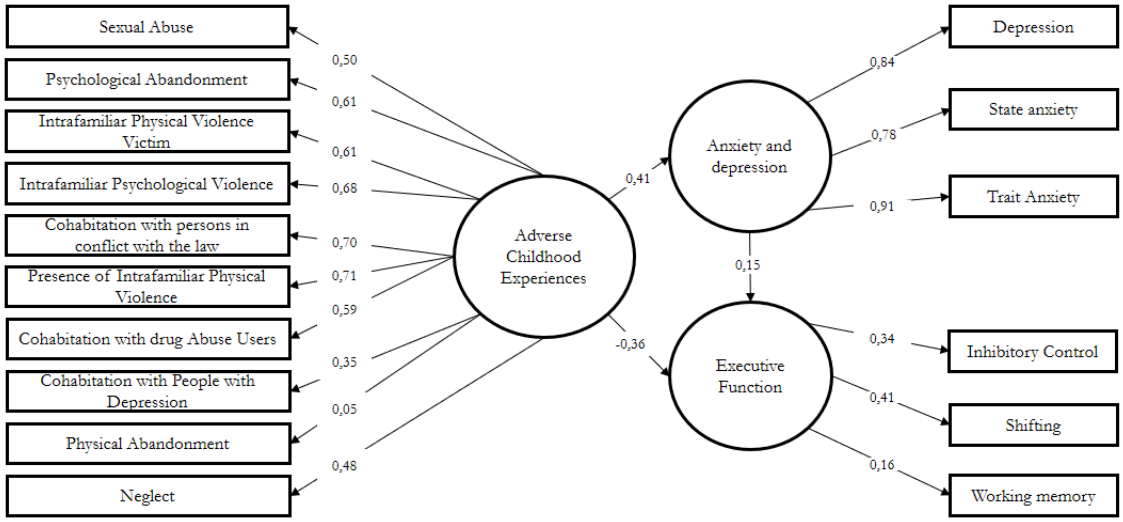


**Figure 1.** Structural equation model of the effect of the exogenous latent variable adverse childhood experiences on the endogenous latent variables of anxiety-depression and executive functioning

Table 7 presents the measurement models for each latent variable, providing detailed information on the factor loading coefficients (λ), their 95% confidence intervals (CI), p-values, and coefficients of determination ($R^2$). The adverse childhood experiences exhibited high factor loadings for the various indicators, particularly for those who had been victims of physical domestic violence (λ = 0.714) and those who had lived with someone in conflict with the law (λ = 0.700). However, the indicator of family problems - abandonment demonstrated a relatively low loading value (λ = 0.054). In the domain of executive functioning, the indicators of working memory (λ = 0.410) and inhibition (λ = 0.336) exhibited satisfactory factor loadings. Regarding

anxiety and depression, all indicators were found to be significant, with high factor loadings for trait anxiety (λ = 0.913), state anxiety (λ = 0.776), and depression (λ = 0.837). This reflects a robust and well-adjusted model for this latent variable.

**Table 7.** Structure of the latent variables from the loadings of the observed variables of the proposed SEM model

| *Latent Variables* | *Observed Variables* | *λ* | *λ 95%* | | *p* | *R²* |
|---|---|---|---|---|---|---|
| | | | *Lower* | *Upper* | | |
| **Adverse childhood experiences** | Neglect | 0.482 | 0.314 | 0.651 | < .001 | 0,233 |
| | Family problems - abandonment | 0.054 | -0.069 | 0.177 | 0.392 | 0,003 |
| | Living with people who suffer from depression | 0.349 | 0.220 | 0.478 | < .001 | 0,122 |
| | Living with people who abuse substances | 0.586 | 0.461 | 0.711 | < .001 | 0,343 |
| | Victim of physical domestic violence | 0.714 | 0.591 | 0.836 | < .001 | 0,509 |
| | Living with someone in conflict with the law | 0.700 | 0.538 | 0.862 | < .001 | 0,491 |
| | Psychological domestic violence | 0.681 | 0.555 | 0.806 | < .001 | 0,463 |
| | Victim of physical domestic violence | 0.613 | 0.493 | 0.733 | < .001 | 0,376 |
| | Psychological-moral abandonment | 0.606 | 0.482 | 0.730 | < .001 | 0,367 |
| | Sexual abuse | 0.504 | 0.369 | 0.638 | < .001 | 0,254 |
| **Executive Functions** | Shifting | 0.157 | -0.057 | 0.371 | 0.151 | 0,025 |
| | Working memory | 0.410 | 0.094 | 0.726 | 0.016 | 0,168 |
| | Inhibition | 0.336 | 0.069 | 0.604 | 0.017 | 0,113 |
| **Anxiety and depression** | Trait Anxiety | 0.913 | 0.693 | 1.133 | < .001 | 0,833 |
| | Anxiety Status | 0.776 | 0.597 | 0.955 | < .001 | 0,602 |
| | Depression | 0.837 | 0.643 | 1.030 | < .001 | 0,700 |

