

Non-Suicidal Self-Injury Behavior in Adolescents and Neuropsychology: An Integrative Review From 2015 to 2022

Comportamiento Autolesivo en la Adolescencia y Neuropsicología: Revisión Integrativa de 2015 a 2022

Gislaine Chaves¹ ORCID: 0000-0002-9239-8401
Leila Salomão de La Plata Cury Tardivo² ORCID: 0000-0002-8391-0610

Abstract

Adolescence includes psychological, social, biological, and more specifically, neurological changes. The development involves the strengthening of emotional regulation and the suitability of executive functions linked to the performance of the prefrontal cortex. In contrast, the disturbance of this process refers to emotional dysregulation, common in most psychopathologies or risky behaviors, such as self-injurious behavior. The study aimed to conduct an integrative literature review on neuropsychological aspects linked to

non-suicidal self-injury. The searches were performed in the Portal CAPES and Google Scholar database. Four hundred eighty-seven studies were found, 14 of which are eligible for this review. Associations of self-injurious behavior with impairments in dimensions of emotional regulation, impulsivity/compulsivity, decision-making, psychological stress and coping style, and suicide behavior were observed.

Keywords: Adolescent development; Self-injurious behavior; Non-Suicidal Self Injury; Neuropsychology; Emotion Regulation.

¹PhD candidate at the Department of Clinical Psychology in University of São Paulo

²PhD and Associate Professor at the Department of Clinical Psychology in University of São Paulo

Corresponding Author: gislaine.ch@usp.br

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Resumen

El desarrollo esperado en la adolescencia pasa por el fortalecimiento de la regulación emocional y la adecuación de las funciones ejecutivas vinculadas al desempeño de la corteza prefrontal. En cambio, la perturbación de este proceso hace referencia a la desregulación emocional, común en la mayoría de las psicopatologías o conductas de riesgo, como la autolesión. Esto es una revisión integradora de la literatura sobre aspectos neuropsicológicos vinculados a las autolesiones no suicidas. Las búsquedas se realizaron en el Portal CAPES y en la base de datos Google Scholar. Se encontraron 487 estudios, 14 de los cuales son elegibles para esta revisión. Se observaron asociaciones de la conducta autolesiva con alteraciones en el campo de la regulación emocional, y conducta suicida.

Palabras clave: Desarrollo del Adolescente; Conducta Autodestructiva; Conducta autolesiva; Neuropsicología; Regulación Emocional

Introduction

Adolescence involves psychological and social changes that co-occur with the biological and, more specifically, neurological maturation of the individual. This is when a series of delicate adjustments are at stake in the brain's prefrontal cortex and the executive function's expansion (Arain et al., 2013; Raupp et al., 2018). In gray matter, there is a kind of cleansing (usually associated with favoring emotional regulation and learning), in which the most frequent neural connections are strengthened and those almost never used are eliminated.

The expected development of white matter is related to the suitability of executive functions, that is, skills that contribute to the healthy interaction of the individual in interaction with the world, and that involve the regulation of emotions, inhibitory control, of interpersonal relationships and mental flexibility (Arain et al., 2013; Mata et al., 2011; Smith et al., 2019).

Emotional regulation combines the processes by which emotional experience (e.g., joy) and expression (e.g., smile) are shaped in the service of adaptive functioning, which can involve automatic and volitional process (Izard et al., 2008; Smith et al., 2019). This concept refers to the conscious and/or unconscious mechanisms involved in the task of maintaining, elevating or minimizing the affective feedback, including feelings, behaviors and physiological responses that sustain emotions. In contrast, emotional dysregulation refers to disturbance of this process, being common in most psychopathologies or risk behaviors, such as Non-Suicidal Self-Injury (NSSI) (Derbidge, 2013; Izard et al., 2008; Smith et al., 2019).

NSSI is recognized for its complexity. It concerns the act of injuring oneself, with or without the intention of death, through the provocation of minor or moderate injuries in the body. There are many biological, psychological and/or social motivations for the behavior, however, the most widely reported by young people is related to the relief of emotional pain (Chaves et al. 2019, 2021; Ferreira et al., 2021; Rodríguez-Blanco et al., 2021; Valencia-Agudo et al., 2018; Wolff et al., 2019). The high prevalence of the phenomenon makes it currently considered by the World Health Organization (WHO) to be a public health

problem. The physical and psychological consequences of this behavior are intense, especially given its association with suicidal behavior (Ammerman et al., 2018; Barreto Carvalho et al., 2017; Zhou et al., 2022).

The literature points out interrelationships between the self-injury and the regulation of emotion. Executive functions play an important role in the NSSI, highlighting them as well as problem-solving skills. Authors suggest that the behavior is linked to damages in the prefrontal cortex, more specifically, in the orthofrontal circuits, responsible for such functions. The person would face difficulties to attenuate, regulate or avoid negative emotional states (Ammerman et al., 2018; Smith et al., 2019).

