Engaging in Non-suicidal Self-Injury: The Contribution of Early Life Experiences, Attachment and Emotion Dysregulation.

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Declaration of Own Work

I, Rania Christoforou, declare that this thesis has been composed solely by myself and that it has not been submitted elsewhere, in whole or in part, for any other academic purposes. Except where otherwise stated by reference or acknowledgement, the work presented is entirely my own.

Name: Rania Christoforou   **Signature:** *[signature]*   **Date:** 16.05.2020

Dedication / Acknowledgements

I would like to dedicate the following thesis to my parents, my brother and my partner, who supported me, each one of them in their own way, in pursuing one of my life-long dreams, a PhD in Clinical Psychology.

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Table of Contents

Abstract

Background: Non-suicidal self-injury (NSSI) has attracted the attention of several clinicians and researchers due to its rising prevalence rates, its impact both on an individual and on a community level and more specifically, due to the possibility that it could form a distinct clinical category in the Diagnostic and Statistical Manual of Mental Disorders. Particular emphasis is given on accurately conceptualizing NSSI, which includes the risk factors leading to it. Although there are numerous studies supporting the role of early life experiences, attachment and emotion dysregulation, there is a lack of recent reviews investigating the contribution of all these factors together and a lack of studies investigating the interaction of all these factors, which might lead to NSSI engagement. Theorists and researchers investigating the interaction of two of the three aforementioned risk factors, suggest that the effect of early life experiences on NSSI might be serially mediated by attachment and emotion dysregulation. However, there is no study exclusively investigating this pathway. Additionally, it has been observed that the majority of studies examining the role of early life experiences have focused on basic forms of adversities, such as physical, sexual and emotional abuse, limiting in this way the scope of their effect. This demonstrates the need for a more inclusive measure, such as the Adverse Childhood Experiences-International Questionnaire, which has not been validated within a NSSI population. **Objectives:** Therefore, the following thesis aimed: i) to provide a more recent systematic review and meta-analysis of the effects of early life experiences, attachment and emotion dysregulation (Systematic Review), ii) to investigate the proposed pathway leading to NSSI (Empirical Paper 1) and iii) to examine the psychometric properties of the ACE-IQ (Empirical Paper 2). **Results:** Systematic Review - The findings from the systematic review and meta-analysis supported the effect of childhood maltreatment (d=0.271, p<0.001) and

emotion dysregulation (d=0.198, p < 0.001) on NSSI. Although a significant effect was not

demonstrated from the meta-analysis due to limited evidence (d=0.015, p=0.392), several

studies supported the effect of insecure attachment on NSSI too. Empirical paper 1 - The

proposed serial mediational model between early life experiences and NSSI via attachment

and emotion dysregulation was supported [Indirect effect = 0.004, SE = 0.002, 95% CI

(0.0007, 0.0090)]. Empirical paper 2 - The ACE-IQ was found to be a reliable (Cronbach's

alpha = 0.854) and valid measure (Convergent validity – r = 0.85, p<0.001 with the CTQ-SF;

Predictive validity – R^2 = 0.12, p=0.001 of the SHI total score; Discriminant validity – F-

value = 13.90, p<0.001) to be used with individuals engaging in NSSI. However, some issues

were identified with the factor structure of the ACE-IQ. **Conclusion:** The findings were in

accordance to previous theories and studies. Several research and clinical implications were

discussed, such as the use of the proposed pathway for identifying individuals, who might be

at risk of engaging in NSSI and for developing prevention strategies. Lastly, some

suggestions were made for future studies, such as to expand the current proposed pathway by

adding resiliency factors that might lead to NSSI engagement instead of suicide attempts.

Additionally, a modification of the ACE-IQ was suggested to improve its subscales.

Introduction

In recent years particular attention has been paid to non-suicidal self-injury (NSSI) or otherwise known as deliberate self-harm (DSH) due to its rising prevalence rates and its impact both on a personal and societal level (Wester, Trepal, & King, 2018). Particularly, there is a growing concern that NSSI could be a distinct clinical phenomenon and not a suicide attempt or a symptom of borderline personality disorder (Brausch & Gutierrez, 2010; Selby, Bender, Gordon, Nock, & Joiner, 2012). Conceptualizing NSSI accurately and its underlying risk factors and functions is crucial in enhancing clarity in clinical care by identifying the right clinical diagnosis and hence, the most appropriate treatment. Therefore, the current thesis is aiming to shed light to the processes leading to NSSI, which might aid in its distinction from other mental health difficulties. In this chapter, NSSI will be conceptualized based on previous definitions, research, its history, its epidemiology, its impact, its assessment, its functions and the risk factors leading to NSSI behaviors. Gaps in literature will be addressed, which will lead to the thesis objectives and hence, to the research questions.

Non-suicidal Self-Injury (NSSI)

As previously stated, NSSI is also referred to as DSH. The term NSSI is mainly adopted by studies and clinicians, which and who are based in the USA and Canada, while the term "DSH" is used within Europe and Australia (Muehlenkamp, Claes, Havertape, & Plener, 2012).

Definition

Favazza (1998) defined NSSI as "a direct destruction or alteration of body tissue without conscious suicidal intent" and this is the most commonly used reference of the

definition within the NSSI literature until today. The term "direct" was used to explain that the act of self-injury occurs without any intervening steps (Nock, 2009). Due to the emphasis given to the non-suicidal intent of the act, Favazza's (1998) definition is closer to the conceptualization of the concept as it is used within the USA and Canada. In contrast in Europe, the definition is considered more encompassing by focusing on the presence of a purposeful intention to harm oneself without ending one's life, than on the intention itself, categorizing both NSSI and suicide attempts under the same umbrella (Muehlenkamp et al., 2012). Both definitions though agree that socially sanctioned behaviors of self-injury are excluded from the definition (such as tattooing). Common self-harm behaviors include self-cutting, self-hitting, self-scratching and self-burning.

Despite the general acceptance of the two definitions, findings from current research and suggestions from clinical guidelines suggest that some behaviors previously considered as suicidal, could be a form of NSSI (Hawton et al., 2012; NCCMH, 2012). For example, according to the National Collaboration Center for Mental Health (NCCMH, 2012) self-cutting, which is considered as one of the main acts of NSSI and self-poisoning, which is perceived a suicide-related behavior, need similar management. This indirectly suggests that self-cutting and self-poisoning might fall under the same umbrella, which is supported by a multicenter study of self-harm in England (Hawton et al., 2012). Hawton et al. (2012) found that self-cutting elicited greater risk of suicide and repetition of the behavior than self-poisoning, which was previously considered as a lethal act of self-harm and hence, a suicide attempt, which demonstrates that self-poisoning might not be as lethal as previously thought (Hawton et al., 2012). Furthermore, studies have argued that the function of NSSI is different to the function of suicide attempts (Favazza, 1998; Zetterqvist, Lundh, Dahlström, & Svedin, 2013). Therefore, one could argue that regardless of the behavior, the intention of it and its function have a more significant role in distinguishing it from suicide attempts.

Consequently, taking into consideration previous definitions, research and clinical guidelines, the definition adopted for this thesis is that NSSI is a non-socially sanctioned act, which leads to deliberate direct destruction of body tissue or an alteration of the biochemistry of one's body without conscious suicidal intent.

NSSI & Suicide attempts

Distinguishing NSSI from suicide attempts is one of the fundamental reasons for investigating NSSI in depth. Misdiagnosing the observed behavior could lead to inaccurate treatment planning, misallocation of emergency resources and unnecessary hospitalizations, which could become iatrogenic (Klonsky, May, & Glenn, 2013). NSSI has been intertwined with suicide attempts for many years and untangling their differences has been very difficult despite their primary differentiating feature, which is the lack of the intention to die in individuals engaging in NSSI (Muehlenkamp & Kerr, 2010). Although the two behaviors often co-occur, NSSI has been observed to be more prevalent, more frequent, less severe and with different functions (sometimes used even to avoid suicidal urges; Klonsky et al., 2013). Consequently, it is important to distinguish the two concepts, without ignoring their association and the potential effect of NSSI to future suicide attempts (Ribeiro et al., 2016).

Classification

One of the pioneering steps towards the distinction of the two concepts was the suggestion to include NSSI as a distinct disorder in future versions of the Diagnostic and Statistical Manual of Mental Disorders (DSM). Attempts to include NSSI in the DSM began since early 1980s by Kahan and Pattison (1984), who introduced the concept of "deliberate self-harm syndrome" and proposed its inclusion as a separate diagnostic category in the fourth version of the DSM. Kahan and Pattison (1984) described that tension preceded the act

of self-injury and afterwards there was a sense of release/relief. A few years later, Favazza and Rosenthal (1990; 1993) proposed that a "syndrome of self-mutilation" should be included within impulse disorders and began to form the definition that it is used until today. Muehlenkamp (2005) reviewed the evidence on the field and supported the proposal that "deliberate self-harm injury syndrome" should be included in the DSM as a separate clinical syndrome. However, Muehlenkamp (2005) also recognized that there was a limited number of high quality studies investigating the syndrome, the definition of the syndrome was still not consistent between studies and there was a difficulty in identifying the etiology of NSSI. With these limitations, its inclusion within the DSM required more research. In the fifth version of the DSM (DSM-5; American Psychiatric Association [APA], 2013), the American Psychiatric Association adopted the terminology of "Non-suicidal self-injury" (i.e. NSSI) and proposed certain diagnostic criteria (see Table 1), which were listed under the "Conditions for Further Study", encouraging in this way more research on the topic and particularly on the risk factors of NSSI.

Table 1.

Proposed Criteria for Non-suicidal Self-Injury.

Proposed Criteria
A. In the last year, the individual has, on 5 or more days, engaged in intentional self-inflicted damage to the surface of his or her body of a sort likely to induce bleeding, bruising, or pain (e.g. cutting, burning, stabbing, hitting, excessive rubbing), with the expectation that the injury will lead to only minor or moderate physical harm (i.e. there is no suicidal intent).   **Note:** The absence of suicidal intent has either been stated by the individual or can be inferred by the individual's repeated engagement in a behavior that the individual knows, or has learned, is not likely to result in death.
B. The individual engages in self-injurious behavior with one or more of the following expectations: 1. To obtain relief from a negative feeling or cognitive state.   2. To resolve an interpersonal difficulty.   3. To induce a positive feeling state.   **Note:** The desired relief or response is experienced during or shortly after the self-injury, and the individual may display patterns of behavior suggesting a dependence on repeatedly engaging in it.

C. The intentional self-injury is associated with at least one of the following:
    1. Interpersonal difficulties or negative feelings or thoughts, such as depression, anxiety, tension, anger, generalized distress, or self-criticism, occurring in the period immediately prior to the self-injurious act.
    2. Prior to engaging in the act, a period of preoccupation with the intended behavior that is difficult to control.
    3. Thinking about self-injury that occurs frequently, even when it is not acted upon.
D. The behavior is not socially sanctioned (e.g. body piercing, tattooing, part of a religious or cultural ritual) and is not restricted to picking a scab or nail biting.
E. The behavior or its consequences cause clinically significant distress or interference in interpersonal, academic, or other important areas of functioning.
F. The behavior does not occur exclusively during psychotic episodes, delirium, substance intoxication, or substance withdrawal. In individuals with a neurodevelopmental disorder, the behavior is not part of a pattern of repetitive stereotypies. The behavior is not better explained by another mental disorder or medical condition (e.g. psychotic disorder, autism spectrum disorder, intellectual disability, Lesch-Nyhan syndrome, stereotypic movement disorder with self-injury, trichotillomania [hair-pulling disorder], excoriation [skin-picking] disorder).

Source: DSM-5 (American Psychiatric Association, 2013).

History of NSSI

The history of NSSI has also attracted limited attention by researchers or experts on the topic. Favazza (1996) and Nock (2009) were two of the few who attempted to provide a cultural understanding of the origins of NSSI and they did that by linking NSSI to body modification rituals. Nock (2009) explained that both body modification rituals and NSSI have a function to correct or prevent pathological or destabilizing conditions, which might have a negative impact both on the community and/or on the individual. He provided several examples, such as the procedure of amputation to prevent the spread of gangrene and the Hamadsha rituals (Nock, 2009). During the Hamadsha rituals, her followers cut themselves, take their blood and use it on their body in order to heal themselves from any physical or mental condition. Therefore, Nock (2009) used these examples to explain that body modification rituals exist in our lives both within the medical and spiritual worlds, hence, they are not unfamiliar to people. Western adolescents sometimes cut themselves as a rite-of-passage into adult life (Nock, 2009). Consequently, NSSI is already mentally associated with

the ability to provide the opportunity to heal or make a new start and although no one knows the actual origins of NSSI, this seems to provide a plausible explanation of possibly an instinctively first contact with NSSI. According to Anderson et al. (2017), there are numerous studies supporting the link between on-screen violence and child/adolescent behavior and several theories, such as social learning theory, which suggest that children imitate the behaviors that they see on screen. Therefore, one could suggest that NSSI might have been disseminated by social media and the Internet throughout the years. This was supported by a review on the impact of social contagion to NSSI, which found that social media and peers have an important role in disseminating NSSI behavior (Jarvi, Jackson, Swenson, & Crawford, 2013).

Epidemiology of NSSI

Taking into consideration the lack of a universally agreed definition of NSSI and that many people, who engage in NSSI are in the community and hence, their behaviors do not come to the clinical attention, examining the prevalence rates of NSSI has been challenging throughout the years (Rodham & Hawton, 2009). Studies have shown that NSSI begins in adolescence, around the age of 11 to 15 years old (Tatnell, Kelada, Hasking, & Martin, 2014; Andover, Primack, Gibb, & Pepper, 2010). Early NSSI onset (i.e. before the age of 11 years old) was correlated with increased number of NSSI acts (Ammerman, Jacobucci, Kleiman, Uyeji, & McCloskey, 2018). Although historically there was an assumption that NSSI was more prevalent in women than men, numerous studies have found no gender differences, leading to inconclusive findings (Gratz, 2001; Klonsky, Oltmanns, & Turkheimer, 2003). Therefore, a recent meta-analysis was conducted in order to investigate whether there is an actual gender difference in the prevalence of NSSI (Bresin & Schoenleber, 2015). Bresin and Schoenleber (2015) supported that there is a gender difference and suggested that females

have increased odds of engaging in NSSI. However, the difference in effect sizes was considered small for epidemiological studies (Chen, Cohen, & Chen, 2010). Additionally, the gender difference was found to be larger in clinical populations compared to community or student populations, indicating that males might be underrepresented because they are less likely to seek treatment compared to women (Bresin & Schoenleber, 2015). It could also be that males are more likely to be involved in socially acceptable self-harm behaviors, such as violent sports or fighting, which might serve the same function as NSSI. Woodman, Hardy, Barlow, and Le Scanff (2010) found that engagement in high-risk sports was a form of emotion regulation for some individuals, which is one of the main functions of NSSI.

With regards to age differences in prevalence rates, a systematic review by Cipriano, Cella and Cotrufo (2017) demonstrated that adolescents have the highest prevalence rates ranging from 7.5% to 46.5% compared to university students (38.9%) and adults (4-23%). These prevalence rates are expected since NSSI begins in adolescence and many people grow out of it when they reach adulthood (Plener, Schumacher, Munz, & Groschwitz, 2015). Racial group differences were also reported, although they are limited to USA populations (Polanco-Roman, Tsypes, Soffer, & Miranda, 2014; Wester & Trepal, 2015). For example, Wester and Trepal (2015) found that African American (8.4%) and Asian American (7%) are less likely to engage in NSSI compared to Hispanic (17.8%), Caucasian (16.3%), Multiracial (16.1%) and Native American (28.6%) (Wester & Trepal, 2015). Nevertheless, these outcomes should be treated with caution since they might not reflect ethnic differences existing outside the USA. Lastly, a significant difference in prevalence rates was observed between clinical populations (21%) and individuals living in the community (4%; Briere & Gil, 1998). However, the findings of this study are outdated and there is a lack of recent

comparisons within the literature. It is expected though that the same difference exists, but the prevalence rates are now much higher.

Impact of NSSI

Given the high prevalence rates of NSSI both in a clinical and in a community setting, it is particularly important to consider its impact. One of the most commonly reported consequences of engaging in NSSI is the increased risk for future suicide attempts or completed suicides (Hamza, Stewart, & Willoughby, 2012). However, there is also a negative cascade of events, which is rarely reported in the literature (Waals et al., 2018). According to Taylor, McDonald, Smith, Nicholson and Forrester (2019), individuals engaging in NSSI experience elevated levels of shame compared to individuals who never engaged in NSSI. Shame-proneness has been found to increase the likelihood of engaging in NSSI behaviors via internalizing shame-coping (i.e. "attack self and withdraw"; Mahtani, Hasking, & Melvin, 2019). Consequently, individuals engaging in NSSI enter a vicious circle, with elevated levels of shame leading to an increase likelihood of NSSI behaviors and vice-versa. As a result, there is an increasing level of concern from the family, which might attempt to control the self-injurer's behavior, leading to feelings of intrusion and reduced independence, impacting both the individual and his/her family environment (Waals et al., 2018). Additionally, shame could lead to withdrawal and hence, to feelings of isolation and distress, increasing the likelihood of developing other mental health difficulties, such as depression (de Jong Gierveld, van Tilburg, & Dykstra, 2006; Matthews et al., 2016). Furthermore, disclosure of NSSI has been related to a reduction in perceived social support by the individual engaging in NSSI behaviors, further enhancing the feeling of isolation (Hasking, Rees, Martin, & Quigley, 2015). However, despite the negative impact of NSSI, individuals

engaging in those behaviors tend to report positive consequences resulting from self-injury, such as experiencing relief and calmness (Chapman & Dixon-Gordon, 2007).

Functions of NSSI

These positive consequences of NSSI have been related to its different functions. According to the four-functions model of NSSI developed by Nock and Prinstein (2004), individuals engage in NSSI for automatic-negative reinforcement, for automatic-positive reinforcement, for social-negative reinforcement and for social-positive reinforcement, with the automatic-negative reinforcement function being the most frequently endorsed. The automatic-negative reinforcement function refers to the use of NSSI for reducing tension or negative affective states (e.g. "to stop bad feelings") and the automatic-positive reinforcement function refers to the use of NSSI for achieving a desirable physiological state (e.g. to feel something when you are feeling numb; Nock & Prinstein, 2004, p.886). Additionally, the social reinforcement functions refer to the use of NSSI to avoid unwanted interpersonal tasks (e.g. avoid punishment; social-negative reinforcement) or to gain attention from others or gain access to materials (e.g. to inform others about negative psychological state; social-positive reinforcement; Nock & Prinstein, 2004). This four-function model was supported by a review of the evidence and a meta-analysis, which supported the previously described functions and the fact that the intrapersonal (i.e. automatic) functions are the most common ones (Klonsky, 2007; Taylor et al., 2018). However, Klonsky (2007) named the function categories differently, giving emphasis to the actual purpose (i.e. 1) affect regulation, 2) anti-dissociation, 3) anti-suicide, 4) interpersonal boundaries, 5) interpersonal-influence, 6) self-punishment, and 7) sensation-seeking). Since self-punishment, sensation seeking, dissociation and desire to end one's life, are all related to personal emotional states, it is suggested that individuals engaging in NSSI have a difficulty with coping with their

17

emotions. Additionally, having the need to engage in NSSI in order to influence others and to set boundaries, indicates a difficulty with interpersonal relationships. These two aforementioned difficulties propose that individuals engaging in NSSI might have a predisposition, limiting them to cope with emotions and to interact with others in a more adaptive way. This predisposition can be explained be the risk factors of NSSI.

Risk Factors of NSSI

Theoretical Models

Despite the biological risk factors related to NSSI, which are beyond the scope of this study, interpersonal and developmental models have been proposed in an attempt to explain the underlying processes leading to NSSI (Jacobson & Batejan, 2014). Both interpersonal models and developmental models suggest that childhood maltreatment and early relationship disturbances have a significant role in NSSI engagement (Bunclark & Crowe, 2000; Gratz, 2003). According to attachment theorists, maladaptive interpersonal experiences in early childhood can lead to a reduced capacity to form supportive relationships and to develop mature regulation skills (Yates, 2004). Therefore, early maladaptive experiences might be indirectly related to NSSI behaviors via attachment and emotion dysregulation. Similarly, developmental theorists focus on the role of childhood maltreatment and insecure attachment (Farber, 2002). More specifically, three developmental pathways have been proposed: 1) the representational path, 2) the regulatory path and 3) the reactive path (Nock, 2009).