## 4. Discussion

The present research found some effects of adverse experiences on executive functioning and focused on studying the mediating effect that anxiety and depression may have on the relationship of these variables in a sample of young adults from Manizales in Colombia. For this purpose, the presence of ACE in the sample was analyzed, the levels of anxiety and depression were measured and their performance in tasks associated with the executive functions of Shifting was analyzed by means of the percentage of perseverative responses of the WCST, inhibitory control was evaluated by means of the stroop test and working memory was evaluated by means of the homonymous index of the WAIS IV.

Following the research of authors such as Lund et al. (2020) who suggest analyzing the effects of specific adverse experiences on executive functioning, a significant effect of some ECAs on executive functions was identified, for example it was found that sexual abuse explains part of the decrease in working memory, as pointed out by Fergusson et al. (2013). It was also identified that inhibitory control decreases when there is cohabitation in childhood with substance

abusers, as well as when there is cohabitation with people in conflict with the law, confirming for this variable the findings of (Hawkins et al., 2021; Lund et al., 2020; Lynch & Widom, 2022) that explain that the neglect associated with these variables is related to these low scores in executive functioning. In addition, it was found that early exposure to living with individuals who present depression is associated with higher scores on executive functioning of change, an aspect that complements the findings of Lund et al. (2020) that explain a compensatory response of change for those with this antecedent, suggesting to extend this research from variables such as resilience as they explain it (Lynch & Widom, 2022; Trinidad, 2021).

However, these causal relationships are weak, and although they are related to what has been found by other authors, they are not strong enough to explain an alteration in executive functioning. Only trait anxiety provided a significant direct effect in predicting lower performance in inhibitory control, which according to Friedman and Miyake (2017) is fundamental for attentional control and would explain an interference in cognitive control, rather than an alteration in executive functions, which according to Adrover-Roig et al. (2023) is supported by a tendency to an increase in response time in those who present anxiety, rather than a permanent alteration in executive functioning. This conclusion is consistent with what is indicated by (Jiang et al., 2019) when mentioning a significant relationship between the intensity and frequency of emotions, with physical and mental alterations. This means that in studies with non-clinical populations, some weak and inconclusive relationships can be found.

Therefore, it is determined that it is possible that other variables mediate the relationship between ACEs and executive functioning. Faced with this question, authors such as Kalia and Knauft (2020) do not find conclusive the mediation of emotions between adverse childhood experiences and executive functioning; instead, they conclude that it is coping strategies such as cognitive reappraisal that mediate this relationship. (2016) consider that it is emotional regulation that mediates this relationship between independent and dependent variables, rather than anxious or depressive signs per se.

In other analyses, it is concluded that adverse experiences as a single exogenous latent variable predicts a strong and significant effect on endogenous emotional variables of trait and state anxiety as well as on levels of depression. Confirming findings reported in previous studies, regarding the association between adverse experiences during childhood and the manifestation of clinical symptoms of depression and anxiety in adulthood (Amone-P'Olak & Letswai, 2020; Jiang et al., 2019; Mao et al., 2023; Muwanguzi et al., 2023; Schellhaas et al., 2022; Stern & Thayer., 2019). In parallel, the ACE variable establishes a moderately strong negative relationship with the endogenous latent variable executive functioning. This suggests that ACEs

have a negative impact on adult executive functioning, confirming the findings of Lynch and Widom (2022), Hawkins et al. (2021), and Lund et al. (2020). However, it is determined that the emotional variables of anxiety and depression do not establish a mediating effect between adverse experiences and executive functioning as this mediating relationship is weak and not considered statistically significant. For this reason, the null hypothesis is adopted.