There are significant data to understand the neuropsychological bases underlying self-injury. However, most studies refer to adult populations, with a gap in the specialized literature regarding adolescents with this behavior. Therefore, it is considered that investigating the most intimate relationship between body and mind can be an important step to better understand the neuropsychological bases of self-injurious behavior in adolescence.

Integrative reviews are a way to gather knowledge in a specific area and time, enabling the synthesis and incorporation of new findings in practice since it deals with clinical care, knowledge, and quality of evidence found. Despite systematic reviews continuing as a strongly recommended method for evidence-based practice, integrative reviews are more appropriate when the research in the field is still developing, and the focus of the study is most comprehensive, allowing experimental and non-experimental studies (Souza et al.,

2010).

The following stages provided the structure for this review: (a) selection of the scope and research question; (b) establishment of inclusion and exclusion criteria; (c) classification of the studies found; (d) analysis of data from the selected studies; (e) interpretation of findings; and (f) presentation of the knowledge review (Souza et al., 2010). This method enables the finding of timely data that favor the foundation for assertive decision-making by health professionals. This study starts from the prior question: "What does neuropsychology have to tell us about non-suicidal self-injury behavior in adolescence?"

Methodology

Search Strategy

This paper is a literature review in the following database, Portal de Periódicos da Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES), which provides access to reliable, high-quality national and international papers. In order to achieve relevant studies, the following search strategies were used in English and Portuguese:

- Neuropsychology/Neuropsicologia AND Adolescent/adolescente AND Non-Suicidal Self-Injury/autolesão;
- Adolescent/adolescente AND NSSI/autolesão AND Neuro/neuro;
- Emotional regulation/regulação emocional AND Adolescent/adolescente AND Non-Suicidal Self-Injury/autolesão;
- Decision Making/Tomada de decisão AND Adolescent/adolescente AND Non-Suicidal Self-Injury/autolesão;

- Problem Solving/Resolução de problema AND Adolescent/adolescente AND Non-Suicidal Self-Injury/autolesão;
- Stress Psychological/estresse psicológico AND Adolescent/adolescente AND Non-Suicidal Self-Injury/autolesão.

The selection of the terms “Neuropsychology” and “Adolescent” in both languages, English and Portuguese, was made in structured vocabulary of the Health Sciences Descriptors (DeCS) from Biblioteca Virtual em Saúde (2008). The term “non-suicidal self-injury” and “NSSI” was considered because their popularly use by the scientific community and derived from literature reviews (Valencia-Agudo et al., 2018; Wolff et al., 2019).

Study Selection Criteria and Procedures

Inclusion criteria were: (a) English and Portuguese publications; (b) published between 2017 to 2022; (c) access free; (d) adolescents participants (age range 10-19); (e) samples from community; (f) non-suicidal self-injury behavior being the main focus of the paper.

The first author performed data collection. The titles and abstracts were screened, papers that met the inclusion criteria were identified and each full text was screened again to ensure a thorough search. Reasons for exclusion were listed and other studies were added when convenient. The search was conducted in March 2023. The data obtained were compiled and manually entered in an Excel spreadsheet, duplicates were removed, and full-text papers added. Figure 1 outlines the study acquisition and inclusion process.

Data Analysis

Each study's following elements were verified: Year, Country, Sample, Purpose, Research tools, and Main results related to NSSI behavior in adolescents. After, the data obtained were analyzed to compose the categories that oriented and enriched the discussion of this study. Figure 1 illustrates the study acquisition and inclusion process.

Results and Discussion

A total of 487 studies were recovered. Through CAPES, 456 papers were identified and the Google Scholar platform located 31 studies. Out of them, 378 papers were excluded for various reasons (i.e. study with adults, adults and adolescents, etc), 10 were duplicates, and 68 studies were selected. Of this total, 54 studies were excluded because they did not meet one or more inclusion criteria. A final selection of 14 eligible studies was obtained to compose this review.

The number of papers found is considered lower than expected. One of the reasons could be related to the focus of the present research. It means to say that few studies had examined neuropsychology in interrelation with NSSI behavior in the field of adolescence. A significant amount of papers with the adult population reinforces this comprehension. Table 1 and Table 2 were built to organize critical findings from the studies selected.