According to the representational path, childhood maltreatment exacerbates or develops a negative representation of the self, and others or of the self in relation to others, which then contributes to NSSI behaviors because the individual turns towards the body for self-punishment or self-soothing (Nock, 2009). Additionally, the regulatory path proposes that

maltreated children are more likely to form a disorganized attachment, which reduces the

capacity of a child to progress normatively towards symbolic play and language and hence,

all experiences are symbolized on a somatosensory level (i.e. through sensation, behavior and

somatization), leading to NSSI behaviors (Nock, 2009). Furthermore, according to the

reactive path, traumatic childhood experiences may induce alterations in biological systems,

which are related to flight-fight reactions and the stress system, which in turn contribute to

NSSI engagement based on biological theories (Nock, 2009). Consequently, taking into

consideration all the aforementioned models, it is suggested that theoretically the proposed

pathway leading to NSSI begins from childhood maltreatment, which influences the

representation of self, the attachment of the individual and his/her biological process, which

in turn influence his/her emotion regulation, leading to NSSI (see Figure 1). Self-

representation is also influenced by the attachment style (Mikulincer, 1995). Therefore, if

biological alterations are excluded from this model because they are beyond the scope of this

thesis, one could argue that the main pathway leading to NSSI is from childhood

maltreatment to NSSI via insecure attachment and emotion dysregulation.
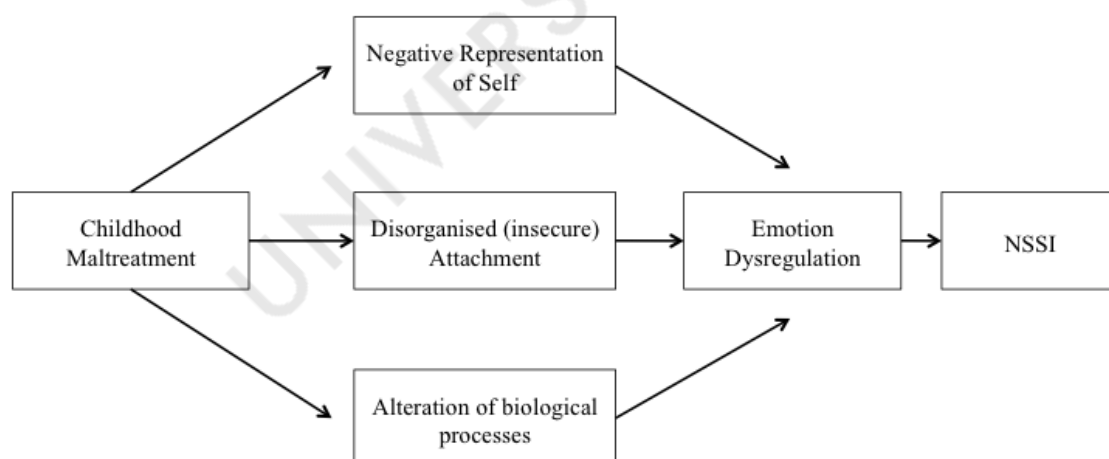
Figure 1. Representation of the three developmental pathways.

Empirical findings & Gaps in Literature

To our knowledge, there is not a single study investigating empirically the proposed pathway, although there is a study investigating the cumulative contribution of childhood maltreatment, attachment and emotion dysregulation on NSSI (Tatnell, Hasking, Newman, Taffe, & Martin, 2017). Findings from this study suggested that the cumulative effect of the aforementioned factors was a significant predictor of NSSI, proposing that the risk of engaging in NSSI is multifactorial. Numerous studies also supported the individual contribution of childhood maltreatment, attachment and emotion dysregulation on NSSI, further supporting the notion that there are several risk factors (Gunter, Chibnall, Antoniak, Philibert, & Hollenbeck, 2011; Martin et al., 2017; Midkiff, Lindsey, & Meadows, 2018). Although the majority of studies have investigated the effect of childhood maltreatment, attachment and emotion dysregulation separately, some studies attempted to explore the interaction of these factors. For example, Kimball and Diddams (2007) investigated the mediational role of emotion dysregulation on the relationship between attachment and NSSI and Titelius et al. (2018) investigated the meditational role of emotion dysregulation on the relationship between child maltreatment and NSSI, demonstrating significant mediational pathways. Nevertheless, there is still a gap in literature on the serial mediational effect of attachment and emotion dysregulation on the relationship between childhood maltreatment and NSSI.

Although, there are several reviews on the individual effects of childhood experiences, attachment and emotion regulation on NSSI (Liu, Scopelliti, Pittman, & Zamora, 2018; Buckmaster, McNulty, & Guerin, 2019; Wolff et al., 2019), only two reviews focused on synthesizing the data from all the risk factors together (Gratz, 2003; Fliege, Lee, Grimm, &

Klapp, 2009). Those two reviews supported the notion that childhood experiences, attachment and emotion dysregulation are three of the most prominent risk factors of NSSI and briefly explored their interaction. However, they lacked recent evidence on the topic and meta-analytic data, indicating a need for more up-to-date reviews and meta-analyses.

Additionally, examining the articles investigating the impact of childhood maltreatment on NSSI, it was observed that the majority of studies reported in the reviews were focusing only on basic forms of childhood maltreatment (e.g. sexual abuse, physical abuse and emotional abuse; Bornovalova, Tull, Gratz, Levy, & Lejuez, 2011; Franzke, Wabnitz, & Catani, 2015). Although sexual abuse, physical abuse and emotional abuse are core areas within the childhood maltreatment literature, there are several other experiences, which could also be considered as childhood adversities, such as bullying (Anda, Butchart, Felitti, & Brown, 2010). According to Chartier, Walker and Naimark (2010), the cumulative effect of childhood adversities can be particularly detrimental. Therefore, examining a variety of adversities is important in order to observe the real scale of its impact. This cannot be achieved by commonly used childhood maltreatment measures, such as the Childhood Trauma Questionnaire (CTQ; Bernstein et al., 1994), which focuses only on sexual abuse, physical abuse and emotional abuse. There is a need of a more inclusive measure, such as the Adverse Childhood Experiences International Questionnaire (ACE-IQ; World Health Organization [WHO], 2018), which explores numerous additional adversities, such as dysfunctional family environment, parental loss and violence within a peer, community or collective setting.

Thesis Objectives

Consequently, the current study aims to firstly, systematically review the evidence on the effects of childhood maltreatment, attachment, emotion dysregulation and their interaction on NSSI, while providing meta-analytic data on their effects. Secondly, the study aims to investigate the proposed serial mediational effect of attachment and emotion dysregulation on the relationship between early life experiences and NSSI using the ACE-IQ to examine the adverse childhood experiences. Thirdly, due to the absence of formal validation of ACE-IQ with individuals engaging in NSSI, the study aims to investigate the psychometric properties of the ACE-IQ measure within this population.

Research Questions

Therefore, this thesis is divided into three papers, with each paper addressing different research questions. In paper 1, a systematic review and meta-analysis will address the questions: i) "Do early life experiences predict self-harm?", ii) "Does the type of attachment of an individual predict self-harm?" and iii) "Does the ability of oneself to regulate emotions predict self-harm?". Paper 2 will explore the proposed pathway leading to NSSI by investigating the following research questions: i) "Does attachment mediate the relationship between early life experiences and emotion dysregulation?", ii) "Does emotion dysregulation mediate the relationship between attachment and NSSI?" and iii) "Do attachment and emotion dysregulation serially mediate the relationship between early life experiences and NSSI?". Lastly, Paper 3 will investigate the psychometric properties of the ACE-IQ by addressing the questions: i) "Is ACE-IQ a reliable questionnaire?" and ii) "Is ACE-IQ a valid questionnaire?".

THE ROLE OF EARLY LIFE EXPERIENCES, ATTACHMENT AND EMOTION REGULATION IN PREDICTING SELF-HARM IN ADULTS: A SYSTEMATIC REVIEW AND META-ANALYSIS.

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Highlights

- Childhood maltreatment showed a significant effect in predicting NSSI behavior.

- Emotion dysregulation seems to have a moderational or mediational role in NSSI.

- Not enough literature on attachment and NSSI to support a significant effect.

- A model combining all three risk factors might be better in predicting NSSI.

Abstract

Background: Despite the growing body of evidence that engagement in non-suicidal self-injury (NSSI) is multifactorial, systematic reviews on the risk factors of NSSI have given emphasis on individual factors. Additionally, meta-analyses were only conducted for two of the most prominent risk factors (childhood maltreatment and emotion dysregulation). Therefore, the present systematic review and meta-analysis was conducted to address these gaps in literature. **Methods:** Key databases (such as Embase, PubMed Central, and Scopus) were searched up to October 2019 and a total of 11996 articles were screened for eligibility based on specific criteria. Seventy-nine articles were deemed eligible for inclusion in the review and analyses were conducted using both a narrative synthesis and a meta-analytical approach. **Results:** Findings from both the narrative synthesis and meta-analysis suggest that childhood maltreatment (d=0.271, p< 0.001) and emotion dysregulation (d=0.198, p<0.001) have a significant effect on NSSI. However, literature on the effects of attachment on NSSI remains inconclusive. Preoccupied insecure attachment seems to have a role in the development of NSSI, however, this is not supported by the meta-analysis (d=0.015, p=0.392). **Conclusion:** It is suggested that a potential serial mediation model involving of combination of these factors might be more fruitful for predicting NSSI.

Keywords: childhood maltreatment, emotion dysregulation, attachment, self-harm

Introduction

Non-suicidal self-injury (NSSI), or otherwise known as "deliberate self-harm" (DSH), has been a growing clinical and public health concern (Ammmerman et al., 2019; Lengel & Mullins-Sweatt, 2013) due to its increasing prevalence and serious consequences. Particularly, NSSI has been described as one of the most prominent risk factors for completed suicide (Nagra, Lin & Upthegrove, 2016). Its high comorbidity with several mental illnesses, such as Borderline Personality disorder (Turner et al., 2015), Post-traumatic Stress Disorder (Ford & Gómez, 2015), Depression (Nitkowski & Petermann, 2011) and Eating Disorders (Claes & Muehlenkamp, 2013) can interfere with treatment procedures and it can lead to feelings of guilt, shame, disappointment and disapproval, which raise difficulties both on a personal and on an interpersonal level (O'Keefe, 2000). However, NSSI is also present in non-clinical populations, especially in adolescents and among university students usually as an emotion regulation strategy (Jacobson & Gould, 2007; Taylor et al., 2018). According to a systematic review by Cipriano, Cella and Cotrufo (2017), the prevalence rates range between 7.5 - 46.5% in adolescents, around 38.9% in university students and 4 - 23% among adults.

Although there is no formal conceptualization of the definition of NSSI, it has been mainly defined as a "direct destruction or alteration of body tissue without conscious suicidal intent" (Favazza, 1998). Some definitions are limited to forms of NSSI such as self-cutting, self-burning and self-hitting, which are in accordance to the definition by Favazza and other definitions are more inclusive, sometimes including suicide attempts within. Findings from the "Multicentre Study of Self-harm in England" (Hawton et al., 2012) suggest that other forms of self-harming behavior could be added to the definition, such as self-poisoning (excluding self-poisoning for recreational use), due to the fact that they are not as lethal as previously thought and they need similar management according to the National

Collaboration Centre for Mental Health (NCCMH, 2012). Consequently, the definition of NSSI used for this study is: "a direct destruction or alteration of the body tissue" (Favazza, 1998) or an alteration of the biochemistry of one's body, without conscious suicidal intent and with no social or cultural approval.

Due to the absence of clear understanding of the concept, there are also discrepancies on the risk factors leading to NSSI. Studies demonstrate a correlation between NSSI and many risk factors, with three of the most prominent ones being childhood adversity, insecure attachment and emotion dysregulation (Fox et al., 2015). Childhood adversity refers to "experiences that are likely to require significant adaptation by an average child (under the age of 16 years old) and that represent a deviation from the expectable environment" (McLauglin, 2016), such as physical, sexual and emotional abuse and physical and emotional neglect. Attachment refers to the type of relationship an individual forms with primitive attachment figures (usually the mother), which is described as insecure, when the relationship is characterized by anxiety, fear or mixed emotions due to failure of the attachment figure to meet the needs of the child (Bowlby, 1988). Lastly, emotion regulation has been correlated to NSSI both as a function and as a risk factor. For the purposes of this paper, emotion dysregulation will only be considered as a risk factor for developing NSSI. Emotion dysregulation as a risk factor is defined as having difficulties in the ability to experience genuine emotions and to express these emotions in a way that allows modulation of both positive and negative emotions (Bridges, Denham, & Ganiban, 2004).

From both theoretical and empirical models, childhood adversity is considered to be one of the most important contributors to the development of insecure attachment (Bowlby, 1969/1982; Lamb et al., 1985; Baer & Martinez, 2006). Childhood adversity in all of its forms can begin from home. Children who are emotionally or physically abused or neglected by their attachment figure are more likely to develop an insecure attachment based on the

Minnesota study (Egeland & Sroufe, 1981). Additionally, models suggest that insecure attachment could minimize the ability of a child to learn how to properly regulate his/her emotions (Brumariu, 2015). Therefore, taking these interrelations into consideration, it can be argued that the pathways leading to NSSI behavior are much more complex than they are currently presented in the literature, since all the risk factors are related to each other. This argument is supported by a study conducted by Fox et al. (2019), which investigated the impact of statistical complexity on the predictive accuracy for NSSI. Findings from the study demonstrated that machine learning algorithms models outperformed univariate logistic regression models and the multiple logistic regression model, suggesting that model complexity was positively correlated with predictive accuracy.

This comes into contrast to recent systematic reviews on the topic, which are focusing only on one NSSI risk factor (Wrath & Adams, 2019; Liu, Scopelliti, Pittman, & Zamora, 2018; Wolff et al., 2019). For example, Wrath and Adams (2019) investigated the relationship between self-injurious behaviours and adult attachment and Wolff et al. (2019) investigated the relationship between emotion dysregulation and NSSI. To our knowledge, there are only two systematic reviews (Gratz, 2003; Fliege et al., 2009), which tried to synthesize data from several risk factors. However, both reviews have been produced at the early stages of NSSI research and they lack recent articles on the topic. Furthermore, both reviews were qualitative in nature, indicating a meta-analytic gap in the literature.

This study addresses these gaps in literature by systematically reviewing and conducting a meta-analysis on articles exploring the relationship between NSSI and three of the most prominent risk factors (childhood adversity, insecure attachment and emotion dysregulation). The objective of the study was to systematically identify related articles, to synthesize their outcomes both qualitatively and quantitatively and to critically appraise the overall findings. The principal questions were: i) Do early life experiences predict self-harm?

ii) Does the type of attachment of an individual predict self-harm? and iii) Does the ability of oneself to regulate emotions predict self-harm? Given that particular emphasis is given on adolescent studies in previous reviews, the current review focuses on synthesizing data just from adult studies in order to explore any potential differences between the two populations.

Method

Protocol Registration & Guidance

The systematic review and meta-analysis was registered in advance on the International Prospective Register of Systematic Reviews (PROSPERO). The registration number of the study is CRD42019139428 (PROSPERO 2019). The full protocol can be found on: https://www.crd.york.ac.uk/prospero/display_record.php?ID=CRD42019139428. The procedure followed was based on the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) guidelines (Moher, Liberati, Tetzlaff, & Altman, 2009).

Eligibility Criteria

Eligibility criteria were determined before the initial searches of the literature. Studies were considered eligible for inclusion in this systematic review, if : 1) the study was either an observational study (cross-sectional or longitudinal), a randomized controlled trial or a non-randomized controlled trial, 2) the study included a measure of NSSI, as it is defined for the purposes of this paper, 3) the study included a measure of at least one of the risk factors being investigated (early life experiences, attachment and emotion regulation), 4) the study investigated the relationship between one of the predictor variables (early life experiences, attachment and emotion regulation) and NSSI, 5) the study was written in English, 6) it was published in a peer-reviewed journal or at least accepted for publication, and lastly, 7)

participants included in the study were all 17 years old or above. Studies were excluded if they: 1) were case studies, 2) were written in any language other than English, 3) were not fitting the aforementioned inclusion criteria and were not specific to NSSI, and 4) had no separate analysis for self-harm without suicidal intent.

Although the study was focusing on NSSI, there were no restrictions on the underlying mental health difficulties of the participants. As it was suggested by Nock (2009), the functions and risk factors of NSSI are similar to all individuals, regardless of mental health difficulties. Additionally, there were no restrictions on possible mediators to the relationship between predictors and NSSI. Despite the focus of the systematic review on the risk factors leading to NSSI, intervention studies were also included if the relationship between one of the predictors and NSSI was investigated separately. In those cases, emphasis was given only on the relationship and not on the intervention or exposure being explored. Comparator or control groups were not considered central for conducting this review.

Search Strategy

Key databases (Embase, PsycARTICLES, PsycINFO, PubMed Central, Global Health and Scopus) were searched comprehensively by the first author. A combination of search terms related to childhood maltreatment, insecure attachment, emotion dysregulation and NSSI was used (see Appendix A). No restrictions were set on the language, as articles not written in the English language were excluded after retrieval of outcomes. The final search was run on the 28th October 2019. Following the electronic search, hand-in searches were performed in order to identify further eligible articles from the reference list of already eligible articles and previous systematic reviews.

Study Selection

The electronic search yielded a total of 11,996 articles, which were screened based on the aforementioned eligibility criteria by the first author. When the author was unsure if the study met the criteria due to limited information from the title or the abstract, the articles were retained for further screening at the next stage. Additionally, hand-in searches were conducted by looking at the reference lists of the 72 eligible articles and the references of nine relevant systematic reviews (Gratz, 2003; Klosky & Moyer, 2008; Fliege et al., 2009; Lang & Sharma-Patel, 2011; Serafini et al., 2017; Liu et al., 2018; Buckmaster et al., 2019; Wrath & Adams, 2019; Wolff et al., 2019). The study selection process is presented in Figure 1. More than half of the articles (56.25% - 45 articles) were assessed for eligibility by a second reviewer. The two reviewers disagreed on only two articles, indicating a 96% reliability of the study selection process. Disagreements were discussed between the two reviewers and decisions were made for final inclusions.
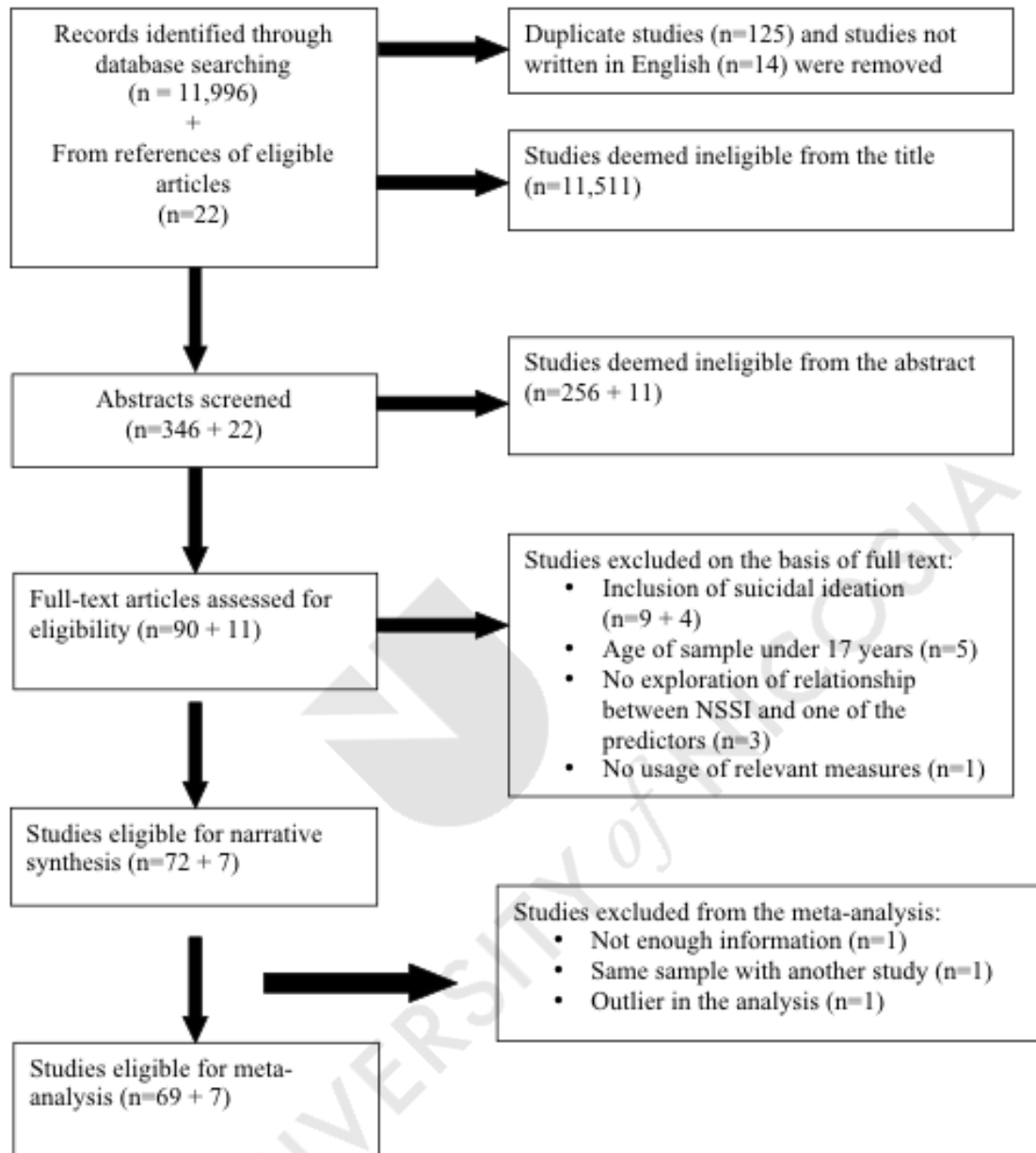
Figure 1. Flow diagram of study selection process with reasons for exclusion of studies.