This allows us to identify that we should aim to evaluate the mediating effect of cognitive aspects such as coping strategies and not of emotions on the effect that ACEs can generate on executive functioning, as mentioned by Kalia and Knauft (2020) and Wante et al. (2016) who suggest that positive reappraisal and emotional regulation respectively is what mediates the relationship between ACEs and executive functions. In turn, authors such as Jo et al. (2024) suggest that the stimulation of mental flexibility improves resilience as these two are statistically related, which may explain the statistical finding of better performance in shifting in people who lived in childhood with depressed people. Explaining also that the absence of effects between ACEs and executive functioning reported by Muwanguzi et al. (2023) may be due to the non-contemplation of the mediating effect of coping strategies in this relationship.

For this reason, it is suggested that future research evaluate the mediation of coping strategies between the independent and dependent variable, as well as expanding the sample size and including subjects from different regions of the country, since the variables may behave differently in other contexts, as Trinidad (2021) explains. It is also suggested to deepen the ACES questionnaire through an interview to increase the reliability of the report of these experiences, as this helps to mitigate the bias in what is evaluated. Finally, it is suggested to integrate the observable variables into latent variables, as was done in the present research, which made it possible to see more clearly the relationships and effects between the variables.

The researchers report that there were no conflicts of interest in this research.

**5. Strengths and Limitations**

The results of this research denote a strength in the statistical model used, as it allowed determining that the integration of ACEs as a single exogenous latent variable explains the presence of emotional variables such as anxiety and depression, highlighting the relevance of ACEs as a predictor of these clinical pathologies, also suggesting a slight direct and indirect effect on different executive functions., providing a high-level analytical approach. Furthermore, the inclusion of a non-clinical sample allows us to generalize the findings to broader populations, complementing previous research conducted in clinical settings.

However, it is important to keep in mind the limitations of this research. The sample, although diverse in socioeconomic strata, was geographically restricted to a single city, which may limit

the applicability of the findings to other regions or cultural settings (Trinidad, 2021). The use of self-reported data on ACEs may introduce recall bias or social desirability. Furthermore, although the study identified significant relationships, the mediating role of emotional variables on executive functioning proved to be weak, indicating the need for larger sample sizes and longitudinal designs to strengthen causal inferences.

## 6. Conclusions

The results of this study highlight the significant and long-lasting impact of ECAs on emotional well-being, as evidenced by their strong association with anxiety and depression in adulthood. Furthermore, ACEs negatively impact executive functioning, particularly inhibitory control, corroborating previous research on the cognitive sequelae of early adversity. However, the limited mediating role of emotional variables indicates the complexity of these relationships and suggests that emotional factors alone may not be determinants of impaired executive functioning.

These results emphasize the importance of context-specific research and the incorporation of protective factors, such as resilience, in future studies (Lynch & Widom, 2022; Trinidad, 2021). By advancing our understanding of this domain, specific interventions can be developed to mitigate the long-term consequences of childhood adversity on cognitive and emotional well-being.

## Ethical approval

The conditions regulated by the Helsinki Declaration deontological and bioethical code of the Psychologist Law 1090 of 2006 decreed by the Congress of the Republic and specified by the Ministry of Social Protection of Colombia were taken into account. The research process was approved by the Ethics Committee of the Católica Luis Amigó University in February of 2022 with the approval number 0330.

## Informed Consent Statement

Each participant was informed about the aims and procedures of the study and gave written informed consent before being included and audiotaped.

## Data Availability Statement

Requests to access the datasets should be directed to the corresponding author.

## Conflict of Interest Statement

The authors declare that the research was conducted in the absence of any potential conflict of interest.

**Authors' Contribution**

JFP, the primary author, was responsible for designing the research proposal, constructing the introduction, and developing the methodological design. He also conducted various evaluations in collaboration with CGM, who contributed to the evaluation and data collection. AGT performed the statistical analysis. The main author also constructed discussions and conclusions.

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