The papers were published between 2015 and 2022. The majority (50%, seven of them) in 2022. This finding shows the attention that the theme has had, especially in the last year. Researchers justify the lack of studies in the field of adolescence and the importance of deep knowledge about the

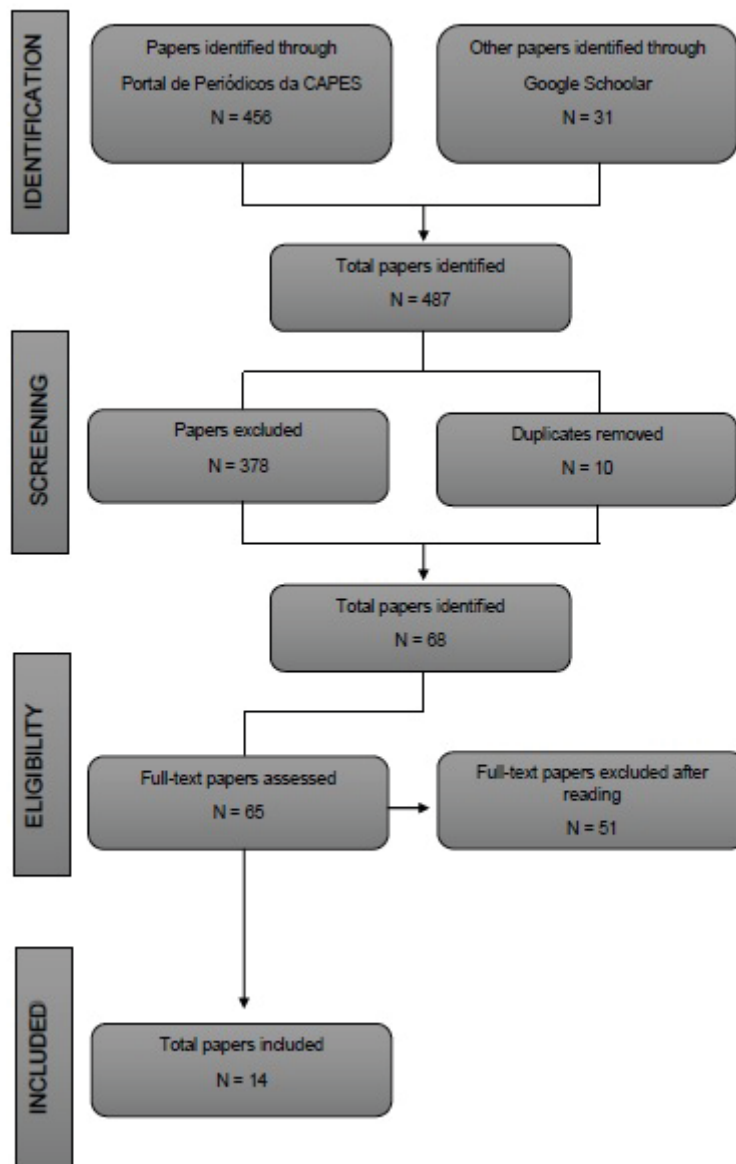
Figure 1*Flow Diagram of Identified Studies*

Table 1*Sample Data from Each Study*

Author/Year	Country	Sample
Brausch et al., 2022	United States	696 adolescents, 53 with NSSI behavior. The age ranged from 14 to 17 years
Gu et al., 2022	China	841 adolescents, 355 with NSSI behavior. The age ranged from 12 to 19 years old
Mozafari et al., 2022	Iran	100 adolescents, 50 with NSSI behavior. The age ranged from 15 to 17 years
Lan et al., 2022	China	2325 middle school students, being 401 with a history of NSSI behavior. The age ranged from 11 to 18 years
Liu et al., 2022	China	3645 adolescents, 857 with NSSI behavior. The age ranged from 10 to 16
Lutz et al., 2022	United Kingdom	240 adolescents, 50 with NSSI behavior. The age ranged from 15 to 17 years
Zhou et al., 2022	China	8361 adolescents, 476 with NSSI behavior. The mean age was 14.62 years
Kim et al., 2020	United States	140 adolescents, being 50 with NSSI. The age ranged from 13 to 18 years.
Chen & Chun , 2019	Taiwan	809 adolescents being 161 with NSSI behavior. The age ranged from 13 to 18
Cerutti et al., 2018	Italy	709 middle school students, being 204 with NSSI behavior. The age ranged from 10 to 15 years.
Wan et al., 2020	China	9704 adolescents, 3740 with NSSI behavior. The age range from 11 to 19
Brausch & Woods, 2019	United States	803 adolescents, 66 with NSSI behavior. The age ranged from 12 to 15
Xavier et al., 2018	Portugal	776 adolescents, 171 with NSSI. The age ranged from 12 to 18 years.
Kiekens et al, 2015	Belgium	946 adolescents, 230 with NSSI behavior. The age ranged from 12 to 19

Table 2
Data Obtained from Each Study Related to Neuropsychology, NSSI and Adolescence