Data Extraction

The data extracted from all eligible studies was separated into five different categories: 1) General study information (title, type of research, country conducted, authors, year of publication & conflicts of interest), 2) Eligibility (list of all eligibility criteria), 3) Participants (number, average age, % of females, diagnosis, recruitment, type of self-harm), 4) Results (description of primary outcome measures & outcomes), and 5) Conclusions (summary of key conclusions, strengths & limitations). Only data related to the research questions of this systematic review was extracted from the articles. A summary of extracted information can be found in Appendix B.

Risk of Bias (Quality) Assessment

After data extraction, a risk of bias (quality) assessment was carried out. Due to the absence of a formal and universal tool for all types of research, two assessment tools were used to assess the studies based on the quality criteria meeting their type of research. As recommended by Zeng et al. (2015), an adapted version of the Newcastle-Ottawa Quality Assessment Scale (Modesti et al., 2016) was used for assessing the observational studies and RCTs were assessed using the revised version of the Cochrane risk-of-bias tool for randomized trials (Sterne et al., 2019). The Newcastle-Ottawa Quality Assessment scale is composed of three categories (Selection, Comparability, Outcome; see Appendix D) and assessment results are presented in the form of stars. While Cochrane's assessment tool is divided into five domains [Risk of bias: 1) arising from the randomization process, 2) due to deviations from the intended interventions (effect of assignment to intervention), 3) due to missing data, 4) in measurement tools, 5) in selection of the reported result; see Appendix E] and assessment outcomes are presented in the form of judgment as "low risk", "some

concerns" and "high risk". Each domain has a risk-of-bias judgment, which contributes towards a general risk-of-bias assessment at the end of the tool.

All eligible studies were assessed for their quality by the first author as it is presented in Appendix D and Appendix E. Sixteen articles were also assessed by other two reviewers. The agreement between the reviewers was 87.5%. Disagreements were discussed and a common understanding and decision was reached. Despite of the quality assessment of the studies, all studies were included in the review and findings from low quality studies were treated with caution.

Strategy for Data Synthesis

Narrative Synthesis. All eligible studies were analyzed using narrative synthesis based on the Popay et al.'s (2006) "Guidance on the Conduct of Narrative Synthesis in Systematic Reviews". Although this guide is primarily focused on narrative synthesis techniques for synthesizing data for effectiveness and implementation studies, Snilstveit, Oliver, and Vojtkova (2012) argued that it can be useful for other type of studies too. The basic elements of synthesis suggested by Popay et al. (2006) are: 1) to develop a theory related to the association being investigated, 2) to develop a preliminary synthesis of findings of included studies, 3) to explore further relationships in the data and to 4) assess the robustness of the synthesis.

Meta-analysis.

Transforming / Computing effect sizes. Due to the expected diverse reporting of effect sizes in the literature, a common "language" was needed before synthesizing the data in a quantitative way. Cohen's d is considered to be the most suitable estimate for summarizing dichotomous and continuous data (Botella & Gambara, 2006) and hence, all estimates were computed into Cohen's d, along with its standard error (see Appendix C). In the absence of

any available statistical information, the studies were excluded from the review (N=1). The magnitude of effect size was predetermined by Cohen's (1988) guidelines (small effect = 0.2, moderate effect = 0.5, large effect = 0.8).

Statistical analysis. Meta-analytic statistical procedures were conducted with the use of the Comprehensive Meta-Analysis software (CMA; version 3.0; Borenstein, Hedges, Higgins, & Rothstein, 2013). A random-effects model was selected since the eligible studies did not have an identical true effect size (Borenstein, Hedges, Higgins, & Rothstein, 2009). Cohen's d values and standard errors were entered into the program separately for each study predictor (childhood maltreatment, attachment and emotion regulation). Studies investigating the relationship of more than one predictor with NSSI were considered as separate studies. Only data related to the association explored by the specific meta-analysis was reported. As an outcome, three different pooled effect sizes were calculated, one for each predictor. The heterogeneity of studies was determined by I^2, which is considered as the most appropriate statistic to evaluate the heterogeneity of studies with different effect size indexes (Huedo-Medina, Sanchez-Meca, Martin-Martinez, & Botella, 2006). Interpretations of heterogeneity were made based on the percentage reported, with 0% indicating no heterogeneity, 25% showing low heterogeneity and with 50% and 75% marking a moderate and high heterogeneity respectively. Lastly, publication bias was calculated by Egger's regression intercept (Egger, Smith, Schneider, & Minder, 1997).

Results

Characteristics of Reviewed Studies

The majority of the studies were published after 2010 (N=59) and especially within the last five years (i.e. after 2014; N=36). Studies were conducted in 16 different countries, but

the majority of them were in the USA (N=40). The association between insecure attachment and NSSI was mainly investigated in Canada and Australia. Literature on insecure attachment and NSSI presents itself as being at a very early stage when compared to the other two sub-categories (childhood adversity and emotion dysregulation).

Study focus. From the 79 articles included in this review, 44 studies were focused on the relationship between adverse childhood experiences and NSSI, nine studies only on the relationship between insecure attachment and NSSI and 21 studies were investigating only the association between emotion dysregulation and NSSI. Five studies (Gratz & Chapman, 2007; Gratz & Roemer, 2008; Bedi et al., 2014; Yurkowski et al., 2015; Tatnell et al., 2018) investigated more than one variable of interest in association with NSSI, hence, they were included in more than one section. Only data referring to the corresponding section was reported under each sub-category.

Study design. Among the 79 studies included in the review, 76 studies were observational and three studies implemented a randomized-controlled study design (RCT; see Appendix B). All three RCT studies explored the relationship of NSSI with emotion dysregulation. Observational studies were aiming to associate NSSI with the different concepts at a specific point in time, indicating an emphasis on a cross-sectional study design, with only six studies adopting a longitudinal approach. The most common form of assessment was the use of self-reports.

Sample characteristics. The sample used in the RCT studies was mainly females, which is very similar to the sample used in observational studies. More specifically, there was only one male participant in one of the three RCTs (Bentley et al., 2017). The average age of the participants included in the RCT studies was 29 years old. In observational studies, the average age was 26 years old, which indicates a slightly younger population. For the majority of studies, the presence of diagnosis was not assessed or not reported (N=44). When

the presence of diagnosis was accessed, most of the studies reported a diagnosis of Borderline Personality Disorder (BPD), several Mood Disorders (e.g. Depression) and stimulant-dependence.

Quality assessment. The quality of the studies varied between the sub-categories. Studies investigating the association between NSSI and adverse life events appeared to be of higher quality than studies investigating the relationship between NSSI and emotion dysregulation or insecure attachment. Their main differences were in the sample used and in the reporting of statistical analyses (see Appendix D & Appendix E). Studies investigating the relationship between childhood maltreatment and NSSI were more likely to have samples, which were justified and satisfactory. Additionally, the reporting of their findings was more clearly described, and all the measurements were more likely to be presented. Overall, the majority of studies in all sub-categories were relying on self-report data, which introduces a lot of biases in findings (Stone et al., 1999; Van de Mortel, 2008). However, the majority of studies were using validated measures and they were controlling for possible confounding variables, optimizing in this way the validity of their results.

Exclusion of studies. Two studies (Zweig-Frank et al., 1994b; Gratz, 2006) were included in the narrative synthesis, but excluded from the meta-analysis. The reasons for exclusion were that: 1) the Zweig-Frank et al. (1994b) study did not include enough information to be included in the meta-analysis and there was no contact person to retrieve the missing data and 2) Gratz (2006) used the same population as the Gratz and Roemer (2008) study, which was already included in the meta-analysis.

Narrative Synthesis

Adverse childhood experiences & NSSI. The relationship between adverse childhood experiences and NSSI was investigated only through observational studies.

Observational studies. The first studies investigating this relationship provided contradictory results, even with similar samples (participants with borderline personality disorder). Van der Kolk, Perry and Herman (1991) supported that traumatic experiences in childhood, such as sexual and physical abuse were significant predictors of NSSI behavior, while Zweig-Frank, Paris and Guzder (1994a+b) demonstrated a non-significant relationship between adverse childhood experiences and NSSI. However, individuals within the NSSI group in the Zweig-Frank et al. (1994a) study had more experiences of childhood sexual abuse than the comparison group (non-NSSI group). Therefore, it can be argued that maybe the lack of power, due to the small sample, did not allow a significant finding to occur. The authors suggested that a non-significant finding could be an indicator of a mediational effect between early life experiences and NSSI. The significant relationship between childhood maltreatment and NSSI was further supported by future studies (Sansone, Sansone, & Wiederman, 1995; Zlotnick et al., 1996), however, no particular emphasis was given to possible mediators or moderators to the relationship. Two studies (Rodriguez-Srednicki, 2002; Gratz, Conrad, & Roemer, 2002) demonstrated that adverse childhood experiences were not a unique predictor to NSSI, further suggesting an indirect effect between them. This suggestion was supported by Paivio and McCulloch (2004) and Gladstone et al. (2004), who both found a significant mediational relationship between childhood adversity and NSSI via alexithymia and personality dysfunction respectively. Gladstone et al. (2004) also argued that childhood sexual abuse can be a mediator to the relationship between childhood physical abuse and NSSI. However, a significant direct relationship between childhood sexual abuse and NSSI was also reported.

Although the majority of studies conducted were based on samples with personality disorders, this relationship was supported with other populations too. For example, Evren and Evren (2005) and Evren, Kural, and Cakmak (2006) investigated the relationship between

childhood physical abuse and NSSI in a sample of 136 and 112 stimulant-dependent

individuals respectively. The findings confirmed that there was indeed a predictive

relationship between childhood abuse and NSSI. Roe-Sepowitz (2007) and Gratz and

Chapman (2007) further confirmed this relationship with incarcerated women and

undergraduate psychology students respectively. With the progress of research on the topic,

researchers attempted to investigate also the effect of gender on the predictive relationship

between adverse experiences and NSSI. Although no gender differences were observed

between males and females regarding, prevalence of NSSI, the age of onset, method of NSSI,

reasons, triggers, blockers, duration or outcomes, a gender difference was observed in the

predictive variables, suggesting that the effect of gender should be controlled in future studies

(Oyefeso, Brown, Chiang, & Clancy, 2008; Yates, Carlson, & Egeland, 2008; O'Neill et al.,

2018). Controlling for gender effects in the relationship is also crucial due to cultural

differences. Idig-Camuroglu and Golge (2018) demonstrated that gender differences existed

in a sample of 285 university students from Turkey, even with regards to NSSI engagement.

 Subgroup analyses were also explored. Yates et al. (2008) found that child sexual abuse

and physical neglect had a predictive effect on recurrent NSSI, while child physical abuse

was more predictive of intermittent use of NSSI, which suggests that the NSSI phenomenon

is multidimensional. Muehlenkamp, Kerr, Bradley, and Larsen (2010) investigated the

difference between recurrent and intermittent users and demonstrated that there were no

significant differences with regards to the different childhood abuse categories, except for

physical abuse, partly supporting Yates et al.'s (2008) outcomes. This specific relationship

between physical abuse and episodic NSSI could demonstrate a need for a form of

reenactment of previous trauma (Wachter et al., 2009).

All studies from 2011 replicated the significant relationship between adverse childhood experiences (particularly sexual abuse) and NSSI (Bornovalova, Tull, Gratz, Levy, & Lejuez, 2011; Martin, Bureau, Cloutier, & Lafontaine, 2011; Nada-Raja & Skegg, 2011; Zanarini, Laudate, Frankenburg, Reich, & Fitzmaurice, 2011). However, Evren, Dalbudak, Evren, Cetin and Durkaya (2011) found that early life trauma despite its relationship with NSSI, was not a significant predictor to it, further supporting the argument that adverse life experiences and NSSI are related through a mediational process, possibly through processes associated to negative affect (Evren et al., 2011). The impact of negative affectivity was also reported in the study conducted by Gunter, Chibnall, Antoniak, Philibert and Hollenbeck (2011), which demonstrated a greater contribution of post-traumatic stress disorder in the prediction of NSSI than the traumatic experience itself.

Closely related variables were further explored in order to identify the mediators to the association between adverse childhood experiences and NSSI. Dissociation, alexithymia, self-blame and urgency significantly and independently reduced the direct effect of childhood adversity on NSSI (Arens, Gaher, & Simons, 2012; Swannell et al., 2012; Franzke, Wabnitz, & Catani, 2015; Talmon & Ginzburg, 2018). However, although Arens et al. (2012) found no gender differences in the mediational relationship, Swannell et al. (2012) reported that alexithymia was not a significant mediator to the relationship between child maltreatment and NSSI in males. Meta-analytic research on alexithymia and gender has shown that males are more likely to exhibit alexithymic behavior than females because of the traditional masculinity ideology, which encourages men to talk less about their emotions than females (Levant, Hall, Williams, & Hasan, 2009). Therefore, alexithymia might be a more normative behavior for men compared to women. Alexithymic symptoms in women might indicate an underlying pathology, possibly originating from trauma, indicating a gender difference in the predictors and not in the NSSI, which further supports Yates et al.'s (2008) conclusions

described previously. Arens, Gaher, Simons, and Dvorak (2014) also explored the mediational effect of distress tolerance, sense of control and desire for control. Although none of the variables was a significant mediator when the full sample was included in the analysis, sense of control reached significance with those reporting self-harm.

Another explanation of the minor inconsistencies presented in the literature regarding the relationship between childhood maltreatment and NSSI, was offered by Martin et al. (2016). Martin et al. (2016) proposed that these inconsistencies might be due to relational trauma, i.e. not only due to the experience itself, but also because of the characteristics developed as an outcome of this experience (e.g. elevated stress exposure). Findings demonstrated that both adverse life events and perceived relational trauma were significant unique predictors of NSSI. However, no other studies included in this review attempted to replicate this finding and hence, further research is required to investigate whether relational trauma is indeed a unique predictor of NSSI and not a mediator to the relationship between adverse life events and NSSI.

In addition to relational trauma, it is important to distinguish the relationship between early life trauma and recent traumatic experiences with NSSI. According to Nobakht and Dale (2017), self-harm sub-groups (i.e. frequent self-harm, infrequent self-harm and no self-harm) were significantly different only with regards to early life experiences, demonstrating a possible pattern between certain early life events and frequency of engagement in self-harm. For example, Merza, Papp, Molnar and Szabo (2017), found that experiencing child sexual abuse and witnessing trauma was more related to frequent use than moderate or no use at all of NSSI. On the other hand, with regards to recent traumatic events, a significant difference was only observed between frequent and no use of self-harm (i.e. infrequent self-harm group was not significantly different from other groups). The distinct relationships observed between childhood and recent traumatic events could be an outcome of the distinct functions

leading to NSSI behavior, possibly suggesting a different pathway. However, recent traumatic events could also be related to previous traumatic experiences, transforming in this way the pathways into complex overarching mind maps. For example, Caron, Lafontaine and Bureau (2017a) found that intimate partner victimization mediated the relationship between child maltreatment and NSSI, demonstrating an interaction between previous traumatic experiences and recent traumatic events, further confirming the complexity of the pathways involved. It is possible that other variables, such as attachment are also included in the model serially mediating the relationship.

During the last two years, researchers have focused on exploring these complex relations further by investigating multiple unique predictors of NSSI, which add to the contribution of early life experiences, instead of focusing on the interaction of already associated predictors. For example, Chang et al. (2019) investigated the contribution of perfectionism while controlling for early life experiences, McMahon et al. (2018) investigated the independent contribution of impulsivity and Richmond-Rakerd et al. (2018) explored the genetic vulnerability to NSSI in addition to trauma exposure. Furthermore, McLafferty et al. (2019) demonstrated that childhood adversity was associated to NSSI, in the presence of current high levels of stress experienced by the individual. Contrary, a study conducted by Macrynikola, Miranda and Soffer (2018) turned the attention to the resilience factors that might act as a buffer to the relationship between childhood adversity and self-harm. The interaction effect between childhood adversity and social connectedness was not significant in predicting self-harm, indicating that social connectedness is probably not a buffer to the relationship. However, the self-report measure used was addressing the concept of "loneliness" and not social connectedness directly, which might have influenced the outcomes of the study. Further research is definitely needed in order to explore other resilience factors to the relationship between childhood adversity and NSSI.

Insecure attachment & NSSI. Another predictor that was independently assessed was insecure attachment. Although insecure attachment is one of the three most prominent risk factors of NSSI, research on insecure attachment is still very limited and only observational studies have been identified for this systematic review.

Observational studies. The first study that met the criteria for inclusion was a study conducted by Bureau et al. (2010), who investigated whether characteristics of insecure attachment will be more present in a self-harm population than in a non-self-harm population. They used a sample of 1238 (NSSI = 105) psychology students and they demonstrated that there was a significant difference in attachment characteristics between the two groups. Participants who reported self-harm were more likely to have parent-child relationships characterized by "failed protection, more fear, less care, more overprotection, less trust, less communication and more alienation" (Bureau et al., 2010, p.490) and insecure attachment was shown to have a predictive effect on NSSI. However, when the analyses were repeated separately for males and females, it was observed that insecure attachment characteristics were not related to NSSI behavior with regards to men. These findings suggest that a gender difference might exist in the predictive ability of insecure attachment on NSSI. Nevertheless, this gender difference was not supported by Hallab and Covic (2010; N=114 psychology students), who found a significant difference between the two groups (NSSI and non-NSSI group), but a non-significant direct effect of attachment on NSSI. Non-significant findings might indicate an indirect relationship, as it was previously proposed for non-significant pathways within the child maltreatment literature. The possible mediational effect was investigated and Hallab and Covic (2010) found that stress mediated the pathway between insecure attachment and NSSI. Stress is strongly related to emotion regulation, another prominent risk factor of NSSI.

The relationship of insecure attachment and NSSI was further investigated in a small sample of clinical population (N=78; Bolen, Winter, & Hodges, 2012). Adult survivors of childhood sexual abuse were asked about their engagement in NSSI behavior and their attachment style. Findings from this study (Bolen et al., 2012) revealed that insecure attachment was related to NSSI behavior and it had a predictive role in NSSI. Importantly, the sample used were survivors of sexual abuse, which might demonstrate that despite the childhood maltreatment, the style of attachment is still independently contributing to the prediction of NSSI. Although the sample was very small, the outcomes of this study in addition to previous findings suggest that regardless of the type of population (non-clinical or clinical), the association between insecure attachment and NSSI is present. This could be explained by a study conducted by Braga and Gonçalves (2014), who found that psychopathological symptoms within non-clinical populations (university students) were the ones related to NSSI behavior. Braga and Gonçalves (2014) also found a significant association of attachment to NSSI. However, no analyses were conducted linking the three aspects together. Perceptions of parental bonding have also been investigated for their relationship with NSSI. Martin, Bureau, Yurkowski, Lafontaine and Cloutier (2015) used several self-report measures of attachment in order to categorize participants into four different profiles based on their parent-child relationship (1. Negative-invalidating, 2. Positive-Moderate, 3. Positive-Idealistic, 4. Negative-disturbed). Findings indicated that individuals with a negative-invalidating and a negative-disturbed parent-child relationship were more likely to engage in NSSI, which supports findings from previous studies.

More complex pathways describing the relationship between attachment and NSSI, have only recently began to emerge. Claes, Raedt, van de Walle and Bosmans (2016) found a significant mediational pathway between trust in the availability of their attachment figure

and engagement in NSSI through communication with the attachment figure. The mediational pathway though was moderated by an attentional bias towards the mother. Despite the promising findings on demonstrating the pathways leading to NSSI through the different attachment characteristics (trust, communication and attentional bias to the attachment figure), outcomes should be interpreted with caution due to the small sample size of the study (N=42) and the selected sample (only university students). Partial support to the aforementioned findings is provided by Martin's et al. (2017) study, which found that preoccupation with the attachment figure and not dismissing attachment states of mind was associated to NSSI behavior. Taking into consideration that primitive attachment styles form the basis of our future relationships (Pascuzzo, Cyr, & Moss, 2013), studies have also investigated the role of romantic attachment to the development of NSSI. For example, a study conducted by Caron, Lafontaine and Bureau (2017b) explored this relationship and found that attachment anxiety, which is part of the preoccupied attachment style, was positively related to NSSI behavior, demonstrating a similar pattern to the primitive attachment styles. Consequently, it is observed that insecure attachment and particularly preoccupied insecure attachment has a significant role in the development of NSSI behavior.

Going beyond the attachment characteristics, Tatnell, Hasking and Newman (2018) explored the relationship between preoccupied attachment style and specifically, the attachment-related anxiety and NSSI further. They demonstrated that attachment-related anxiety with the mother was indeed a predictor of NSSI, but only indirectly, through limited access to emotion regulation strategies. Unfortunately, the sample (N=237) was also based on university students, hence, generalizability of the findings can be limited. Data from a clinical population (N=200) demonstrated that emotional pain was a mediator to the relationship between preoccupied attachment and NSSI (Molaie et al., 2019). Emotional pain was defined as "feelings of intolerable agonizing mental pain and anguish" (Molaie et al., 2019, p. 3),

which is very closely related to emotion dysregulation (Greenberg & Bolger, 2001).

Consequently, it can be argued that the actual mediator was emotion dysregulation, which led

to intolerable feelings of pain. Importantly, all other types of attachment styles were also

investigated in the study (Molaie et al., 2019) and although the NSSI group scored higher on

all insecure types, only preoccupied attachment style was a predictor of NSSI behavior.

Therefore, the type of insecure attachment that seems to have a predictive role in the

development of NSSI is the preoccupied attachment style. However, only a few studies have

investigated this relationship and more studies are needed before reaching a conclusion.