Author/Year	Purpose	Research tools	Main results about NSSI
Brausch et al., 2022	To examine emotion regulation using comprehensive multi-method assessment to identify which specific deficits are uniquely related to NSSI and suicide ideation	The Self-Injurious Thoughts and Behaviors Interview. The Suicidal Ideation Questionnaire – Junior. The Difficulties in Emotion Regulation Scale. The Emotion Regulation Questionnaire for Children and Adolescents. The Emotion Stroop Test	Emotion suppression was the only unique and significant predictor of past-year NSSI and lack of access to emotion regulation strategies was the strongest predictor of both past-year presence of suicide ideation and suicide ideation severity
Gu et al., 2022	How and for whom maladaptive perfectionism is related to adolescent NSSI. To test the assumption that being mindful would be a protective factor in the process	Frost Multidimensional Perfectionism Scale. Depression Anxiety Stress Scale. Mindfulness Attention Awareness Scale. Inventory of Statements about Self-Injury	Maladaptive perfectionism predicted NSSI through the indirect effect of psychological distress. Self-Injury serves a function in emotion regulation and the communication of distress
Mozafari et al., 2022	To investigate the differences between two groups of adolescents with NSSI and normal counterparts in executive functions, behavioral activation and behavioral inhibition system (BAS/BIS) and emotion regulation	Bart Balloon Risk Task. Wisconsin Card Classification Task. Emotion Dysregulation Scale. Behavioral Activation/Behavioral Inhibition Scale	NSSI group had higher scores on risky decision making, behavioral inhibition, emotion dysregulation, and lower scores on cognitive flexibility than participants without history of NSSI

Author/Year	Purpose	Research tools	Main results about NSSI
Lan et al., 2022	To explore the relationship between catastrophizing and NSSI and its mechanism, the mediating effects of parental support and negative emotions on catastrophizing and NSSI	Catastrophizing tendency scale. Emotional self-rating scale. Parental support scale. Self-rating scale of NSSI	Catastrophizing tendency and emotional state was correlated with negative emotions. Negative emotions play a significant mediating role in the prediction of NSSI by catastrophizing tendency
Liu et al., 2022	To examine the mediating effect of emotion dysregulation and the moderating effect of impulsivity using the Interaction of Person-Affect-Cognition-Execution (I-PACE) model in adolescents with repetitive NSSI	Childhood Trauma Questionnaire Short Form. Difficulties in Emotion Regulation Scale. Chinese version of the Barratt Impulsiveness Scale. Deliberate Self-Harm Inventory	Childhood maltreatment was directly related to NSSI and indirectly related to NSSI through emotion dysregulation in both occasional and repetitive NSSI groups. Impulsivity played a moderating role in the relationship between emotion dysregulation and repetitive NSSI
Lutz et al., 2022	To evaluate whether impulsivity and compulsivity are differentially related to sporadic /max. 1-3 instances per year vs repetitive NSSI (4 or more instances per year). NSSI behavior using Computerized laboratory tasks	Affective Go/No-Go(AGNG) task from the CANTAB battery. Cambridge Gambling Task. Probabilistic Reversal Task	Repetitive NSSI is associated with increased behavioral compulsivity and disadvantageous decision making, but not with behavioral impulsivity

Author/Year	Purpose	Research tools	Main results about NSSI
Zhou et al., 2022	To investigate the association between coping styles, gender, their interactions and NSSI	Demographic characteristics. The Ottawa Self-Injury Inventory. Coping Styles Scale developed by Shulin Chen	NSSI group scored significantly higher than the non-NSSI group for emotion-oriented coping styles such as tolerance, avoidance, venting emotions, and fantasy/denial. The five dimensions and gender were significantly associated with NSSI
Kim et al., 2020	To probe how different assessments of emotion dysregulation might differentiate mutually three groups: (1) with NSSI, (2) with suicide attempts (SA) and (3) controls.	Child Schedule for Affective Disorders and Schizophrenia, present and lifetime version. Barratt Impulsiveness Scale. Dimensions of Aggression Inventory. Distress Tolerance Scale. Emotion Reactivity Scale. Children's Affective Liability Scale	NSSI have a more severe constellation of emotion dysregulation traits compared to an SA group. Low distress tolerance and high emotion reactivity were significantly more likely to engage in NSSI compared to groups.
Chen & Chun, 2019	To identify Taiwanese female adolescent clusters with NSSI and to evaluate the association of specific forms of emotion dysregulation with NSSI	The Difficulties in Emotion Regulation Scale. Deliberate Self-Harm Inventory. The Positive and Negative Affect Schedule	Severe group reported earlier onset of NSSI, higher negative affect, less emotion regulation strategies and more difficulty with impulse control.