Recent studies suggest an indirect relationship to NSSI, which is mediated through emotion-

related factors, such as stress, emotion dysregulation and emotional pain. Findings on gender

differences remain inconclusive for this relationship.

Emotion dysregulation & NSSI. As previously mentioned, emotion dysregulation has

been suggested to be a mediational factor to other independent predictors of NSSI, such as

childhood maltreatment and preoccupied insecure attachment. However, there are many

studies, both observational and some randomized controlled trials, investigating specifically

the correlation between emotion dysregulation and NSSI.

Randomised-controlled trials (RCTs). Emotion dysregulation is the only prominent

risk factor that has been investigated through RCTs. However, two of the three published

RCTs have used the same population, indicating sparsity in this area of research. The two

RCTs conducted within the same research group (Gratz, Tull & Levy, 2014; Gratz, Bardeen,

Levy, Dixon-Gordon, & Tull, 2015) investigated the effect of an emotion regulation group

therapy on NSSI and its mechanisms of change. The sample used was very small (N=61) and

very specific (women with borderline personality disorder). They found that the emotion

regulation group was effective in reducing NSSI behavior through the learning of emotion

regulation techniques. However, there was no direct effect of emotion regulation on NSSI.

The outcomes showed that the group was able to improve the cognitive symptoms of borderline personality disorder, which in turn was able to reduce NSSI behavior through improved emotion regulation. Their findings were supported by Bentley, Nock, Sauer-Zavala, Gorman, & Barlow (2017), who found that eight out of ten participants demonstrated clinically meaningful reductions in NSSI following exposure to emotion regulation therapies (mindful emotion awareness training and cognitive reappraisal). However, the mechanisms of change were not investigated in this study. Although promising results have been observed from these RCTs, the very small and specific sample sizes of these RTCs make it difficult to conclude on the effect of emotion dysregulation on NSSI.

      Observational studies. Contrary to RCTs, there are many observational studies, but with similar limitations. One of the pioneering studies on the topic was conducted by Gratz and Chapman (2007), who investigated the contribution of both childhood maltreatment and emotion dysregulation in the development of NSSI behavior. Findings demonstrated that although the NSSI group scored higher on childhood maltreatment and emotion dysregulation, none of the factors was independently correlated with NSSI. Gratz and Chapman (2007) explained this non-significant finding as an outcome of low statistical power due to the small sample size of the study (N=97). However, when the factors were entered into logistic regression analysis, physical abuse and emotion dysregulation reliably predicted NSSI. Emotion dysregulation was found to account for 10% of NSSI behavior. Notably, the participants were only male students, hence, findings from this study have limited generalizability and should be interpreted with caution.

      Gratz and Tull (2010) tried to replicate these findings with a mixed-gender and clinical population (residents in a drug and alcohol treatment center). The outcomes showed that individuals within the NSSI group demonstrated higher levels of emotion dysregulation than the non-NSSI group. These findings remained significant even after controlling for other

relevant risk factors (gender, post-traumatic stress disorder, borderline personality disorder, substance use severity and child maltreatment), indicating that emotion dysregulation has an independent and unique contribution to NSSI behavior. However, there were no differences in emotion dysregulation between those who reported recent NSSI and non-recent NSSI. The sample was again very small (N = 61) and very specific to generalize the outcomes. Martin, White, Flanagan, Yensel and Bloomberg (2011) attempted to overcome the limitations from the previous study using a larger sample (N=455) and a multisite approach (the population were still in-patients with stimulant-dependence). Martin et al. (2011) replicated the findings by showing that individuals with a history of NSSI reported significantly higher levels of emotion dysregulation and there were no differences in emotion dysregulation between participants with and without recent NSSI behaviors. Consequently, it can be argued that NSSI is related to higher levels of emotion dysregulation in stimulant-dependent individuals, but no difference is observed within NSSI sub-categories based on recency of behavior.

Due to the specificity of the aforementioned samples, literature has shifted to other population groups to be able to generalize the findings on the topic. Wilcox et al. (2012) used a sample of 1081 students to investigate the predictive abilities of emotion dysregulation on NSSI. Although, they found a significant predictive effect of emotion dysregulation on NSSI, even after controlling for lifetime suicide attempt, the NSSI subgroup was again very small in size (N=75 for lifetime NSSI and N=24 for past-year NSSI). Therefore, although a progress was observed within the emotion dysregulation literature, the limitations remained very similar throughout the years.

Despite the small sample sizes, researchers continued investigating more complex models. For example, Muehlenkamp, Bagge, Tull and Gratz (2013) investigated the moderation effect of body regard on the relationship between emotion dysregulation and NSSI (N=398, but only 102 with NSSI history). They found that emotion dysregulation was

not a significant predictor of NSSI and that its effect was only significant among individuals with low body regard. These inconsistencies in outcomes between studies could be a reflection of the limitations of the studies (i.e. the small sample sizes) or an indication that other processes (moderational or mediational) are involved in the relationship between emotion dysregulation and NSSI. Bedi, Muller and Classen (2014) investigated whether cumulative risk of internal risk factors might be implicated in developing NSSI. With a sample of treatment-seeking women with a history of childhood abuse (NSSI N=67, non-NSSI N= 100), they investigated the contribution of emotion dysregulation, along with insecure attachment, alexithymia, dissociation, self-soothing and frequencies of previous suicide attempts in developing NSSI behaviors. Findings demonstrated that participants within the NSSI group reported greater difficulties with emotion dysregulation than the non-NSSI group. Although there were no significant differences with regards to their attachment style between groups, the full model was found significant in predicting NSSI behavior, indicating that cumulative adversity might be a risk factor of NSSI, suggesting a multifactorial approach to NSSI. Interestingly, the non-significant difference found between the two groups, could demonstrate that childhood maltreatment is a catalytic factor in determining the attachment style of an individual, suggesting a very close relationship between the two already mentioned prominent risk factors of NSSI. The interaction of these risk factors will be explored in the next sections.

One of the limitations of the aforementioned studies was the use of self-report data in order to explore the association between emotion dysregulation and NSSI, which might have been biasing the results. Laboratory analyses were conducted by Davis et al. (2014) to investigate the association further, while controlling for these self-report biases. Davis et al. (2014) conducted two studies, one using an emotion regulation task, which guided participants through emotion regulation strategies while being exposed to emotional clips

(N=148, only 25 with NSSI) and one with another emotion regulation task along with fMRI data (N=48, 21 with NSSI). Findings from both studies revealed that the NSSI group demonstrated lower ability to regulate emotions compared to the non-NSSI group. They also found a difference in the activation of left-amydgala regulation, but not in the right amygdala regulation, indicating a partial emotional dysregulation within the NSSI group. According to biological theories, left amydgalae are involved in the evaluation of an emotional stimulus, while right amydgalae play a more dynamic role in the detection of the stimulus (Baeken et al., 2014). Additionally, the right amydgala have been suggested to be involved in the processing of negative emotions, while left amydgala of positive emotions (Davidson & Irwin, 1999). Consequently, Davis et al. (2014) study could suggest that individuals engaging in NSSI behavior demonstrate reduced abilities to regulate their emotions due to difficulties in evaluating the emotional stimulus, but also due to a dysregulation in processing positive feelings.

While studies continued to replicate the association between emotion dysregulation and NSSI (Terzi et al., 2017), demonstrating a more consistent relationship, researchers explored the effect of comorbidity of NSSI with other disorders. Navarro-Haro, Wessman, Botella, and García-Palacios (2015) demonstrated that emotion dysregulation was a significant predictor of NSSI in a sample of 68 women diagnosed with borderline personality disorder and comorbid eating disorder. Additionally, Buckholdt et al. (2015) found that co-occurrence with other clinically-relevant maladaptive behaviors (e.g. disordered eating and substance misuse) was related to greater difficulties in regulating emotions, which suggested that comorbidity might be enhancing the effect of emotion dysregulation on NSSI (Weintraub, van de Loo, Gitlin & Miklowitz, 2017). A possible explanation could have been that the internalizing behaviours exhibited by the participants with eating disorders, were the ones mediating the relationship between emotion dysregulation and NSSI. Krazler, Fehling,

Anestis, & Selby (2016) showed that a significant relationship between emotion dysregulation and NSSI was only present through the mediational effect of internalizing symptoms. However, the comorbidity of substance misuse (Buckholdt et al., 2015), which is related to externalizing behaviors, partly contradicts this finding. Gholamrezaei, Heath and Panaghi (2017) found that emotion dysregulation was not a significant predictor of NSSI after controlling for anxiety in a sample of 556 undergraduate students in Iran, hence supporting the mediational effect of internalizing behaviors.

Other factors that were found to interact with emotion dysregulation in order to predict NSSI behavior were self-concept clarity as a mediator to the relationship (Lear & Pepper, 2016), negative affectivity as an interaction variable with emotion dysregulation (Nicolai, Wielgus, & Mezulis, 2016), impulsivity as an independent predictor (Terzi et al., 2017) and coping self-efficacy as an non-independent interaction variable (not a significant mediator; Midkiff, Lindsey, & Meadows, 2018). According to Watson and Clark (1984), the construct of negative affectivity reflects individual differences in negative emotionality and self-concept, hence, self-concept clarity and negative affectivity are very closely related. Studies have shown that self-concept clarity is also related to insecure attachment (Wu, 2009; Emery, Gardner, Carswell, & Finkel, 2018), which is one of the most prominent risk factors of NSSI, indicating perhaps an underlying contribution of insecure attachment to the relationship between emotion dysregulation and NSSI. Theories and empirical evidence also associate attachment with impulsivity (Olson, Bates, & Bayles, 1990) and coping self-efficacy (Wright, Firsick, Kacmarski, & Jenkins-Guarnieri, 2017). Attachment plays a foundational role in the development of emotion regulation (Gentzler, Contreras-Grau, Kerns, & Weimer, 2005) and hence, to the ability and perception of the ability of a child to cope based on reflective behaviors from the attachment figure. Impulsivity reflects the ability of an individual to exercise self-control, which is a subset of the concept of emotion regulation. Consequently, it

can be argued that all factors interacting with emotion dysregulation and NSSI are related to the attachment style of the participants.

A common misconception within the NSSI literature is the high association given between emotion reactivity and emotion dysregulation, which is actually based only on a very small overlap between the two concepts (Zelkowitz, Cole, Han, & Tomarken, 2016). Zelkowitz et al. (2016) investigated the two concepts independently for their contribution to NSSI behavior. They found that emotion dysregulation was related to NSSI and was a significant predictor of NSSI behavior, whilst emotion reactivity had no significant relationship to NSSI.

Lastly, one of the most recent studies on the topic conducted by Ewing, Hamza, and Willoughby (2019) suggested and supported a bidirectional relationship between emotion dysregulation and NSSI. Outcomes of this study showed that there was a significant indirect effect between stressful experiences and NSSI through emotion dysregulation over time, as well as a significant indirect path from NSSI to stressful experiences via emotion dysregulation. These findings demonstrate the complexity involved in the association between the two variables (emotion dysregulation and NSSI) and the need for further exploration of more complex models in order to gain a greater understanding of NSSI behavior.

Interaction of risk factors. Reviewing the aforementioned articles on the associations between childhood maltreatment, insecure attachment, emotion dysregulation and NSSI, it becomes apparent that the risk for engaging in NSSI behavior is multifactorial. Additionally, all the risk factors are correlated to each other, prompting the need to investigate their intercorrelations with regards to NSSI behavior. Although none of the studies have investigated the interplay of all three prominent risk factors together in the development of NSSI behavior, some studies have focused on two of these risk factors. Gratz (2006)

investigated the interaction of childhood maltreatment and emotional inexpressivity in predicting self-harm (N=249 females) and found a non-significant finding, despite the significant independent effect of each variable. However, expanding her research on a smaller sample of male university students (Gratz and Chapman, 2007), they found a significant effect in predicting NSSI when all variables of childhood maltreatment and emotion dysregulation were included. This difference in findings could be an outcome of gender differences or of a distinct effect of emotion dysregulation, which cannot be observed through emotional inexpressivity alone. Additionally, it could demonstrate the cumulative effect of childhood maltreatment and emotion dysregulation in predicting NSSI. Gratz and Roemer (2008) explored the association of the two variables (childhood maltreatment and emotion dysregulation) in the same female sample as in Gratz (2006) study and used the total effect of emotion dysregulation, demonstrating a significant effect of emotion dysregulation and childhood maltreatment on NSSI, supporting Gratz and Chapman's findings. A partial mediation was supported when a significant indirect effect was observed between childhood maltreatment and NSSI through limited access to emotion regulation strategies. Armey, Nugent and Crowther (2012) supported Gratz (2006) by demonstrating a non-significant interaction effect of childhood maltreatment and emotion dysregulation on NSSI behavior. Consequently, it is suggested that emotion dysregulation might have a mediational effect to the relationship between childhood maltreatment and NSSI, but not a moderational role. This is supported by Karatzias, Power and Mahoney (2017), who found that emotion dysregulation mediated the relationship between childhood trauma and NSSI in a sample of 89 female prisoners. Another mediational variable in the relationship between childhood maltreatment and NSSI was found to be parental care (Johnstone et al., 2015).

Contrary, Tresno, Ito and Mearns (2013) found a significant interaction effect of childhood maltreatment and emotion dysregulation in predicting NSSI behavior. Tresno et al. (2013) supported that strong negative mood regulation (i.e. low mood dysregulation) can buffer the effects of childhood trauma on NSSI. However, the sample of the study is very small (N=313 but only 31 within the NSSI group) and hence, outcomes should be interpreted with caution. Further support of the moderational role of emotion dysregulation in the association of childhood trauma and NSSI is provided by Dixon-Gordon, Tull and Gratz (2014), who demonstrated a significant moderational effect among individuals with high levels of emotional dysregulation. However, in contrast to Tresno et al. (2013), Dixon-Gordon et al. (2014) found a non-significant moderational effect with individuals with low levels of emotion dysregulation, indicating that the moderational role of emotion dysregulation might be only exhibited on individuals with high emotion dysregulation levels.

A different combination of the risk factors has also been explored. Yurkowski et al. (2015), Tatnell, Hasking, Newman (2018) and Guerin-Marion, Martin, Lafontaine and Bureau (2019) investigated the mediational role of emotion dysregulation on the effect of attachment on NSSI and found significant findings, particularly, when emotion dysregulation was measured with regards to limited access in emotion regulation strategies. Therefore, the interaction between attachment, emotion dysregulation and NSSI has been found to be more consistent in comparison to the interaction between childhood maltreatment, emotion dysregulation and NSSI. This consistency suggests that further research should maintain the mediational model identified and explore the contribution of early life experiences to the aforementioned pathway.

Meta-analysis

Three meta-analyses were conducted in order to investigate the overall predictive ability of each of the three most prominent risk factors. The number of studies included in each meta-analysis was: i) 45 studies for the overall effect of adverse childhood experiences on NSSI, ii) 12 studies for the overall effect of insecure attachment on NSSI and iii) 23 for the overall effect of emotion dysregulation on NSSI. Given that the homogeneity of studies is very important in a meta-analytic context, only observational studies were included in the analysis (Borenstein et al., 2009). It would have been ideal to conduct a distinct meta-analysis for RCTs, however, due to the extremely small number of studies (N=3 and two are with the same population), this was not possible.

Adverse childhood experiences & NSSI.

Heterogeneity between studies. Testing for the heterogeneity of observational studies referring to adverse childhood experiences, it was observed that there is a high degree of variance in the effect sizes [$Q(74) = 2583.04$, $p < 0.001$]. This was confirmed by an I^2 value of 97.14%, which showed high heterogeneity. Sensitivity analyses were conducted and one study (Wachter et al., 2009) was excluded from the meta-analysis, as it was considered an outlier to the dataset based on its Z-value (Ghosh & Vogt, 2012). After the exclusion, the heterogeneity remained high [$Q(73)=862.25$, $p < 0.001$, $I^2 = 91.53\%$], which was expected due to the variety of childhood maltreatment forms included in each study. Consequently, a subgroup analysis was conducted to identify possible differences in the effects of distinct adversity types. The subgroups created were: i) emotional abuse, ii) emotional neglect, iii) sexual abuse, iv) physical abuse, v) physical neglect, vi) overall childhood maltreatment and vii) other minor subgroups such as degree of adversity, sexual assault, onset of abuse and multiple traumas, which were created based on very few studies (1-3). From the subgroup analysis, high heterogeneity was observed even within the subgroups, but only in the main

ones: i) emotional abuse [Q(5)= 29.81, p < 0.001, I^2 =83.23%], ii) physical abuse [Q(13)=

83.09, p < 0.001, I^2 =84.35%], iii) sexual abuse [Q(16)= 66.95, p < 0.001, I^2 =76.10%] and

iv) overall childhood maltreatment [Q(25)= 564. 54, p < 0.001, I^2 =95.57%], which were the

subgroups with the highest number of studies (N=6, N=14, N=17 and N=26 respectively).

Subgroup contrast analyses have demonstrated both within [Q(63)=745.34, p< 0.001] and

between [Q(10)=116.91, p<0.001] studies significant heterogeneity.

Effect sizes and significance. Taking into consideration the high heterogeneity

between the studies, a fixed effect size was not assumed and hence, a random model was

used to calculate the pooled effect sizes. The meta-analysis revealed a significant small to

medium overall effect of adverse childhood experiences on NSSI (d=0.271, SE= 0.042, 95%

CI [0.189, 0.353], p < 0.001), which increased after accounting for subgroup effects

(d=0.382, SE=0.032, 95% CI [0.320, 0.445], p< 0.001). Subgroup analyses demonstrated that

only certain adverse childhood experiences have shown significant effects on NSSI behavior,

ranging from small to medium effects. Significant effects have been demonstrated by

emotional neglect [d=0.418, SE=0.116, 95% CI (0.192, 0.645), p< 0.001], multiple traumas

[d=0.425, SE = 0.147, 95% CI (0.137, 0.713), p = 0.004], studies investigating overall

maltreatment [d=0.254, SE=0.064, 95% CI (0.130, 0.379), p< 0.001], physical abuse

[d=0.317, SE=0.128, 95% CI (0.066, 0.586), p=0.013], physical neglect [d=0.397, SE=0.132,

95% CI (0.139, 0.655), p=0.003] and sexual assault [d=0.693, SE=0.059, 95% CI (0.576,

0.809), p<0.001]. However, particular attention should be paid to the fact that emotional

neglect (N=3), multiple traumas (N=1), physical neglect (3) and sexual assault (N=1) have

been investigated in very few studies and hence, interpretation of their effect sizes should be

made with caution. Overall childhood maltreatment (N=26) and physical abuse (N=14) seem

to have the greatest and most reliable effect on NSSI behaviour. Surprisingly, subgroup

analyses on sexual abuse [d=0.178, SE=0.104, 95% CI (-0.026, 0.381), p=0.087] and

emotional abuse [d=0.334, SE= 0.189, 95% CI (-0.036, 0.704), p=0.077] have shown non-significant findings, but only marginally. The level of adversities (high, moderate, low) and onset of adversities have demonstrated non-significant effects on NSSI behaviour, however, these analyses were based on only one study (see Figure 2) and hence, should be again interpreted with caution.

Publication bias. Publication bias was investigated with the total set of studies (excluding the outlier) using Egger's regression intercept, which demonstrated a significant finding (Egger's regression intercept = 1.04, 95% CI [0.152, 1.937], p = 0.022). A significant finding suggests that publication bias exists within the literature investigating childhood maltreatment and NSSI. This is also supported from the Funnel Plot (see Appendix F) and the narrative synthesis of this review, since only two outdated studies showed a non-significant effect of childhood maltreatment on NSSI.