Author/Year	Purpose	Research tools	Main results about NSSI
Cerutti et al., 2018	To investigate difficulty in identifying and describing feelings, NSSI behavior, quality of attachment, life stressors and suicidal ideation and the relationship among them.	Deliberate Self-Harm Inventory. Suicidal Ideation. Difficulty in Identifying and Describing Feelings. The Inventory of Parent and Peer Attachment. Life Stressor Checklist-Revised	Positive relationships among all constructs analyzed. Difficulty in identifying and describing feelings significantly mediated the effect of quality attachment (parent and peer) on NSSI and suicidal ideation
Wan et al., 2020	To identify gender differences in the impacts of positive coping style on NSSI, and investigate the impacts at different levels of Adverse Childhood Experience (ACE)	The Trait Coping Style Questionnaire. Screening question for NSSI. Adverse Childhood Experiences. Child Trauma Questionnaire	High level of negative components may have a higher risk of NSSI in both genders, regardless of exposure to ACEs. NSSI was significantly increased with the low positive coping style in girls with ≥ 3 ACEs- NSSI was increased with high negative coping style in both girls and boys across all ACEs
Brausch & Woods, 2019	To examine emotion regulation deficits as prospective predictors of suicide ideation at a 6-month follow-up as moderated by the presence or absence of NSSI behavior	Inventory of Statements about Self-Injury. Eating Disorder Inventory. Acceptance and Action Questionnaire - Junior	Poor emotion regulation and NSSI behavior could increase risk for future suicide ideation and attempt. Both experiential avoidance and interoceptive deficits were significantly and prospectively predictive of suicide ideation severity.

Author/Year	Purpose	Research tools	Main results about NSSI
Xavier et al., 2018	To examine the mediating role of rumination, experiential avoidance, dissociation and depressive symptoms in the association between daily peer hassles and NSSI, and to explore gender differences	Daily Hassles Microsystem Scale. Ruminative Responses Scale – short version. Avoidance and Fusion Questionnaire for Youth. Adolescent Dissociative Experiences Scale-II. Depression Anxiety and Stress Scales. Risk-taking and Self-harm Inventory for Adolescents	Path analysis showed that daily peer hassles indirectly impact on NSSI through increased levels of brooding, experiential avoidance, dissociation, and depressive symptoms
Kiekens et al, 2015	To examine: (1) the prevalence of NSSI, (2) the associations between Big Five personality traits and NSSI engagement, and (3) whether these associations are mediated by perceived stress and coping.	NSSI Subscale of the Self-Harm-Inventory. Dutch Quick Big Five Personality Questionnaire. Perceived Stress Scale. Utrecht Coping List for Adolescents	Personality traits and NSSI were consistently with perceived stress and depressive coping. A higher versatility of NSSI was associated with higher scores of perceived stress and depressive coping and with lower scores on active and optimistic coping.

underlying links with adolescent's NSSI in neuropsychology terms.

Researchers from China published five studies (36%), followed by researchers from the United States with three studies (21%). All the papers (100%) were written in English. Most of the studies from China showed data compatible with the study of Xiao et al. (2022). In their meta-analysis, Chinese papers occupied more than half of the results, which demonstrates the current concerns about the spread of NSSI among adolescents in the country.

Thirty thousand ninety-five (100%) individuals participated in the studies, of which 6.660 (22%) performed single or repetitive self-injurious behavior (present or past). The age between 10 and 19 years and the five-year difference range (e.g., 13 to 18 or 10 to 15) predominated among the included studies. This prevalence is similar to other studies with community samples (Andover et al., 2015; Somer et al., 2015), as well as the interval of difference, with the onset of NSSI being common in early adolescence (10-13 years), with a peak between 14-15 years old (Esposito et al., 2022).

All the papers (100%) used the terms emotion dysregulation or emotion regulation at least one time in the manuscripts. Four times the term was searched in view of relation NSSI and suicide (Brausch et al., 2022; Brausch & Woods, 2019; Chen & Chun, 2019; Kim et al., 2020), and ten times was combined with other dimensions (Cerutti et al., 2018; Gu et al., 2022; Kiekens et al., 2015; Lan et al., 2022; Liu et al., 2022; Lutz et al., 2022; Mozafari et al., 2022; Wan et al., 2020; Xavier et al., 2018; Zhou et al., 2022). These results reinforce the strong association between NSSI and suicide risk

in adolescents, as an established important factor pointed out in the specialized literature (Brausch et al., 2022; Brausch & Woods, 2019; Chen & Chun, 2019; Kim et al., 2020).

It shows the difficulty in distinguishing phenomenologically both concepts despite many efforts made by the scientific community. Suicide ideation remains since 2011 as the second leading cause of death in adolescents, and NSSI is a predictor that amplified the chances of the individual engage to future suicide attempt. Some reasons about that strong association are that both of them were linked with emotional dysregulation, and that adolescence is a period that increases the vulnerability for the behavior (Brausch & Woods, 2019). Therefore, emotion regulation has many dimensions that have been extensively studied, originating several researches.

Fifty-nine measurement tools were used. Seven instruments were the maximum applied in research (Kim et al., 2020), and three were the minimum (Chen & Chun, 2019; Lutz et al., 2022; Wan et al., 2020; Zhou et al., 2022), an average of four instruments per study. It is common in the field of neuropsychology the use several instruments, which is called a test battery, and involves the use of various tools with the finality to achieve a specific goal. For Kim et al. (2020) the use of many instruments and multi-informant inventory are an efficient way to deep the knowledge about NSSI behavior.

The categories of analysis were defined in view of the frequency of more than one repetition theme in the same paper. Hence, the final total is higher than the quantity of selected papers. It is useful to

remember that the division into categories is only a didactic way to illustrate the findings in this research. Table 3 contemplates the main data.

The purpose of 12 studies (48%) involved examining Emotion regulation and some other constructs such as experimental avoidance, interoceptive, catastrophizing, maladaptive perfectionism, and emotion suppression in adolescents with NSSI. Impulsivity, Compulsivity, and Decision-making were investigated in six papers (24%). Psychological stress and Coping style were verified in seven studies (28%).

Emotion Regulation

Recognizing, distinguishing, and talking about emotions and feelings is a situation requiring great effort for people with NSSI (Brausch et al., 2022; Cerutti et al., 2018; Mozafari et al., 2022). Such understanding supports the idea about emotion dysregulation's effect on NSSI behavior.

In line with these references, emotion regulation strategies, acceptance of negative emotions, and impulse control were dimensions that are difficult to handle for

adolescents with NSSI (Chen & Chun, 2019; Lutz et al., 2022). A lack of self-control and scarcity of strategy to deal with the emotions added to the intention of the act increased the chances of NSSI. Chen and Chun (2019) highlight that suppression or avoiding negative feelings progressively commits to emotional accumulation and it may cause a "rebound effect" which contributes to higher intense negative emotions.

Emotional reactivity was also found to be an important factor associated with NSSI. Kim et al. (2020), in order to differentiate the mechanisms linked to suicide and NSSI in American adolescents, bare that those with NSSI had lower tolerance to suffering and greater emotional reactivity. Children's Affective Lability Scale was the unique instrument that predicted whether the teenager was more prone to an NSSI or suicidal behavior, being the scores higher among the NSSI populations. Affective lability is defined as a faster, overblown change of mood.

Limited access to or some lack of emotion regulation strategies were an important risk factor for suicide ideation

Table 3

Summary of Categories Obtained from Each Study Related to Neuropsychology, NSSI and Adolescence

Categories	Frequency	%
Emotion regulation	12	48
Impulsivity / Compulsivity and Decision-making	6	24
Psychological stress and Coping style	7	28
Total	25	100

(Brausch et al., 2022; Mozafari et al., 2022). Brausch et al. (2022), with the intention to explore the specific deficits linked to NSSI and suicide in the past year and recent suicide ideation severity, mention in their investigation with American schools adolescents that suppression was the unique dimension, between others analyzed (e.g. non-acceptance of emotions, lack of goal directed, etc), directly associated with NSSI. Suppression is a specific strategy that involves the inhibition of emotion expression, being a dysfunctional mechanism that worsens the emotion regulation given the influence of the body response and control.

Brausch and Woods (2019) sought to identify the deficits in experimental avoidance and interoceptive dimensions in relationship with suicide ideation, and the NSSI. Experimental avoidance serves to escape internal negative emotions, so unbearable to deal with that NSSI behavior became a way to solve them. It contributes, on the one hand, to reduce emotional arousal, but on the other can stimulate the behavior of negative reinforcement (Xavier et al., 2018). Interoceptive skills are the capability to pay attention, recognize and manage emotional clues, and as well the body. Both of the concepts were predictive of suicide ideation severity after six months even post-control of suicide ideation in the start of study, depending on NSSI potentiality. More specifically, NSSI behavior highly influenced to engagement in future suicide behavior (e.g. ideation or attempts) given the emotion dysregulation. In contrast, the study discuss that emotional dysregulation without NSSI may not be a danger to suicide behavior.

Gu et al. (2022) refer that

maladjusted perfectionism indirectly predicted NSSI in Chinese adolescents under psychological distress. This kind of perfectionism describes the propensity “to interpret even the smallest of mistakes as indicative of failure, combined with a belief that failure will result in the loss of others' respect” (Kawamura & Frost, 2004, as cited in Gu et al., 2022, p. 2). Lan et al. (2022) explore the relationship between catastrophizing emotion, NSSI, and parental support for negative emotions, and found that catastrophizing tendency may contribute to the development of negative emotions, and it leads to triggering NSSI behavior on several levels. Catastrophizing emotion is a potential cognitive distortion of thinking, which involves a tendency to amplify negative feelings, anguish, and its possible bad consequences. For the authors, the social and parental support diminish the tendency to engage in catastrophizing emotion and negative feelings, which contributes to diminish NSSI behavior.