Meta Analysis of Childhood adversity

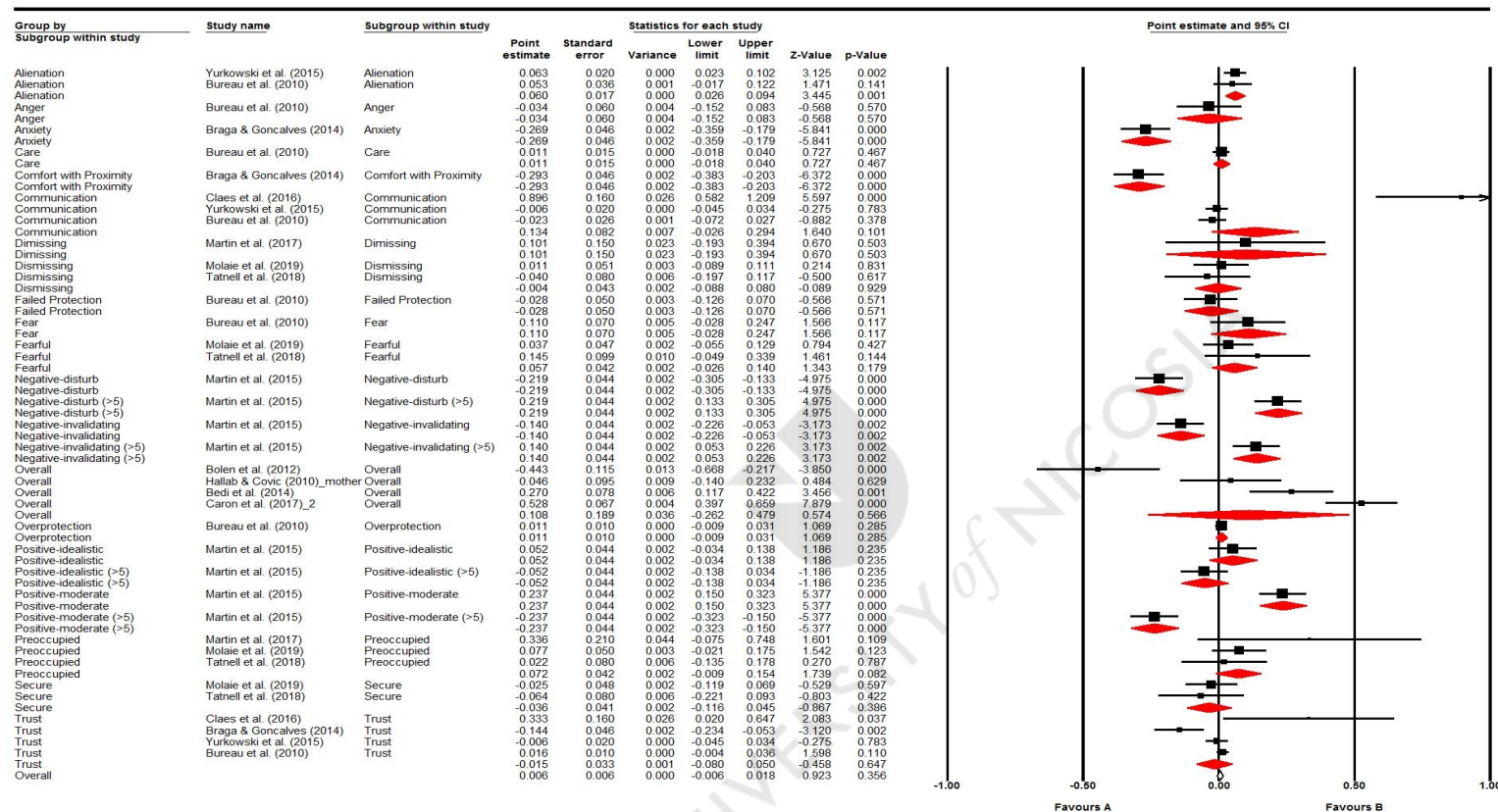| Subgroup within study	Study name	Subgroup within study	Point estimate	Standard error	Variance	Lower limit	Upper limit	Z-Value	p-Value
Emotional abuse	Howard et al. (2017)	Emotional abuse	0.754	0.123	0.015	0.513	0.995	6.128	0.000
Emotional abuse	Roe-Sepowitz (2007)	Emotional abuse	0.957	3.688	13.601	-6.272	8.185	0.259	0.795
Emotional abuse	Idig-Camuroglu & Golge (2018)_men	Emotional abuse	0.038	0.102	0.010	-0.162	0.238	0.369	0.712
Emotional abuse	Idig-Camuroglu & Golge (2018)_women	Emotional abuse	0.026	0.074	0.005	-0.119	0.171	0.349	0.727
Emotional abuse	MoMahon et al. (2018)_men	Emotional abuse	0.720	0.712	0.507	-0.676	2.115	1.011	0.312
Emotional abuse	MoMahon et al. (2018)_women	Emotional abuse	0.554	0.307	-0.315	1.857	1.392	0.164	
Emotional abuse			0.771	0.189	0.036	-0.035	0.704	1.770	0.077
Emotional neglect	Howard et al. (2017)	Emotional neglect	0.334						
Emotional neglect	Howard et al. (2017)	Emotional neglect	0.397	0.122	0.015	0.158	0.636	3.252	0.001
Emotional neglect	MoMahon et al. (2018)_men	Emotional neglect	0.523	0.490	0.240	-0.438	1.483	1.066	0.286
Emotional neglect	MoMahon et al. (2018)_women	Emotional neglect	0.720	0.541	0.293	-0.341	1.780	1.330	0.183
Emotional neglect			0.418	0.116	0.013	0.192	0.645	3.618	0.000
High risk of adversities	O'Neill et al. (2018)	High risk of adversities	0.943	3.332	11.102	-5.588	7.473	0.283	0.777
High risk of adversities			0.943	3.332	11.102	-5.588	7.473	0.283	0.777
Moderate risk of adversities	O'Neill et al. (2018)	Moderate risk of adversities	0.556	0.857	0.734	-1.124	2.235	0.648	0.517
Moderate risk of adversities			0.556	0.857	0.734	-1.124	2.235	0.648	0.517
Multiple traumas	Howard et al. (2017)	Multiple traumas	0.425	0.147	0.022	0.137	0.713	2.893	0.004
Multiple traumas			0.425	0.147	0.022	0.137	0.713	2.893	0.004
Onset of abuse	Weaver et al. (2004)	Onset of abuse	-0.061	0.108	0.012	-0.272	0.150	-0.566	0.571
Onset of abuse			-0.061	0.108	0.012	-0.272	0.150	-0.566	0.571
Overall	Franzke et al. (2015)	Overall	0.064	0.109	0.012	-0.150	0.278	0.588	0.556
Overall	Paivio et al. (2004)	Overall	0.797	0.100	0.010	0.601	0.992	7.965	0.000
Overall	Evren et al. (2006)	Overall	0.430	0.576	0.332	-0.699	1.559	0.746	0.455
Overall	Gladstone et al. (2004)	Overall	0.396	0.182	0.033	0.039	0.752	2.174	0.030
Overall	Evren et al. (2011)	Overall	0.505	0.941	0.886	-1.340	2.350	0.537	0.591
Overall	Zlotnick et al. (1996)	Overall	0.046	0.072	0.005	-0.096	0.187	0.633	0.527
Overall	Nobakht & Dale (2017)	Overall	0.042	0.071	0.005	-0.098	0.181	0.582	0.560
Overall	Gratz & Roemer (2008)	Overall	0.374	0.457	0.208	-0.521	1.269	0.819	0.413
Overall	Zanarini et al. (2011)	Overall	0.541	0.580	0.336	-0.595	1.678	0.933	0.351
Overall	Tresno et al. (2013)	Overall	0.124	0.057	0.003	0.013	0.236	2.190	0.029
Overall	Gunter et al. (2011)	Overall	0.469	1.013	1.026	-1.516	2.454	0.463	0.644
Overall	Caron et al. (2017)	Overall	0.124	0.150	0.023	-0.170	0.418	0.828	0.408
Overall	Johnstone et al. (2015)	Overall	0.216	0.276	0.076	-0.324	0.756	0.784	0.433
Overall	Arens et al. (2012)	Overall	0.052	0.270	0.073	-0.477	0.581	0.192	0.848
Overall	Rodriguez-srednicki (2002)	Overall	0.408	0.048	0.002	0.315	0.502	8.543	0.000
Overall	Nada-Raja & Skegg (2011)_women	Overall	0.224	0.612	0.375	-0.976	1.423	0.365	0.715
Overall	Nada-Raja & Skegg (2011)_men	Overall	0.505	1.450	2.103	-2.337	3.347	0.348	0.728
Overall	Arens et al. (2014)	Overall	0.023	0.040	0.002	-0.055	0.100	0.575	0.566
Overall	McLafferty et al. (2019)	Overall	0.371	0.434	0.188	-0.479	1.221	0.855	0.392
Overall	Talmon & Ginzburg (2018)	Overall	0.699	0.050	0.003	0.601	0.797	13.984	0.000
Overall	Martin et al. (2016)	Overall	0.201	0.150	0.023	-0.093	0.495	1.340	0.180
Overall	Macrynikola et al. (2018)	Overall	0.193	0.133	0.018	-0.067	0.454	1.453	0.146
Overall	Muehlenkamp et al. (2010)	Overall	0.353	0.016	0.000	0.322	0.384	22.056	0.000
Overall	Richmond-Rakerd et al. (2018)	Overall	0.009	0.010	0.000	-0.011	0.028	0.890	0.373
Overall	Swannell et al. (2012)_females	Overall	0.953	1.276	1.627	-1.547	3.453	0.747	0.455
Overall	Swannell et al. (2012)_males	Overall	0.691	0.997	0.995	-1.264	2.646	0.692	0.489
Overall			0.254	0.064	0.004	0.130	0.379	4.002	0.000
Physical abuse	Armey et al. (2012)	Physical abuse	0.613	0.174	0.030	0.272	0.954	3.521	0.000
Physical abuse	Howard et al. (2017)	Physical abuse	0.501	0.554	0.307	-0.585	1.588	0.904	0.366
Physical abuse	Evren & Evren (2005)	Physical abuse	0.610	0.482	0.232	-0.335	1.555	1.265	0.206
Physical abuse	Van der Kolk et al. (1991)	Physical abuse	0.047	0.119	0.014	-0.186	0.280	0.396	0.692
Physical abuse	Merza et al. (2017)	Physical abuse	-0.073	0.114	0.013	-0.296	0.151	-0.638	0.524
Physical abuse	Gratz & Chapman (2007)	Physical abuse	1.830	37.099	1376.365	-70.883	74.544	0.049	0.961
Physical abuse	Gratz et al. (2002)	Physical abuse	0.113	0.088	0.008	-0.059	0.284	1.283	0.200
Physical abuse	Sansone et al. (1995)	Physical abuse	1.008	0.860	0.740	-0.678	2.693	1.172	0.241
Physical abuse	Yates et al. (2008)	Physical abuse	1.100	7.954	63.266	-14.490	16.689	0.138	0.890
Physical abuse	Idig-Camuroglu & Golge (2018)_men	Physical abuse	0.045	0.102	0.010	-0.155	0.245	0.445	0.656
Physical abuse	Idig-Camuroglu & Golge (2018)_women	Physical abuse	0.032	0.074	0.005	-0.113	0.177	0.433	0.665
Physical abuse	Martin et al. (2011)	Physical abuse	1.017	0.107	0.011	0.807	1.227	9.505	0.000
Physical abuse	MoMahon et al. (2018)_men	Physical abuse	0.762	0.806	0.650	-0.818	2.341	0.945	0.345
Physical abuse	MoMahon et al. (2018)_women	Physical abuse	0.893	0.719	0.517	-0.516	2.302	1.242	0.214
Physical abuse			0.317	0.128	0.016	0.066	0.568	2.479	0.013
Physical neglect	Howard et al. (2017)	Physical neglect	0.375	0.135	0.018	0.110	0.640	2.778	0.005
Physical neglect	MoMahon et al. (2018)_men	Physical neglect	0.708	0.895	0.801	-1.046	2.462	0.791	0.429
Physical neglect	MoMahon et al. (2018)_women	Physical neglect	0.913	0.801	0.642	-0.657	2.483	1.140	0.254
Physical neglect			0.397	0.132	0.017	0.139	0.655	3.013	0.003
Sexual abuse	Armey et al. (2012)	Sexual abuse	0.433	0.174	0.030	0.092	0.774	2.488	0.013
Sexual abuse	Howard et al. (2017)	Sexual abuse	0.668	0.154	0.024	0.366	0.970	4.340	0.000
Sexual abuse	Van der Kolk et al. (1991)	Sexual abuse	0.072	0.119	0.014	-0.161	0.305	0.605	0.545
Sexual abuse	Merza et al. (2017)	Sexual abuse	0.205	0.114	0.013	-0.018	0.428	1.798	0.072
Sexual abuse	Oyefeso et al. (2008)	Sexual abuse	0.452	2.211	4.889	-3.881	4.785	0.204	0.838
Sexual abuse	Gratz & Chapman (2007)	Sexual abuse	-1.393	0.270	0.073	-1.922	-0.863	-5.157	0.000
Sexual abuse	Gratz et al. (2002)	Sexual abuse	-0.126	0.088	0.008	-0.046	0.298	1.437	0.151
Sexual abuse	Zweig-Frank et al. (1994)	Sexual abuse	0.145	0.340	0.116	-0.522	0.811	0.425	0.671
Sexual abuse	Sansone et al. (1995)	Sexual abuse	1.008	0.920	0.846	-0.796	2.811	1.095	0.273
Sexual abuse	Yates et al. (2008)	Sexual abuse	1.250	9.515	90.536	-17.399	19.899	0.131	0.896
Sexual abuse	Bornovalova et al. (2011)	Sexual abuse	0.550	1.069	1.142	-1.545	2.645	0.514	0.607
Sexual abuse	Dixon-Gordon et al. (2014)	Sexual abuse	0.459	0.064	0.030	0.333	0.584	7.154	0.000
Sexual abuse	Roe-Sepowitz (2007)	Sexual abuse	0.828	3.405	11.594	-5.846	7.501	0.243	0.808
Sexual abuse	Idig-Camuroglu & Golge (2018)_men	Sexual abuse	0.041	0.102	0.010	-0.159	0.241	0.402	0.688
Sexual abuse	Johnstone et al. (2015)	Sexual abuse	0.174	0.265	0.070	-0.346	0.693	0.655	0.512
Sexual abuse	MoMahon et al. (2018)_men	Sexual abuse	0.961	1.224	1.498	-1.438	3.359	0.785	0.433
Sexual abuse	MoMahon et al. (2018)_women	Sexual abuse	0.990	0.760	0.578	-0.500	2.479	1.302	0.193
Sexual abuse			0.178	0.104	0.011	-0.026	0.381	1.710	0.087
Sexual assault	Chang et al. (2019)	Sexual assault	0.693	0.059	0.004	0.576	0.809	11.675	0.000
Sexual assault			0.693	0.059	0.004	0.576	0.809	11.675	0.000
Overall			0.382	0.032	0.001	0.320	0.445	11.961	0.000

Point estimate and 95% CI — scale: -2.00, -1.00, 0.00, 1.00, 2.00 — Favours A / Favours B

Figure 2. Subgroup analysis of the effect of childhood maltreatment on NSSI behavior. The figure presents the subgroup names, study authors, individual study characteristics and pooled effect sizes. Black lines represent the 95% confidence interval of individual studies, the red diamonds represent the pooled effect of each subgroup and the white diamond represents the total pooled effect of childhood maltreatment on NSSI while taking into consideration the subgroup analysis.

Insecure attachment & NSSI.

Heterogeneity between studies. Heterogeneity tests have demonstrated a significant high degree of variance in effect sizes of attachment on NSSI [Q(37)=366.24, I^2 = 89.897]. Sensitivity analyses showed no particular outliers to the dataset. Therefore, subgroup analyses were conducted in order to investigate the heterogeneity further. Heterogeneity was indicated only in three attachment variables: i) communication (I^2 = 93.78%), ii) trust (I^2 = 81.35%) and iii) overall attachment (I^2 = 94.83%), which were the ones with the higher number of studies. Significant heterogeneity was observed both within [Q(14)=109.69, p<0.001] and between [Q(23)=256.55, p < 0.001] attachment subgroups.

Pooled effect sizes and significance. Pooled effect sizes revealed a non-significant effect of attachment on NSSI (d=0.015, SE=0.018, 95% CI [-0.020, 0.01], p=0.392), even after subgroups were taken into consideration (d=0.006, SE=0.006, 95% CI [-0.006, 0.018], p=0.356). Significant effect sizes were only reached by alienation (d= 0.06, SE= 0.017, 95% CI [0.026, 0.094], p=0.001), anxiety (d=-0.269, SE=0.046, 95% CI [-0.359, -0.179], p<0.001), comfort with proximity (d=-0.293, SE=0.046, 95% CI [-0.383, -0.203], p<0.001), negative disturb (d= -0.219, SE=0.044, 95% CI [-0.305, -0.133], p<0.001), negative invalidating (d=-0.140, SE=0.044, 95% CI [-0.226, -0.053], 0<0.001) and positive-moderate (d=0.237, SE=0.044, 95% CI [0.150, 0.323], p<0.001) perception of attachment. However, findings should be interpreted with caution because all these variables were based on one or two studies (see Figure 3). In contrast to the narrative review, preoccupied style of attachment has failed to reach significance (d=0.072, SE=0.042, 95% CI [-0.009, 0.154], p=0.082).

Meta Analysis of Attachment and NSSI

Group by / Subgroup within study	Study name	Subgroup within study	Point estimate	Standard error	Variance	Lower limit	Upper limit	Z-Value	p-Value
Alienation	Yurkowski et al. (2015)	Alienation	0.063	0.020	0.000	0.023	0.102	3.125	0.002
Alienation	Bureau et al. (2010)	Alienation	0.053	0.036	0.001	-0.017	0.122	1.471	0.141
Alienation			0.060	0.017	0.000	0.026	0.094	3.445	0.001
Anger	Bureau et al. (2010)	Anger	-0.034	0.060	0.004	-0.152	0.083	-0.568	0.570
Anger			-0.034	0.060	0.004	-0.152	0.083	-0.568	0.570
Anxiety	Braga & Goncalves (2014)	Anxiety	-0.269	0.046	0.002	-0.359	-0.179	-5.841	0.000
Anxiety			-0.269	0.046	0.002	-0.359	-0.179	-5.841	0.000
Care	Bureau et al. (2010)	Care	0.011	0.015	0.000	-0.018	0.040	0.727	0.467
Care			0.011	0.015	0.000	-0.018	0.040	0.727	0.467
Comfort with Proximity	Braga & Goncalves (2014)	Comfort with Proximity	-0.293	0.046	0.002	-0.383	-0.203	-6.372	0.000
Comfort with Proximity			-0.293	0.046	0.002	-0.383	-0.203	-6.372	0.000
Communication	Claes et al. (2016)	Communication	0.896	0.160	0.026	0.582	1.209	5.597	0.000
Communication	Yurkowski et al. (2015)	Communication	-0.006	0.020	0.000	-0.045	0.034	-0.275	0.783
Communication	Bureau et al. (2010)	Communication	-0.023	0.026	0.001	-0.072	0.027	-0.882	0.378
Communication			0.134	0.082	0.007	-0.026	0.294	1.640	0.101
Dimissing	Martin et al. (2017)	Dimissing	0.101	0.150	0.023	-0.193	0.394	0.670	0.503
Dimissing			0.101	0.150	0.023	-0.193	0.394	0.670	0.503
Dismissing	Molaie et al. (2019)	Dismissing	0.011	0.051	0.003	-0.089	0.111	0.214	0.831
Dismissing	Tatnell et al. (2018)	Dismissing	-0.040	0.080	0.006	-0.197	0.117	-0.500	0.617
Dismissing			-0.004	0.043	0.002	-0.088	0.080	-0.089	0.929
Failed Protection	Bureau et al. (2010)	Failed Protection	-0.028	0.050	0.003	-0.126	0.070	-0.566	0.571
Failed Protection			-0.028	0.050	0.003	-0.126	0.070	-0.566	0.571
Fear	Bureau et al. (2010)	Fear	0.110	0.070	0.005	-0.028	0.247	1.566	0.117
Fear			0.110	0.070	0.005	-0.028	0.247	1.566	0.117
Fearful	Molaie et al. (2019)	Fearful	0.037	0.047	0.002	-0.055	0.129	0.794	0.427
Fearful	Tatnell et al. (2018)	Fearful	0.145	0.099	0.010	-0.049	0.339	1.461	0.144
Fearful			0.057	0.042	0.002	-0.026	0.140	1.343	0.179
Negative-disturb	Martin et al. (2015)	Negative-disturb	-0.219	0.044	0.002	-0.305	-0.133	-4.975	0.000
Negative-disturb			-0.219	0.044	0.002	-0.305	-0.133	-4.975	0.000
Negative-disturb (>5)	Martin et al. (2015)	Negative-disturb (>5)	0.219	0.044	0.002	0.133	0.305	4.975	0.000
Negative-disturb (>5)			0.219	0.044	0.002	0.133	0.305	4.975	0.000
Negative-invalidating	Martin et al. (2015)	Negative-invalidating	-0.140	0.044	0.002	-0.226	-0.053	-3.173	0.002
Negative-invalidating			-0.140	0.044	0.002	-0.226	-0.053	-3.173	0.002
Negative-invalidating (>5)	Martin et al. (2015)	Negative-invalidating (>5)	0.140	0.044	0.002	0.053	0.226	3.173	0.002
Negative-invalidating (>5)			0.140	0.044	0.002	0.053	0.226	3.173	0.002
Overall	Bolen et al. (2012)	Overall	-0.443	0.115	0.013	-0.668	-0.217	-3.850	0.000
Overall	Hallab & Covic (2010)_mother	Overall	0.046	0.095	0.009	-0.140	0.232	0.484	0.629
Overall	Bedi et al. (2014)	Overall	0.270	0.078	0.006	0.117	0.422	3.456	0.001
Overall	Caron et al. (2017)_2	Overall	0.528	0.067	0.004	0.397	0.659	7.879	0.000
Overall			0.108	0.189	0.036	-0.262	0.479	0.574	0.566
Overprotection	Bureau et al. (2010)	Overprotection	0.011	0.010	0.000	-0.009	0.031	1.069	0.285
Overprotection			0.011	0.010	0.000	-0.009	0.031	1.069	0.285
Positive-idealistic	Martin et al. (2015)	Positive-idealistic	0.052	0.044	0.002	-0.034	0.138	1.186	0.235
Positive-idealistic			0.052	0.044	0.002	-0.034	0.138	1.186	0.235
Positive-idealistic (>5)	Martin et al. (2015)	Positive-idealistic (>5)	-0.052	0.044	0.002	-0.138	0.034	-1.186	0.235
Positive-idealistic (>5)			-0.052	0.044	0.002	-0.138	0.034	-1.186	0.235
Positive-moderate	Martin et al. (2015)	Positive-moderate	0.237	0.044	0.002	0.150	0.323	5.377	0.000
Positive-moderate			0.237	0.044	0.002	0.150	0.323	5.377	0.000
Positive-moderate (>5)	Martin et al. (2015)	Positive-moderate (>5)	-0.237	0.044	0.002	-0.323	-0.150	-5.377	0.000
Positive-moderate (>5)			-0.237	0.044	0.002	-0.323	-0.150	-5.377	0.000
Preoccupied	Martin et al. (2017)	Preoccupied	0.336	0.210	0.044	-0.075	0.748	1.601	0.109
Preoccupied	Molaie et al. (2019)	Preoccupied	0.077	0.050	0.003	-0.021	0.175	1.542	0.123
Preoccupied	Tatnell et al. (2018)	Preoccupied	0.022	0.080	0.006	-0.135	0.178	0.270	0.787
Preoccupied			0.072	0.042	0.002	-0.009	0.154	1.739	0.082
Secure	Molaie et al. (2019)	Secure	-0.025	0.048	0.002	-0.119	0.069	-0.529	0.597
Secure	Tatnell et al. (2018)	Secure	-0.064	0.080	0.006	-0.221	0.093	-0.803	0.422
Secure			-0.036	0.041	0.002	-0.116	0.045	-0.867	0.386
Trust	Claes et al. (2016)	Trust	0.333	0.160	0.026	0.020	0.647	2.083	0.037
Trust	Braga & Goncalves (2014)	Trust	-0.144	0.046	0.002	-0.234	-0.053	-3.120	0.002
Trust	Yurkowski et al. (2015)	Trust	-0.006	0.020	0.000	-0.045	0.034	-0.275	0.783
Trust	Bureau et al. (2010)	Trust	0.016	0.010	0.000	-0.004	0.036	1.598	0.110
Trust			-0.015	0.033	0.001	-0.080	0.050	-0.458	0.647
Overall			0.006	0.006	0.000	-0.006	0.018	0.923	0.356

Point estimate and 95% CI — Favours A / Favours B (scale from -1.00 to 1.00)

Figure 3. Subgroup analysis of the effect of attachment variables on NSSI behavior. The figure presents the subgroup names, study authors, individual study characteristics and pooled effect sizes. Black lines represent the 95% confidence interval of individual studies, the red diamonds represent the pooled effect of each subgroup and the white diamond represents the total pooled effect of attachment on NSSI while taking into consideration the subgroup analysis.