Xavier et al. (2018) investigated the relationship between the mediating role of rumination, experimental avoidance, dissociation, and depressive symptoms in a sample of Portuguese adolescents with NSSI and having daily peer hassles. The gender differences were also evaluated. Results converge with other studies found in this review showing the indirect effect of strategies of emotion regulation-focused avoidance and depressive symptoms (Cerutti et al., 2018; Gu et al., 2022). The dates found suggested a positive relation between gender and the type of self-aggressive behavior. In front of distress, boys were more likely to engage in brooding and experiential avoidance whereas girls had more facility

to engage in NSSI and develop depressive symptoms.

Cerutti et al. (2018), examining a non-clinical sample of Italy adolescents, point out that NSSI and suicide ideation are also linked with the quality of attachment and stressful events. Attachment is the strong connection with someone, usually the primary figure (e.g. parents, brothers, peers), during life. Low level of attachment can be caused by stressful events in life and has been considered a factor that furthers the development of psychopathology in general, given its relationship with emotion regulation skills in children and adolescents. In the case of NSSI, it would work to deal with the difficulty to recognize and detail feelings and emotions.

Adverse experiences in the early stages of life were directly associated with NSSI behavior in Chinese adolescents (Cerutti et al., 2018; Liu et al., 2022; Lutz et al., 2022; Wan et al., 2020). Adverse childhood experiences are traumatic events in life before adulthood and can include all kinds of psychological and/or physical injuries. Liu et al. (2022) indicated childhood maltreatment was directly associated with repetitive and occasional NSSI behavior. Increased levels of emotional dysregulation and impulsivity were linked with potential addictive risk to NSSI. The data are endorsed by Lutz et al. (2022).

Impulsivity / Compulsivity and Decision-Making

Evidence from studies found in this review suggests difficulties with impulse control in NSSI adolescents (Chen & Chun, 2019; Kim et al., 2020; Liu et al., 2022; Lutz et al., 2022; Mozafari et al., 2022). Chen and Chun

(2019) observed that the severe NSSI group of Chinese adolescents was more prone to having difficulty with control of impulse than the moderate NSSI group. Scores for either a severe or a moderate group of NSSI were higher for negative affect when compared with healthy controls.

Impulsivity refers the action non-planned and non-premeditated in front of external or internal stimuli without worrying about the negative consequences (Liu et al., 2022; Lutz et al., 2022). Control of impulses involves ability to control desires, emotions, and thoughts about oneself and others in various situations, being more difficult in stressful and challenging circumstances. Lutz et al. (2022) mention two dimensions of impulsivity: behavioral disinhibition and impulsive decision-making. The first one is related to the difficulty to stop oneself from doing a mechanic behavior and the second one implies choosing behaviors with a fast and high reward but with a high risk to be a worse choice.

This dimension was deeply investigated by Liu et al. (2022) that sought the likely addictive mechanisms of repetitive NSSI among Chinese adolescents. Emotion regulation and impulsivity were examined with some questionnaires. The results showed positive relations between childhood maltreatment and emotion dysregulation, impulsivity and NSSI frequency. Impulsivity was directly associated with NSSI frequency, as well as emotion dysregulation. Emotion dysregulation and NSSI frequency were weaker in adolescents with repetitive NSSI and low impulsivity, whereas strong in adolescents with repetitive NSSI and higher impulsivity. Impulsivity is linked with inhibitory control, which involves the ability

to think before react.

Lutz et al. (2022) explored the mechanisms involved in NSSI in a group of London adolescents through some neurocognitive measures for impulsivity and compulsivity. Compulsivity is defined as a tendency to engage in a repetitive and continuous behavior despite the negative consequences. The results point out to impairments in decision-making and higher behavioral compulsivity to lifetime or repetitive NSSI group. However, behavioral impulsivity was not linked with NSSI repetitive, but with occasional NSSI. Kim et al. (2020) additionally specify that effective decision-making is linked to neural markers such as emotion-attention circuitry, which can be impaired in NSSI.

Mozafari et al. (2022) examined the executive functions, behavioral activation and inhibition systems, and emotion regulation of two groups, with and without NSSI. Using computer tasks, they found significant impairments in decision-making, behavioral inhibition, emotion dysregulation, and poor cognitive flexibility in adolescents with NSSI, higher than in adolescents without NSSI. The inhibition control is lower in adolescence than in other phases of life, but specially emphasized in NSSI behavior. The inhibition system is related with negative emotions and passive ways to deal with the problems. In addition, the capacity to solve problems was lower in NSSI adolescents, as well as inhibition and decision-making, which means that the group with NSSI usually chooses an answer that works at that moment, but it causes long-term difficulties. Lutz et al. (2022) corroborate these data.