Publication bias. Despite the very small number of studies investigating the association between attachment and NSSI behavior compared to the other prominent risk factors, the analysis has shown that no publication bias exists within this literature. The outcomes from the Egger's regression intercept revealed a non-significant finding (Egger's regression intercept = 0.26, 95% CI [-1.37, 1.89], p=0.75). This is also presented from the Funnel Plot of the analysis (see Appendix F).

Emotion dysregulation & NSSI.

Heterogeneity between studies. Similarly to the other two meta-analyses, heterogeneity in the effect sizes (see Figure 4) of the association between emotion dysregulation and NSSI behavior was found to be significantly high [$Q(54)$=993.50, $p< 0.001$, $I^2 = 94.57\%$]. No outliers were identified from sensitivity analyses. Subgroup analyses indicated that heterogeneity was observed between studies investigating impulse control ($I^2 = 92.10\%$), lack of emotional clarity ($I^2 = 96.61\%$), limited access to emotion regulation strategies ($I^2 = 92.93\%$), non-acceptance of emotions ($I^2 = 93.73\%$), poor emotional awareness ($I^2 = 90.48\%$) and overall emotion dysregulation ($I^2 = 96.76\%$). Studies investigating expressive suppression, cognitive reappraisal and difficulties with goal directed behaviors demonstrated no heterogeneity in the effect sizes ($I^2 = 0\%$). Significant differences were observed both within [$Q(42)$=835.07, $p< 0.001$] and between [$Q(12)$=158.43, $p<0.001$] studies with regards to heterogeneity.

Pooled effect sizes and significance. Pooled effect sizes demonstrated a significant small effect of emotion dysregulation on NSSI behavior [d=0.198, SE=0.025, 95% CI (0.149, 0.248), $p< 0.001$], which remained significant, although reduced, after subgroups were taken into consideration [d=0.034, SE=0.009, 95% CI (0.016, 0.052), $p< 0.001$]. From the emotion

dysregulation subgroups only impulse control [d=0.175, SE=0.077, 95% CI (0.024, 0.325), p=0.023], limited access to emotion regulation strategies [d=0.165, SE=0.069, 95% CI (0.030, 0.299), p=0.016] and overall emotion dysregulation [d=0.404, SE=0.079, 95% CI (0.249, 0.558), p<0.001] showed a significant effect on NSSI. Interestingly, investigating the overall emotion dysregulation and not its subgroups increased the effect size from a small to nearly moderate effect. The impact of emotion dysregulation as a unified concept was supported from the narrative review too. Subgroups very close to reaching significant effects were difficulties with goal directed behaviours (d=0.047, p=0.059) and poor emotional awareness (d=0.130, p=0.055).

Publication bias. The unexpected increase in the effect when only the overall emotion dysregulation subgroup was taken into consideration could reflect a publication bias of only significant findings. This explanation was supported by analyses and the Funnel plot of the studies (see Appendix F), which indicated the existence of publication bias by the Egger's regression intercept test (Egger's regression intercept=4.46, 95% CI [2.64, 6.28], p < 0.001). Additionally, the majority of studies investigating the effect of emotion dysregulation on NSSI behavior were conducted by the same research group and hence, outcomes should be interpreted with caution.

Group by Subgroup within study	Study name	Subgroup within study	Point estimate	Standard error	Variance	Lower limit	Upper limit	Z-Value	p-Value	Point estimate and 95% CI
Cognitive Reappraisal	Navarro-Haro et al. (2015)	Cognitive Reappraisal	0.048	0.124	0.015	-0.195	0.291	0.388	0.698	
Cognitive Reappraisal	Tatnell et al. (2018)	Cognitive Reappraisal	0.016	0.020	0.000	-0.024	0.056	0.799	0.424	
Cognitive Reappraisal	Zelkowitz et al. (2016)	Cognitive Reappraisal	0.027	0.020	0.000	-0.012	0.066	1.345	0.179	
Cognitive Reappraisal			0.022	0.014	0.000	-0.006	0.050	1.554	0.120	
Difficulties with goal directed behaviors	Guerin-Marion et al. (2019)	Difficulties with goal directed behaviors	0.031	0.095	0.009	-0.155	0.217	0.326	0.744	
Difficulties with goal directed behaviors	Gholmzezaei et al. (2017)_men	Difficulties with goal directed behaviors	0.049	0.060	0.004	-0.069	0.166	0.810	0.418	
Difficulties with goal directed behaviors	Tatnell et al. (2018)	Difficulties with goal directed behaviors	0.087	0.041	0.002	0.007	0.167	2.123	0.034	
Difficulties with goal directed behaviors	Zelkowitz et al. (2016)	Difficulties with goal directed behaviors	0.011	0.040	0.002	-0.067	0.089	0.273	0.785	
Difficulties with goal directed behaviors			0.047	0.025	0.001	-0.002	0.096	1.886	0.059	
Expressive Suppression	Navarro-Haro et al. (2015)	Expressive Suppression	0.068	0.124	0.015	-0.175	0.311	0.549	0.583	
Expressive Suppression	Tatnell et al. (2018)	Expressive Suppression	0.032	0.025	0.001	-0.018	0.082	1.259	0.208	
Expressive Suppression	Zelkowitz et al. (2016)	Expressive Suppression	-0.017	0.030	0.001	-0.076	0.042	-0.560	0.575	
Expressive Suppression			0.013	0.019	0.000	-0.025	0.051	0.674	0.500	
External dysfunctional	Zelkowitz et al. (2016)	External dysfunctional	-0.034	0.050	0.003	-0.132	0.064	-0.682	0.495	
External dysfunctional			-0.034	0.050	0.003	-0.132	0.064	-0.682	0.495	
External Functional	Zelkowitz et al. (2016)	External Functional	0.016	0.050	0.003	-0.082	0.114	0.326	0.744	
External Functional			0.016	0.050	0.003	-0.082	0.114	0.326	0.744	
Impulse control	Guerin-Marion et al. (2019)	Impulse control	0.681	0.095	0.009	0.495	0.867	7.168	0.000	
Impulse control	Gholmrezaei et al. (2017)_men	Impulse control	0.211	0.050	0.003	0.113	0.309	4.212	0.000	
Impulse control	Tatnell et al. (2018)	Impulse control	0.063	0.028	0.001	0.008	0.117	2.232	0.026	
Impulse control	Gholmrezaei et al. (2017)_women	Impulse control	0.020	0.050	0.003	-0.078	0.117	0.390	0.697	
Impulse control	Zelkowitz et al. (2016)	Impulse control	0.000	0.050	0.003	-0.098	0.098	0.000	1.000	
Impulse control			0.175	0.077	0.006	0.024	0.325	2.270	0.023	
Internal Dysfunctional	Zelkowitz et al. (2016)	Internal Dysfunctional	0.037	0.060	0.004	-0.080	0.155	0.622	0.534	
Internal Dysfunctional			0.037	0.060	0.004	-0.080	0.155	0.622	0.534	
Internal functional	Zelkowitz et al. (2016)	Internal functional	-0.034	0.050	0.003	-0.132	0.064	-0.682	0.495	
Internal functional			-0.034	0.050	0.003	-0.132	0.064	-0.682	0.495	
Lack of emotional clarity	Guerin-Marion et al. (2019)	Lack of emotional clarity	0.776	0.095	0.009	0.590	0.962	8.168	0.000	
Lack of emotional clarity	Tatnell et al. (2018)	Lack of emotional clarity	0.042	0.036	0.001	-0.028	0.112	1.188	0.235	
Lack of emotional clarity	Zelkowitz et al. (2016)	Lack of emotional clarity	-0.023	0.050	0.003	-0.120	0.075	-0.450	0.653	
Lack of emotional clarity			0.252	0.170	0.029	-0.082	0.586	1.479	0.139	
Limited access to ER strategies	Guerin-Marion et al. (2019)	Limited access to ER strategies	0.768	0.095	0.009	0.582	0.954	8.084	0.000	
Limited access to ER strategies	Gholmrezaei et al. (2017)_men	Limited access to ER strategies	0.050	0.045	0.002	-0.038	0.138	1.107	0.268	
Limited access to ER strategies	Tatnell et al. (2018)	Limited access to ER strategies	0.042	0.018	0.000	0.007	0.077	2.369	0.018	
Limited access to ER strategies	Gholmrezaei et al. (2017)_women	Limited access to ER strategies	0.064	0.050	0.003	-0.034	0.162	1.272	0.203	
Limited access to ER strategies	Zelkowitz et al. (2016)	Limited access to ER strategies	0.053	0.040	0.002	-0.026	0.131	1.313	0.189	
Limited access to ER strategies			0.165	0.069	0.005	0.030	0.299	2.404	0.016	
Nonacceptance of emotions	Guerin-Marion et al. (2019)	Nonacceptance of emotions	0.625	0.095	0.009	0.439	0.811	6.579	0.000	
Nonacceptance of emotions	Tatnell et al. (2018)	Nonacceptance of emotions	-0.028	0.023	0.001	-0.073	0.017	-1.230	0.219	
Nonacceptance of emotions	Gholamrezaei et al. (2017)_women	Nonacceptance of emotions	0.080	0.045	0.002	-0.009	0.168	1.767	0.077	
Nonacceptance of emotions	Zelkowitz et al. (2016)	Nonacceptance of emotions	-0.017	0.030	0.001	-0.076	0.042	-0.560	0.575	
Nonacceptance of emotions			0.131	0.076	0.006	-0.018	0.279	1.721	0.085	
Overall	Davis et al. (2014)_Study 2	Overall	0.807	0.149	0.022	0.515	1.099	5.415	0.000	
Overall	Gratz & Tull (2010)	Overall	0.549	0.131	0.017	0.292	0.805	4.189	0.000	
Overall	Gratz (2015)	Overall	0.100	0.131	0.017	-0.157	0.356	0.760	0.447	
Overall	Lear & Pepper (2016)_lifetime NSSI	Overall	0.956	0.123	0.015	0.715	1.197	7.772	0.000	
Overall	Lear & Pepper (2016)_versatility of NSSI	Overall	1.039	0.123	0.015	0.798	1.280	8.447	0.000	
Overall	Terzi et al. (2017)	Overall	0.075	0.115	0.013	-0.150	0.300	0.651	0.515	
Overall	Gratz & Chapman (2007)	Overall	0.032	0.026	0.001	-0.018	0.082	1.259	0.208	
Overall	Buckholdt et al. (2015)_study 1	Overall	0.089	0.093	0.009	-0.093	0.272	0.960	0.337	
Overall	Nicolai et al. (2016)	Overall	0.330	0.085	0.007	0.164	0.496	3.894	0.000	
Overall	Weintraub et al. (2017)	Overall	0.505	0.085	0.007	0.339	0.672	5.959	0.000	
Overall	Davis et al. (2014)_Study 1	Overall	0.703	0.083	0.007	0.540	0.866	8.471	0.000	
Overall	Krazler et al. (2016)	Overall	0.042	0.080	0.006	-0.115	0.199	0.525	0.600	
Overall	Bedi et al. (2014)	Overall	0.650	0.078	0.006	0.497	0.803	8.333	0.000	
Overall	Midkiff et al. (2018)	Overall	0.790	0.051	0.003	0.690	0.890	15.492	0.000	
Overall	Gratz & Roemer (2008)	Overall	0.371	0.538	0.289	-0.683	1.425	0.690	0.490	
Overall	Muehlenkamp et al. (2013)	Overall	0.030	0.050	0.003	-0.068	0.128	0.598	0.550	
Overall	Ariel Martin et al. (2011)	Overall	0.700	0.047	0.002	0.608	0.792	14.894	0.000	
Overall	Wilcox et al. (2012)	Overall	0.527	1.350	1.823	-2.119	3.173	0.390	0.696	
Overall	Ewing et al. (2019)	Overall	0.005	0.030	0.001	-0.054	0.064	0.160	0.873	
Overall	Yurkowski et al. (2015)	Overall	0.012	0.029	0.001	-0.046	0.070	0.405	0.686	
Overall			0.404	0.079	0.006	0.249	0.558	5.134	0.000	
Poor emotional awareness	Guerin-Marion et al. (2019)	Poor emotional awareness	0.366	0.095	0.009	0.180	0.552	3.853	0.000	
Poor emotional awareness	Tatnell et al. (2018)	Poor emotional awareness	0.000	0.018	0.000	-0.035	0.035	0.000	1.000	
Poor emotional awareness	Gholmrezaei et al. (2017)_women	Poor emotional awareness	0.230	0.050	0.003	0.132	0.328	4.606	0.000	
Poor emotional awareness	Zelkowitz et al. (2016)	Poor emotional awareness	0.011	0.040	0.002	-0.067	0.089	0.273	0.785	
Poor emotional awareness			0.130	0.066	0.005	-0.003	0.263	1.918	0.055	
Overall			0.034	0.009	0.000	0.016	0.052	3.687	0.000	

-1.00   -0.50   0.00   0.50   1.00

Favours A   Favours B

Meta Analysis of Emotion Dysregulation and NSSI

Figure 4. Subgroup analyses of the effect of emotion dysregulation on NSSI behavior. The figure presents the subgroup names, study authors, individual study characteristics and pooled effect sizes. Black lines represent the 95% confidence interval of individual studies, the red diamonds represent the pooled effect of each subgroup and the white diamond represents the total pooled effect of emotion dysregulation on NSSI while taking into consideration the subgroup analysis.

<center>**Discussion**</center>

Reviewing the data on three of the most prominent risk factors of NSSI behavior, childhood adversity, insecure attachment and emotion dysregulation, it was observed that each predictor had a unique association with NSSI. While childhood adversity was found to be associated both directly and indirectly to NSSI behavior, emotion dysregulation appeared to have a more mediational or moderational role in the development of NSSI. Studies investigating the relationship between attachment and NSSI are still very few and with high heterogeneity within their methodology, which limits our understanding of the type of their relationship. What becomes apparent from the attachment literature is that preoccupied insecure attachment seems to be the attachment style related to NSSI behavior. Studies investigating the interactions of these risk factors suggest that a model including all three risk factors might be a promising predictor of NSSI. Meta-analytic data has shown that overall childhood adversity and emotion dysregulation are significantly related with NSSI. Pooled effect sizes revealed a significant small to medium effect of childhood maltreatment and a small effect of emotion dysregulation on NSSI. As expected after the narrative review, the pooled effect of attachment was found to be non-significant. This could be explained by the limited number of studies on the topic, or it could be an indication that other factors are mediating their relationship, such as emotion dysregulation, as it was demonstrated by Yurkowski et al. (2015), Tatnell et al. (2018) and Guerin-Marion et al. (2019).

The outcomes of this systematic review are in agreement with previous systematic reviews on the topics (Serafini et al., 2017; Liu et al., 2018; Buckmaster et al., 2019; Wrath & Adams, 2019), demonstrating an association between childhood maltreatment, attachment, emotion dysregulation and NSSI. Similar to Wrath and Adams (2019) and Buckmaster et al. (2019), there are only a few studies investigating the relationship between attachment and

NSSI and although there are not enough studies to support it, insecure attachment is suggested to be related to NSSI. Meta-analytic outcomes are only calculated previously for childhood maltreatment (Klonsky & Moyer, 2008; Liu et al., 2018) and emotion dysregulation (Wolff et al., 2019). With regards to childhood maltreatment, the effect sizes reported in this systematic review were similar to Liu et al. (2018), who investigated the effect of childhood maltreatment in both adolescents and adults (OR=3.42). In contrast to this study, a publication bias was not found by Liu et al. (2018), which could suggest that studies on adolescents might be covering the missing publication from the adult literature. The pooled effect size reported by Wolff et al. (2019) for emotion dysregulation appears to be slightly higher (OR=2.40) than the findings from this meta-analysis, which could also be explained by the difference in the population used (both adolescents and adults in the Wolff et al. (2019) study).

Despite the thorough investigation of the associations between the three predictors and NSSI, the limitation of this review is mostly the methodology design used by the eligible studies. Findings from the synthesis are based on cross-sectional study designs with self-report data, small sample sizes, high heterogeneity and possible publication bias. Therefore, the findings might not reflect the actual associations between the predictors and NSSI. Additionally, the cross-sectional study designs limit our ability to infer causality between the predictors and NSSI, hence, definitive conclusions to their research questions cannot be drawn. However, studies with self-report data and small sample sizes mark the initial steps of research development within the NSSI literature and hence, reviewing them can aid to design better informed and of higher quality studies. Some of its strengths are its compliance with the NSSI definition (studies with suicidal ideation where excluded), the inclusion of more than one predictors, the use of a variety of search engines and its combination of both a

narrative and a meta-analytic synthesis, which provides a wider understanding of the associations.

Taking into consideration the wider picture provided by this review, findings suggest that it might be fruitful to explore in future studies whether the relationship between childhood maltreatment and NSSI is serially mediated by insecure attachment and emotion dysregulation. Studies investigating the interaction of these variables supported the mediational role of emotion dysregulation in the relationship between childhood maltreatment and NSSI, even with adolescent samples (Titelius et al., 2018), but also in the relationship between attachment and NSSI (Kimbal & Diddams, 2007). Consequently, combining the two proposed models could increase our understanding of the risk processes leading to NSSI behavior. Additionally, given the small proportion of individuals engaging in NSSI behavior, it might be beneficial to focus on NSSI samples, instead of collecting data from a general population and then identifying the NSSI group, in order to increase the NSSI sample sizes and hence, the power of the study and the validity of findings.

In conclusion, 79 studies were reviewed in order to explore the predictive effect of childhood maltreatment, emotion dysregulation and attachment on NSSI behavior. Studies were synthesized both in a narrative form and in a quantitative form using a meta-analytic software. Findings from this systematic review and meta-analysis demonstrated significant effects of childhood maltreatment and emotion dysregulation on NSSI, suggesting that both can be significant predictors of NSSI behavior. Non-significant effects of attachment on NSSI could be attributed to the small number of studies investigating the relationship, but also to other mediational variables influencing the predictive abilities of attachment, as it was indicated in the narrative synthesis. The limitations of the review were based on the methodology of eligible studies. Future studies may benefit from exploring the serial

mediational effect of attachment and emotion dysregulation on the association between

childhood maltreatment and NSSI.

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Appendices

Appendix A. Search string employed for electronic database searches.

"self-harm", OR "self harm", OR "non-suicidal self injury", OR "non suicidal self injury", OR "self-injury", OR "self injury", OR "NSSI", OR "deliberate self-harm", OR "deliberate self harm", OR "self-cut", OR "self cut", OR "self-mutil*", OR "self-inflicted injur*" AND "early life experiences" OR "childhood experiences" OR "adverse early life events" OR "childhood events" OR "early trauma" OR "early life adversity" OR "early life stress" OR "attachment" OR "attach*" OR "emotion regulation" OR "emotion dysregulation" OR "mood regulation" OR "affect regulation" OR "emotion process" AND "adults" OR "adulthood" OR "grown-up" OR "mature person" OR "grown*"

Appendix B. Summary of reviewed studies' characteristics, effect sizes and key findings.

Study	Country	Type of study	Sample size	Gender (% of females)	Mean Age (years)	Diagnosis	Recruitment method	Type of outcome measure	Possible mediators/moderators	Effect sizes of direct relationship (Cohen's d)	Key findings
Arens et al. (2012)	USA	OCS	407	65%	20.33	Not assessed	University	Self-report	Negative Urgency	0.05	Negative urgency mediated the relationship between CM and NSSI
Arens et al. (2014)	USA	OCS	641	73%	19.68	Not assessed	University	Self-report	Negative urgency, Distress Tolerance, Sense of Control and Desire for control	0.02	CM directly associated with NSSI and via distress tolerance and negative urgency.
Armey et al. (2012)	USA	OEMA	36	75%	18.70	Not assessed	University	Self-report	Affect Dysregulation	0.43 for sexual abuse 0.61 for physical abuse	CM before the age of 6 was significantly associated with NSSI. The interaction of trauma history and affect dysregulation was not significant.
Bedi et al. (2014)	Canada	OCS	167	100%	39.95	Not assessed	Women Recovering from Abuse Program	Self-report & Projective tests	N/A	0.65 for ER 0.27 for attachment	NSSI group reported greater difficulties with ER. No significant difference between groups with regards to attachment. Cumulative risk predicted NSSI.
Bentley et al. (2017)	USA	RCT	10	90%	21.3	Several	Referred by institutions, online recruitment	Self-report & Clinical reports	N/A	N/A	Significantly smaller proportions of NSSI acts during the mindful emotion awareness, cognitive reappraisal, and follow-up phases compared to the baseline phase.

Study	Country	Design	N	% Female	Age	Clinical Group	Setting	Measure	Mediator	Effect Size	Findings
Bolen et al. (2012)	USA	OCS	78	Not reported	34.2	Adult survivors of childhood sexual abuse	Specific Agency	Self-report	N/A	-0.44	Attachment was a significant predictor of NSSI.
Bornovalo-va et al. (2011)	USA	OCS	180	28%	43.05	Substance abuse	Inpatient unit	Self-report	N/A	0.55	Only sexual abuse had a significant effect on NSSI.
Braga & Gonçalves (2014)	Portugal	OCS	518	67%	20.9	Not reported	University	Self-report	N/A	-0.27 for anxiety -0.29 for comfort with proximity -0.14 for trust in others.	Significant differences between NSSI group and non-NSSI group with regards to attachment variables.
Buckholdt et al. (2015)	USA	OCS	Study 1: 118 Study 2: 82	Study 1: 76% Study 2: 48%	Study 1: 20.9 Study 2: 36.6	Study 1: Not reported Study 2: Substance abuse	Study 1: University Study 2: Residential substance abuse treatment facility	Self-report	N/A	Study 1: 0.09	No significant differences between NSSI and non-NSSI groups with regards to total ER scale. Differences were reported for certain ER aspects (e.g. goal directed behaviors).
Bureau et al. (2010)	Canada	OCS	1238 (105 with NSSI)	71.6%	19.4	Not assessed	Online university system for psychology students	Self-report	N/A	-0.03 for failed protection -0.03 for anger 0.11 for fear 0.01 for care, & overprotection 0.02 for trust -.02 for communication 0.05 for alienation	Attachment variables predicted NSSI but not in men.
Caron et al. (2017a)	Canada	OCS	406	85%	19.87	Not assessed	University	Self-report	Intimate partner victimization	0.12	CM was directly associated with NSSI.
Caron et al. (2017b)	Canada	OCS	263	87.8%	20.5	Not assessed	Introductory psychology courses and external advertisments	Self-report	N/A	0.53	Insecure attachment and particularly anxiety was related to NSSI behaviors.

78

Chang et al. (2019)	USA	OCS	287	100%	20.2	Unclear	University	Self-report	N/A	0.12	Sexual assault consistently accounted for unique variance in NSSI.
Claes et al. (2016)	Belgium	OCS	42	71.4%	22.76	Not assessed	Through Facebook	Self-report & Experimental	Communication with the mother	0.90 for communication 0.33 for trust	The results showed that students with a more enhanced attentional focus on their mother and low Trust in their mother had a significant higher probability to engage in NSSI compared to students with high Trust in their mother; however, for students with a low attentional focus on mother, the level of Trust did not influence the probability to engage in NSSI.
Davis et al. (2014)	USA	OCS	Study 1: 148 Study 2: 48	Study 1: 42.6% Study 2: 100%	Study 1: 43.7 Study 2: 28	Depression, Anxiety	Postings online – part of a larger study	Self-report & Lab-based	N/A	Study 1: 0.70 Study 2: 0.81	Study 1: The results suggest that although the control groups reduced negative emotion with reappraisal, the NSSI did not. Study 2: NSSI group reported less successful regulation in the amygdala.
Dixon-Gordon et al. (2014)	USA	OCS	246	36.2%	35.6	Mainly PTSD and substance-use	Residential SUD treatment facility	Clinician report and self-report	N/A	0.46	Sexual assault related trauma was a significant predictor of NSSI.
Evren & Evren (2005)	Turkey	OCS	136	0%	28.5 (NSSI group) 40.6 (non-NSSI group)	Substance-dependence	State hospital	Self-report	N/A	0.61	Childhood physical abuse predicted NSSI.
Evren et al. (2006)	Turkey	OCS	112	0%	27.8 (NSSI group) 36.7 (non-	Substance-dependence	State hospital	Self-report + Clinical report	N/A	0.43	Childhood physical abuse predicted NSSI.

					NSSI group)						
Evren et al. (2011)	Turkey	OCS	156	0%	38.7 (NSSI group) 47.1 (non-NSSI group)	Alcohol Dependent	State Hospital	Self-report	N/A	0.51	CM was related to NSSI but not a predictor to it.
Ewing et al. (2019)	Canada	OLT	1132	70.5%	19.11	Not assessed	Posters, classroom announcements, website postings and residence visits.	Self-report	ER	0.005	ER mediated the relationship between stressful experiences and NSSI (bidirectionally)
Franzke et al. (2015)	Germa-ny	OCS	87	100%	41.32	Unclear	Inpatient clinic	Self-report	Dissociative, Post-traumatic, depressive symptoms	0.06	Dissociation independently mediated the relation between CM and NSSI, but not the other mediators.
Gholam-rezaei et al. (2017)	Iran	OCS	556	57.2%	22.65	Not assessed	University	Self-report	N/A	Non-acceptance: 0.08 (women) Impulse: 0.02 (women), 0.21 (men) Awareness: 0.23 (women) Strategies: 0.06 (women), 0.05 (men) Goals: 0.05 (men)	No DERS subscale significantly predicted NSSI after controlling for anxiety and suicide ideation.
Gladstone et al. (2004)	Austra-lia	OCS	126	100%	37.8	Depression, Dysthymia, Adjustment disorder	Mood Disorders Unit at a hospital	Self-report	Personality Dysfunction	0.40	Childhood physical & emotional abuse and neglect were associated with NSSI via personality dysfunction. Direct effect of sexual abuse on NSSI.
Gratz (2006)	USA	OCS	249	100%	23.29	Not assessed	Psychology courses	Self-report	N/A	0.49 for childhood maltreatment	Among women with a history of self-harm, emotional inexpressivity was associated with more frequent self-harm, as was

										0.14 for emotion dysregulation	the combination of greater maltreatment, greater inexpressivity and lower levels of positive affect intensity/reactivity.
Gratz & Chapman (2007)	USA	OCS	97	0%	22.67	Not assessed	University	Self-report	N/A	-1.39 for sexual abuse 1.83 for physical abuse 0.03 for emotion dysregulation	Only physical abuse and emotion dysregulation reliably predicted NSSI.
Gratz et al. (2002)	USA	OCS	133	67%	22.73	Not assessed	University	Self-report	N/A	0.13 for sexual abuse 0.11 for physical abuse	Physical abuse was not a unique predictor to NSSI and sexual abuse was not a predictor for men.
Gratz et al. (2015)	USA	RCT	61	100%	33	Borderline Personality Disorder	Clinical referrals & advertisements	Self-report	ER	0.10	No significant correlation between ER and NSSI (when examined directly). Significant effects were reported for their indirect correlation based on changes in BPD affective + cognitive symptoms.
Gratz & Roemer (2008)	USA	OCS	249	100%	23.29	Not assessed	Undergraduate psychology courses	Self-report	Emotion Dysregulation	0.37 for emotion dysregulation 0.37 for CM	CM and emotion dysregulation independently predicted NSSI. However emotion dysregulation was not a mediator between CM and NSSI. (only strategies were a significant mediator).
Gratz & Tull (2010)	USA	OCS	61	46%	44.45	Cocaine dependence, PTSD, Borderline personality disorder	Inpatient residents in drug and alcohol abuse treatment center	Self-report	N/A	0.55	No significant differences in emotion dysregulation between participants with and without recent NSSI Even when controlling for the influence of other risk factors emotion dysregulation, remained significantly higher among NSSI group.

Gratz, Tull & Levy (2014)	USA	RCT	61	100%	33	Borderline Personality Disorder	Referrals by clinicians & self-referrals	Self-report	N/A	N/A	Particular improvements in NSSI after ER group therapy.
Guerin-Marion et al. (2019)	Canada	OCS	114	89%	20.4	Not assessed	University	Self-report	ER	0.63 for non-acceptance of emotions 0.03 for goal directed behaviors 0.68 for impulse control 0.37 for emotional awareness 0.77 for limited access to strategies 0.78 for emotional clarity	Significant indirect effects of maternal maltreatment on NSSI through limited access to ER strategies, lack of emotional clarity, and difficulties engaging in goal-directed behavior. Indirect effects from paternal maltreatment were only apparent through poorer emotional clarity.
Gunter et al. (2011)	USA	OCS	337 (14% NSSI)	35%	33.9	Several	Community corrections office	Self-report and community records	N/A	0.47	CM was a significant predictor of NSSI
Hallab & Covic (2010)	Australia	OCS	114	81%	18.89	Depression and anxiety	University-based research participation system: psychology students.	Self-report	Mood states	0.05	No significant effect of mother attachment on NSSI, although lower attachment scores were reported by the NSSI group.
Howard et al. (2017)	UK	OCS	89	100%	34.52	59.6% were on psycho-tropic medication	Female prison	Self-report	PTSD symptoms, emotion regulation and dissociation	0.75 for emotion abuse 0.50 for physical abuse 0.67 for sexual abuse 0.40 for emotion neglect 0.38 for physical neglect 0.43 for multiple traumas	Emotion dysregulation mediated the effect of CM on NSSI.

Idig-Camuro-glu & Golge (2018)	Turkey	OCS	1000 (only 285 with NSSI)	69%	Not reported – majority between 18-20	Not assessed	State and Private Universities	Self-report	N/A	0.03 for physical abuse in women 0.03 for emotion abuse in women 0.04 for emotion abuse in men 0.04 for sexual abuse in men 0.05 for physical abuse in men	All types of trauma had a significant effect on NSSI. The interaction between gender and NSSI was significant only on the sexual abuse scale.
Johnsto-ne et al. (2015)	New Zea-land	RCT but data reported was OCS	372 (only 11% with NSSI)	64%	33.3	Non-psychotic major depresssion episode	Outpatients	Clinician-rated & self-report	N/A	0.22 general abuse 0.17 sexual abuse	Not direct association between CM and NSSI
Krazler et al. (2016)	USA	OCS	148	70.9%	21.48	Not assessed	University	Self-report	Internalizing symptoms	0.04	Direct path from emotion dysregulation to NSSI was not significant. However, the indirect association via internalizing symptoms was significant.
Lear & Pepper (2016)	USA	OCS	146	83.65%	19.32	Not assessed	Psychology participant pool at University	Self-report	Self-Concept clarity	0.96 for lifetime NSSI 1.04 for NSSI versatility	Emotion dysregulation was a predictor of lifetime NSSI and NSSI versatility.
Macry-nikola	New York	OCS	1712 (18% NSSI)	81%	22.76	Not assessed	College	Self-report	Social connectedness	0.19	Stressful events were associated with NSSI, but there was no interaction with social connectedness.
Martin, A. et al. (2011)	USA	OCS	455	43%	40.11	Several	Flyers in clinics	Self-report	N/A	0.70	No significant differences in emotion dysregulation between with and without recent NSSI. Higher levels of emotion dysregulation between NSSI and no NSSI group.

Martin et al. (2011)	Canada	OCS	1296 (only 90 with NSSI actions)	74.6%	19.29	Not assessed	University	Self-report	N/A	1.02	The NSSI-action group reported significantly higher severity of sexual abuse history than participants in the other two groups
Martin et al. (2015)	Canada	OCS	528	77.6%	19.32	Not assessed	From introductory psychology courses	Self-report	N/A	For negative invalidating: -0.14 (1-5 times) and 0.14 (more than 5 times). For positive moderate: 0.24 (1-5 times) and -0.24 (more than 5 times) For positive idealistic: 0.05 (1-5 times) and -0.05 (more than 5 times) For negative disturbed: -0.22 (1-5 times) and 0.22 (more than 5 times)	Four different profiles were identified and the NSSI group differed significantly in these groups from the non-NSSI group.
Martin et al. (2016)	Canada	OCS	957	78%	20.14	Not assessed	Research participant pool at a University	Self-report	N/A	0.20	Adverse life events were uniquely associated with NSSI.
Martin et al. (2017)	Canada	OCS	120	88%	20.38	Not assessed	Research participant pool at a University & external advertise-ments posted online	Self-report	N/A	0.34 for preoccupied attachment 0.10 for dismissing attachment	Preoccupied, but not dismissing states of mind were significant predictors of NSSI.
McLaf-ferty et al. (2019)	Ireland	OCS	716	63%	20.69	Not reported	University	Self-report	N/A	0.37	Individuals with CM, who experience stress, were more likely to experience NSSI.

Study	Country	Design	N	% Female	Age	Diagnosis	Recruitment	Measure	Mediator/Moderator	Effect size	Findings
McMa-hon et al. (2018)	USA	OCS	34, 653	58%	Not reported – All above 18 years old	Not reported	Data drawn from a national study	Self-report	Unclear	For emotional neglect: 0.52 in men and 0.54 in women. For physical neglect: 0.71 in men and 0.91 in women. For emotional abuse: 0.72 in men and 0.77 in women. For sexual abuse: 0.96 in men and 0.99 in women. For physical abuse: 0.76 in men and 0.89 in women.	Significant effect of CM on NSSI and specifically, child sexual abuse.
Merza et al. (2017)	Hungary	OCS	80	81.4% in the moderate NSSI group and 94.7% in the super NSSI group	29.6 the moderate NSSI group and 29.7 the super NSSI group	Borderline Personality disorder	Public Psychiatric hospitals	Self-report	N/A	-0.07 for physical abuse 0.21 for sexual abuse	CM significantly related with more NSSI engagement.
Midkiff et al. (2018)	USA	OCS	187	76.5%	20.21	Not assessed	University and word-of-mouth	Self-report	Coping Self-efficacy	0.79	Emotion dysregulation was a unique predictor to NSSI.
Molaie et al. (2019)	USA	OCS	200	53.5%	35.4	Several	Clinical referrals	Self-report	Emotional pain	-0.03 for secure attachment 0.08 for preoccupied attachment 0.01 for dismissing attachment 0.04 for fearful attachment	Preoccupied attachment was the sole significant independent predictor of NSSI. Acute emotional pain was a significant partial mediator of the relationship between preoccupied attachment style and lifetime NSSI.

Muehlen-kamp et al. (2010)	USA	OCS	2238	66%	19.7	Not assessed	University	Self-report	N/A	0.35	Participants with CM were significantly more likely to report NSSI.
Muehlen-kamp et al. (2013)	USA	OCS	398	74.6%	20.25	Not assessed	University	Self-report	N/A	0.03	Emotion dysregulation did not predict NSSI. Significant association between emotion dysregulation and NSSI only among individuals with low body regard.
Nada-Raja & Skegg (2011)	New Zea-land	OLT	916	49%	26	Several	From a cohort study	Self-report	N/A	0.51 for men 0.22 for women	For both genders, childhood sexual abuse was not a significant predictor of NSSI.
Navarro-Haro et al. (2015)	Spain	OCS	91 - 68 in final analys is	100%	27.48	Borderline Personality Disorder & Eating Disorder	Private clinic	Self-report	N/A	0.05 for cognitive reapparaisal 0.07 for expressive suppression	Expressive suppression was related to an increase in NSSI. In addition, the level of expressive suppression determined the effect cognitive reappraisal had on NSSI (and vice versa).
Nicolai et al. (2016)	USA	OCS	142	72%	19.3	Not assessed	Classroom recruitment	Self-report	N/A	0.33	Significant effect of rumination on NSSI.
Nobakht & Dale (2017)	Iran	OCS	200	50%	25.1	Not assessed	University	Self-report	Dissociation, Depersonalizati on/ derealization	0.04	Childhood trauma was associated to NSSI. Depersonalization/ derealization mediated the relationship between childhood trauma and NSSI, while dissociation mediated the relationship between recent trauma and NSSI.
O'Neill et al. (2018)	Ireland	OCS	739	62.5%	21	Mood disorders, GAD, Alcohol dependence	University	Self-report	N/A	0.94 for high risk adversities 0.56 for moderate risk of adversities	Association between NSSI and moderate or high levels of childhood adversities.
Oyefeso et al. (2008)	UK	OCS	80	27.5%	38.4	Stimulant-dependence	Inpatient and outpatient settings	Self-report	N/A	0.45	Sexual harassment independently predicted NSSI.

Study	Country		N								
Paivio & McCulloch (2004)	Canada	OCS	100	100%	21	Not reported	Pool of students	Self-report	Alexithymia	0.80	A significant path from childhood maltreatment to NSSI, which was not significant after controlling for alexithymia.
Richmond-Rakerd et al. (2018)	Austra-lia	OCS	9526	58.6%	31.7	Not assessed	Twin Registry	Self-report	N/A	0.01	Correlation between high-risk trauma exposure and NSSI.
Rodriguez-srednicki (2002)	USA	OCS	441 (only 4.1% with NSSI)	100%	20.6	Not assessed	Public colleges and Universities	Self-report	Dissociation	0.41	No significant difference between childhood sexual abuse and no sexual abuse group with regards to NSSI.
Roe-Sepowitz (2007)	USA	OCS	256 (109 with NSSI)	100%	35.46	Not assessed	From prisons	Self-report	N/A	0.96 for emotional abuse 0.83 for sexual abuse	Significant association between CM and NSSI.
Sansone et al. (1995)	USA	OCS	152	100%	Not reported	Borderline Personality Disorder	Health maintenance organisation	Self-report	N/A	1.01 for sexual abuse and physical abuse	Sexual abuse and physical abuse were predictive of NSSI.
Swannell et al. (2012)	Austra-lia	OCS	11,423 (186 with NSSI)	62.2%	52.11	Several	Electronic white pages	Self-report	Dissociation, alexithymia, self-blame	0.95 for females 0.69 for males	CM increased the odds of NSSI and particularly physical abuse.
Talmon & Ginzburg (2018)	Israel	OCS	766	65%	25.95	Not assessed	Social media networks	Self-report	Dissociation	0.70	Childhood sexual abuse had a significant effect on NSSI, even after controlling for dissociation.
Tatnell et al. (2018)	Austra-lia	OCS	237	89.5%	20.77	Not assessed	University	Self-report	Emotion dysregulation variables	-0.06 for secure attachment -0.04 for dismissing attachment 0.02 for preoccupied attachment 0.14 for fearful attachment 0.03 for suppression	Attachment-related anxiety with mothers indirectly predicted NSSI through limited access to emotion regulation strategies.

										0.02 for reappraisal -0.03 for non-acceptance 0.09 for lack of goals 0.06 for impulse control 0 for awareness 0.04 for strategies 0.04 for clarity	
Terzi et al. (2017)	Italy	OCS	79	79.7%	34	Borderline Personality Disorder	Outpatient centers	Self-report	N/A	0.07	Emotion dysregulation was a significant predictor of NSSI.
Tresno et al. (2013)	Japan	OCS	313 (31 with NSSI)	50%	19	Not reported	Psychology classes	Self-report	N/A	0.12	CM was an independent predictor of NSSI, however, its interaction with emotion dysregulation made it a stronger predictor.
Van der Kolk et al. (1991)	USA	OLT	74	52%	Not reported	Borderline Personality Disorder (32%)	Clinical settings, advertisements and local probation department	Self-report	N/A	0.05 for physical abuse 0.07 for sexual abuse	Childhood trauma predicted NSSI and particularly sexual abuse – the earlier the trauma the more cutting. Dissociation improved the predictive models.
Wachter et al. (2009)	UK	OCS	58	72%	37.05	Mood disorders, anxiety disorders and dissociation	Community mental health teams, psychiatry outpatient clinics and clinical psychology services	Self-report & Interview	N/A	1.03	CM was a significant predictor of NSSI and particularly physical abuse.
Weaver et al. (2004)	USA	OCS	89	100%	33.06	PTSD	Through flyers and letters	Self-report	PTSD	-0.06	Age of onset of sexual abuse significantly predicted NSSI and via PTSD.