Psychological Stress and Coping Style

Previous research showed the links between psychological stress, coping style and NSSI (Cerutti et al., 2018; Gu et al., 2022; Kiekens et al., 2015; Kim et al., 2020; Wan et al., 2020; Zhou et al. 2022). One of the goals of the study by Kiekens et al. (2015) was to examine whether NSSI was mediated by perceived stress and coping in Flemish and Dutch adolescents. The dimensions of neuroticism, perceived stress, and distractive, avoidant, depressive, and emotional coping were higher when compared with adolescents without NSSI. The previous hypothesis were confirmed, being perceived stress directly associated with depressive coping. Perceived stress refers to the feeling or thoughts about the level of stress that one person is under at a specific moment of life. Depressive coping is associated with environmental factors such as poor or lack of bonds with family and friends.

Psychological distress involves a series of non-specific physical and/or psychological signals and symptoms related to stress, anxiety, and depression. All of them are associated with NSSI behavior, being the last one an important link between maladjusted perfectionism, distress, and NSSI (Gu et al., 2022). Moreover, Kim et al. (2020) investigated distress tolerance and emotional reactivity. The NSSI group showed higher levels of stress experience, and lower distress tolerance to manage their internal and external conflicts.

Wan et al. (2020) studied adverse experiences with Chinese adolescents in the early stages of life. The authors examined the relationship between gender and coping styles (negative/ positive) on NSSI. Coping styles are a way to deal with a difficulty

situation that can be positive and/or negative. The results indicated that female adolescents with severe NSSI were more likely to show poor coping style. The adverse experiences were linked in female and male adolescents with increased low coping, the girls with low or moderate NSSI the being most affected.

In the same line of thinking, Zhou et al. (2022) question the relationship between coping styles and gender, and NSSI among Chinese rural students with or without self-injurious behavior. All dimensions examined in this study were higher for the group with NSSI behavior and gender played a moderating role in positive or negative coping for NSSI.

NSSI usually occurs in "distressing negative affective states, especially anger and depression, and mixed emotional states" (Cerutti et al., 2018, p. 2). Stressful and traumatic situations would imply specific body responses, which may be a further risk for engagement in NSSI as a coping strategy. In cases of emotion dysregulation, this probably could be higher. The results of the study performed by Cerutti et al. (2018) provide evidence about the positive correlation between stressful life events and increased frequency of NSSI.

Limitations and Suggestions for Future Research

Several limitations in the current study suggest ideas for future research. One of the limitations refers to the keywords used in this review. NSSI is a popular term in the psychological field to distinguish self-injurious behavior without the intention to die, but the inclusion of other keywords, such as self-injurious behavior and deliberate self-harm could return a higher number of

significant papers. The second may be the database chosen. The absence of papers from Latin American countries, such as Brazil, points out the necessity of investments in research in this field to contribute to a better comprehension of other realities. The third is the absence of qualitative or mixed-methods research, given that exam of only quantitative papers diminishes the possibility of amplifying and deepening the knowledge about the main question, reducing the future hypothesis. The fourth limitation is related to the instruments used in the studies analyzed, which may have influenced the differences found in this study.

Based on the question conducted in this review, it is considered that research focused on Latin American countries could be added to the scientific knowledge of adolescents with NSSI. Furthermore, more research is needed to further explore the variables investigated in this study. Data about the neuropsychological dimension of NSSI in adolescence may contribute to a better understanding of the field and consequently improve the useful information for ways to prevent NSSI in the early stages of development.

Conclusions

Bearing in mind the adolescent's maturational development process and the relationship with NSSI behavior, questions were raised about the links between body and mind, especially in view of the work of discipline neuropsychology. According to the research question guideline: "What does neuropsychology have to tell us about self-injurious behavior in adolescence?" the results found fit with previous findings

showing that emotion dysregulation is often cited as a primary reason for the engagement of individuals in NSSI. The findings point out for relationship between NSSI and impairments in dimensions of impulsivity, compulsivity, decision-making, psychological stress, and coping style.

In addition, the present research indicates a strong association between NSSI and suicide risk in adolescents such as an established important factor, as pointed out in the specialist literature. This study shows the difficulty in distinguishing phenomenologically both concepts despite many efforts made by the scientific

community. Suicide ideation remain since 2011 at the second leading cause of death in adolescents, and NSSI is a predictor that amplified the chances of the individual engage to future suicide attempt. Some reasons about that strong association is both of them were linked with emotional dysregulation, and the adolescence is a period that increase the vulnerability for the NSSI behavior.

Conflicts of Interest

The authors declare that there is no conflict of interest.

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