Weintraub et al. (2017)	USA	OCS	142	70.4%	34.2	Depression, Bipolar	Registry database program, referrals and posting flyers	Self-report & clinician rated	N/A	0.51	Significant association between NSSI and emotion regulation.
Wilcox et al. (2012)	USA	OLT	1081	54%	Not reported (range: 17-19)	Not assessed	Public University	Self-report	N/A	0.53	Affect dysregulation was a significant predictor of NSSI, even after controlling for lifetime suicide attempt.
Yates et al. (2008)	USA	OLT	155 (26 with NSSI)	51.6%	26	Not reported	From a longitudinal study of parents and children	Direct interviews, caregiver interviews, from medical records and teacher interviews	Dissociation and somatization	1.25 for sexual abuse 1.10 for physical abuse	Child sexual abuse increased the likelihood of recurrent self-injury (dissociation as possible mediator), but was not predictive of intermittent NSSI. Child physical abuse was not predictive of recurrent NSSI but it was predictive of intermittent NSSI.
Yurkowski et al. (2015)	Canada	OCS	1153 (79 NSSI)	79%	19.35	Not assessed	Psychology courses	Self-report	ER	0.01 for ER -0.01 for parent trust -0.01 for parent communication 0.06 for parent alienation	Alienated from parents was a predictor of NSSI. No direct effect of attachment on NSSI. ER predicted NSSI. ER mediated the effect of attachment on NSSI.
Zanarini et al. (2011)	USA	OLT	140	80.3%	26.9	Borderline Personality Disorder	Hospital	Interviews	N/A	0.54	Childhood abuse was a predictor of NSSI over time.
Zelkowitz et al. (2016)	USA	OCS	379 (24.46% NSSI)	79.1%	18.62	Not assessed	Undergraduate research pool	Self-report	N/A	-0.02 for expressive suppression 0.03 for cognitive reappraisal 0 for impulse 0.05 for strategies 0.02 for clarity 0.01 for directed goals	Only DERS strategies showed significant effect on NSSI.

										0.01 for awareness -0.02 for nonacceptance -0.03 for Internal Functional -0.03 for external dysfunctional 0.02 for external functional 0.04 for internal dysfunctional	
Zlotnick et al. (1996)	USA	OCS	148 (103 with NSSI)	100%	33	Not specified	Women's psychiatric unit	Self-report	N/A	0.05	Childhood sexual abuse was related to NSSI but could not be tested for predictive abilities due to high colinearity with dissociation.
Zweig-Frank et al. (1994a)	Canada	OCS	150	100%	29	Personality disorders	Outpatient department of a University hospital	Self-report & Clinician-rated	N/A	0.14	CM variables were not significant predictors of NSSI, although greater frequency of child sexual abuse was reported in NSSI group.
Zweig-Frank et al. (1994b)	Canada	OCS	121	0%	31.45	Personality disorders	University clinic and newspaper advertisements	Self-report & Clinician-rated	N/A	Not reported	None of CM factors was a significant predictor of NSSI.

Abbreviations:

CM = childhood maltreatment

ER = emotion regulation

OCS = observational cross-sectional study

OLT = observational longitudinal study

OEMA = observational – ecological momentary assessment study

RCT = randomized controlled trial

90

Appendix C. Methods of computing effect sizes and standard error.

Computations were done with the use of online effect size calculators, such as the Psychometrica calculator (https://www.psychometrica.de/effect_size.html) and the Campbell Collaboration calculator (http://www.campbellcollaboration.org/escalc/html/EffectSizeCalculator-R2.php) and by specific formulas provided in the Cochrane Handbook for Systematic Reviews, such as "SE = (upper limit – lower limit) / 3.92" when the 95% confidence interval was available (Higgins & Green, 2011). When only beta values were reported by the authors, specific formulas were used as recommended by Peterson and Brown (2005), who argued that it is better to use beta-values than to omit studies. Omitting studies could lead to biases in the review outcomes.

Appendix D. Quality assessment of observational studies.

a) Quality assessment of studies investigating childhood maltreatment and NSSI.

Study	Selection (maximum 5 stars)				Comparability (maximum 2 stars)	Outcome (maximum 3 stars)	
	Representati-veness of the sample	*Sample size*	*Non-respondents*	*Ascertainment of risk factor*	*Subject groups comparability – confounding variables controlled*	*Assessment of the outcome*	*Statistical analysis/test*
Cross-sectional studies (N = 42)							
Arens et al. (2012)	★	-	-	★★	★★	★	★
Arens et al. (2014)	★	★	-	★★	★★	★	★
Armey et al. (2012)	★	-	★	★★	★★	★★	-
Bornovalova et al. (2011)	★	★	★	★★	★★	★	★
Caron et al. (2017a)	★	★	-	★★	★★	★	★
Chang et al. (2019)	★	★	-	★	★★	★	-
Dixon-Gordon et al. (2014)	★	★	-	★★	★★	★	-
Evren & Evren (2005)	★	★	★	★★	★	★	★
Evren et al. (2006)	★	★	★	★★	★	★	★

Evren et al. (2011)	★	★	★	★★	★	★	★
Franzke et al. (2015)	★	★	-	★★	-	★	★
Gladstone et al. (2004)	★	★	★	★	★★	★★	-
Gratz & Chapman (2007)	-	-	-	★★	★★	★	★
Gratz & Roemer (2008)	★	★	-	★★	★★	★	★
Gratz et al. (2002)	-	-	-	★★	★★	★	-
Gunter et al. (2011)	★	★	-	★★	★★	★★	★
Howard et al. (2017)	★	★	★	★★	-	★	★
Idig-Camuroglu & Golge (2018)	★	★	★	★★	-	★	-
Johnstone et al. (2015)	★	★	-	★	★★	★★	★
Macrynikola et al. (2018)	★	★	-	★	★★	★	★
Martin et al. (2011)	★	★	-	★★	★★	★	-
Martin et al. (2016)	-	-	-	★★	★★	★	★
McLafferty et al. (2019)	★	★	★	★★	★★	★	★
McMahon et al. (2018)	★	★	★	★★	★★	★	★
Merza et al. (2017)	★	★	-	★★	★★	★	-
Muehlenkamp et al. (2010)	-	-	-	★★	★★	★	-
Nobakht & Dale (2017)	-	★	-	★★	★★	★	★
O'Neill et al. (2018)	★	★	-	★★	★★	★	★
Oyefeso et al. (2008)	★	★	★	★★	★★	★	★
Paivio & McCulloch (2004)	★	★	★	★★	★★	★	-
Richmond-Rakerd et al. (2018)	★	★	-	★	★★	★★	★
Rodriguez-srednicki (2002)	-	-	-	★★	★★	★	-
Roe-Sepowitz (2007)	★	★	-	★★	-	★	★
Sansone et al. (1995)	★	-	-	★	-	★	-
Swannell et al. (2012)	★	★	-	★★	★★	★	★
Talmon & Ginzburg (2018)	★	★	-	★★	★★	★	★
Tresno et al. (2013)	-	★	-	★★	-	★	-
Wachter et al. (2009)	-	-	★	★★	★★	★★	-
Weaver et al. (2004)	★	-	-	★★	★★	★★	-
Zlotnick et al. (1996)	★	★	-	★★	★★	★	-
Zweig – Frank et al. (1994b)	★	★	-	★★	★★	★★	-
Zweig – Frank t al. (1994a)-female	★	★	-	★★	★★	★★	-
Longitudinal studies (N = 4)							
Nada-Raja & Skegg (2011)	★	★	-	★	★★	★	★
Van der Kolk et al. (1991)	★	-	★	★★	-	★★	-
Yates et al. (2008)	-	-	★	★★	★★	★★	★
Zanarini et al. (2011)	★	★	-	★★	★	★★	★

b) Quality assessment of studies investigating attachment and NSSI.

Study	Selection (maximum 5 stars)				Comparability (maximum 2 stars)	Outcome (maximum 3 stars)	
	Representati-veness of the sample	*Sample size*	*Non-respondents*	*Ascertainment of risk factor*	*Subject groups comparability – confounding variables controlled*	*Assessment of the outcome*	*Statistical analysis/test*
Cross-sectional studies (N = 12)							
Bedi et al. (2014)	★	★	-	★★	★★	★★	★
Bolen et al. (2012)	★	-	-	★★	-	★	-
Braga & Goncalves (2014)	★	★	-	★★	-	★	-
Bureau et al. (2010)	-	-	-	★★	★★	★	★
Caron et al. (2017b)	★	★	-	★★	★★	★	-
Claes et al. (2016)	-	-	-	★★	★★	★	★
Hallab & Covic (2010)	-	-	-	★★	★★	★	-
Martin et al. (2015)	-	-	★	★★	★★	★	-
Martin et al. (2017)	★	-	-	★★	★★	★	★
Molaie et al. (2019)	★	★	-	★★	★	★	★
Tatnell et al. (2018)	★	★	-	★★	★★	★	★
Yurkowski et al. (2015)	★	★	-	★★	★★	★	★

c) Quality assessment of studies investigating emotion dysregulation and NSSI.

Study	Selection (maximum 5 stars)				Comparability (maximum 2 stars)	Outcome (maximum 3 stars)	
	Representati-veness of the sample	*Sample size*	*Non-respondents*	*Ascertainment of risk factor*	*Subject groups comparability – confounding variables controlled*	*Assessment of the outcome*	*Statistical analysis/test*
Cross-sectional studies (N = 21)							
Bedi et al. (2014)	★	★	-	★★	★★	★★	★
Buckholdt et al. (2015)	★	★	-	★★	★★	★	-
Davis et al. (2014)	★	★	-	★	★★	★★	-
Gholamrezaei et al. (2017)	-	-	-	★★	★★	★	-
Gratz (2006)	-	-	★	★★	★★	★	★
Gratz & Chapman (2007)	-	-	-	★★	★★	★	★
Gratz & Roemer (2008)	-	-	-	★★	★★	★	★
Gratz & Tull (2010)	★	-	-	★★	★★	★	-

Guerin-Marion et al. (2019)	★	-	-	★★	★★	★	★
Krazler et al. (2016)	-	-	-	★★	★★	★	-
Lear & Pepper (2016)	★	★	-	★★	★★	★	-
Martin, A. et al. (2011)	★	★	-	★★	★★	★	-
Midkiff et al. (2018)	★	★	-	★★	★★	★	★
Muehlenkamp et al. (2013)	-	-	-	★★	★★	★	★
Navarro-Haro et al. (2015)	★	★	★	★★	-	★	★
Nicolai et al. (2016)	★	-	-	★★	★★	★	★
Tatnell et al. (2018)	★	★	-	★★	★★	★	★
Terzi et al. (2017)	★	-	-	★★	-	★	-
Weintraub et al. (2017)	★	★	-	★★	★★	★★	-
Yurkowski et al. (2015)	★	★	-	★★	★★	★	★
Zelkowitz et al. (2016)	★	★	-	★★	-	★	-
Longitudinal studies (N = 2)							
Ewing et al. (2019)	★	★	★	★★	★★	★	★
Wilcox et al. (2012)	★	★	★	★★	★★	★	★

Appendix E. Quality assessment of randomized controlled trials (N=3).

Domain	Signaling Questions	Studies being assessed		
		Bentley et al. (2017)	*Gratz et al. (2014)*	*Gratz et al. (2015)*
Domain 1: Risk of bias arising from the randomization process	*1.1 Was the allocation sequence random?*	Y	Y	Y
	1.2 Was the allocation sequence concealed until participants were enrolled and assigned to interventions?	N	N	N
	1.3 Did baseline differences between intervention groups suggest a problem with the randomization process?	Y	Y	Y
	Risk-of-bias judgement:	High risk	High risk	High risk
Domain 2: Risk of bias due to deviation from the intended interventions (effect of assignment to intervention)	*2.1 Were participants aware of their assigned intervention during the trial?*	PY	PY	PY
	2.2 Were carers and people delivering the interventions aware of participants' assigned intervention during the trial?	Y	Y	Y
	2.3 If Y/PY/NI to 2.1 or 2.2: Were there deviations from the intended intervention that arose because of the trial context?	PN	NI	NI
	2.4 If Y/PY to 2.3: Were these deviations likely to have affected the outcome?	NA	NA	NA
	2.5 If Y/PY/NI to 2.4: Were these deviations from intended intervention balanced between groups?	NA	NA	NA
	2.6 Was an appropriate analysis used to estimate the effect of assignment to intervention?	Y	Y	Y

		2.7 If N/PN/NI to 2.6: Was there potential for a substantial impact (on the result) of the failure to analyse participants in the group to which they were randomized?	NA	NA	NA
		Risk-of-bias judgement:	Low risk	Some concerns	Some concerns
Domain 3: Risk of bias due to missing outcome data		*3.1 Were data for this outcome available for all, or nearly all, participants randomized?*	Y	N	N
		3.2 If N/PN/NI to 3.1: Is there evidence that the result was not biased by missing outcome data?	NA	Y	Y
		3.3 If N/PN to 3.2: Could missingness in the outcome depend on its true value?	NA	NA	NA
		3.4 If Y/PY/NI to 3.3: Is it likely that missingness in the outcome depended on its true value?	NA	NA	NA
		Risk-of-bias judgement:	Low risk	Low risk	Low risk
Domain 4: Risk of bias in measurement of the outcome		*4.1 Was the method of measuring the outcome inappropriate?*	N	N	N
		4.2 Could measurement or ascertainment of the outcome have differed between intervention groups?	N	N	N
		4.3 If N/PN/NI to 4.1 and 4.2: Were outcome assessors aware of the intervention received by study participants?	Y	N	N
		4.4 If Y/PY/NI to 4.3: Could assessment of the outcome have been influenced by knowledge of intervention received?	PY	NA	NA
		4.5 If Y/PY/NI to 4.4: Is it likely that assessment of the outcome was influenced by knowledge of intervention received?	PY	NA	NA
		Risk-of-bias judgement:	High risk	Low risk	Low risk
Domain 5: Risk of bias in selection of the reported result		*5.1 Were the data that produced this result analysed in accordance with a pre-specified analysis plan that was finalized before unblinded outcome data were available for analysis?*	PY	PN	PN
		Is the numerical result being assessed likely to have been selected on the basis of the results, from…			
		5.2 …multiple eligible outcome measurements (e.g. scales, definitions, time points) within the outcome domain?	N	N	N
		5.3 …multiple eligible analyses of the data?	PN	PN	PN
		Risk-of-bias judgement:	Low risk	Some concerns	Some concerns
		Overall Risk-of-bias Judgement:	High risk	High risk	High risk

Appendix F. Funnel Plots investigating publication bias.

a) Publication bias in studies exploring the effect of childhood maltreatment on NSSI.
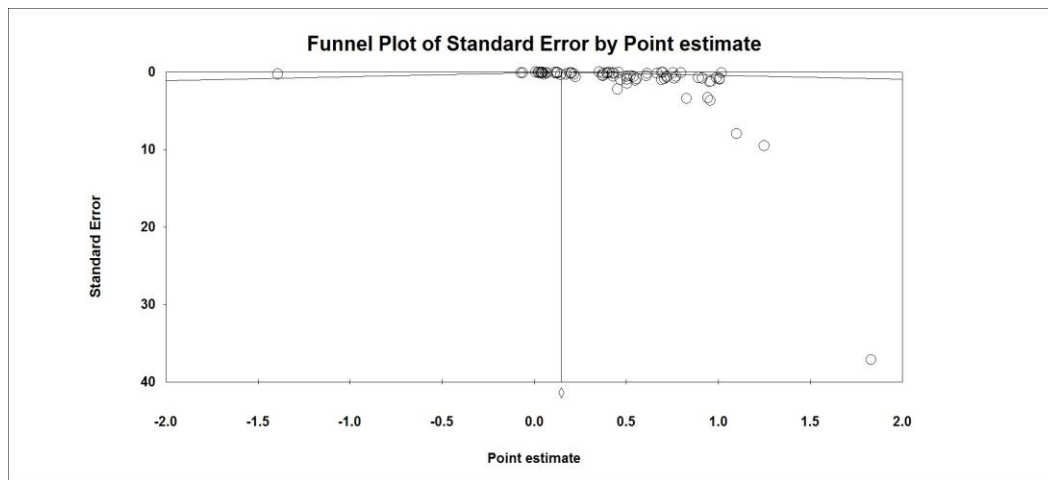
b) Publication bias in studies exploring the effect of attachment on NSSI.
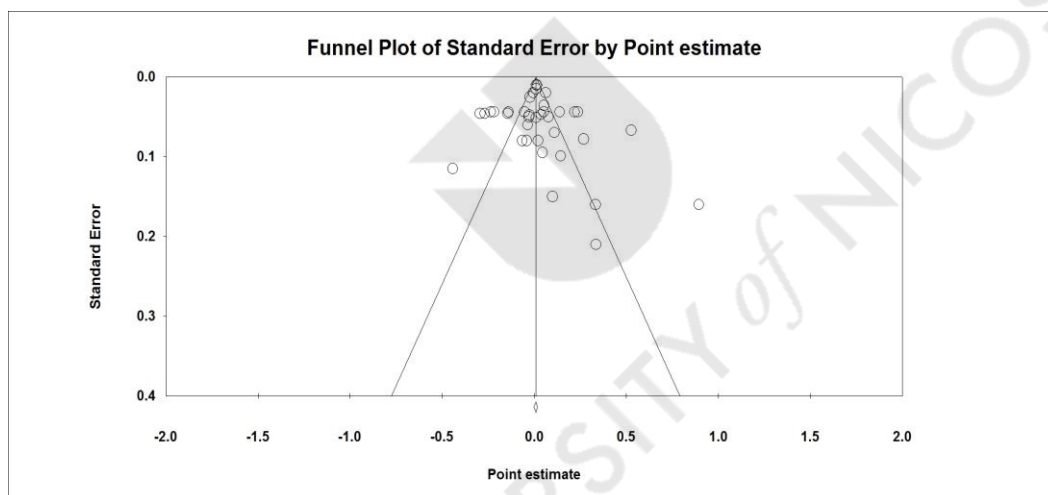
c) Publication bias in studies exploring the effect of emotion dysregulation on NSSI.
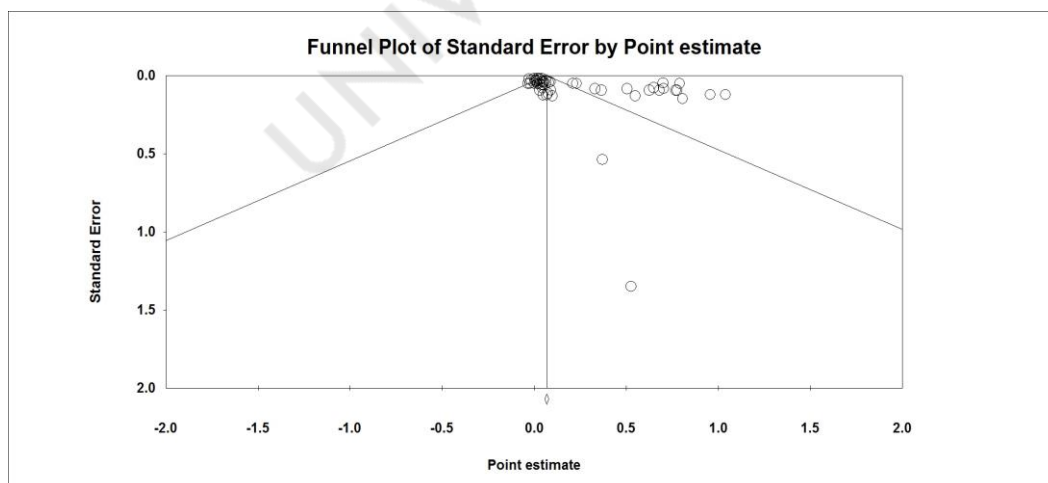
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The serial mediational role of Attachment and Emotion Regulation in the relationship between Early Life Experiences and Non-suicidal Self-Injury

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Abstract

Objective: The aim of the study was to investigate whether the relationship between early life experiences and non-suicidal self-injury (NSSI) is serially mediated by insecure attachment and emotion dysregulation. Studies have shown that all three factors have a significant effect in predicting NSSI behavior, however, there are no previous studies exploring the pathway leading to NSSI with these factors. **Method:** A sample of 284 adults (77% females) was recruited online via specific self-harm groups on social media platforms (e.g. the subreddit r/AdultSelf-Harm on Reddit) and was asked to complete an online survey, consisting of four self-report questionnaires. Conditional process analysis was used to investigate the proposed model (using the PROCESS macro). **Results:** The findings supported the serial mediation model [Indirect effect = 0.004, SE = 0.002, 95% CI (0.0007, 0.0090)], even after controlling for previous suicide attempts. **Conclusions:** The findings of the study seem to provide a fruitful start to the development of conceptual models of NSSI. Applications regarding early identification and assessment of NSSI and the development of specific interventions are discussed.

Keywords: early life experiences, attachment, emotion regulation, self-harm, NSSI

Introduction

Despite the absence of suicidal intent presented in non-suicidal self-injury (NSSI), NSSI has been highly correlated with suicide attempts and completed suicides both in community and clinical samples regardless of age (Grandclerc, De Labrouhe, Spodenkiewicz, Lachal, & Moro, 2016; Ribeiro et al., 2016). Although research on NSSI has increased in recent years, little is known about the phenomenon when compared to suicidal behavior. Due to the absence of a clear understanding of the concept, there are several definitions of NSSI within the literature (Favazza, 1998; Bragazzi, 2014; Groschwitz et al., 2015). However, the majority of studies adopted a definition, which does not take into account outcomes from recent studies (Hawton et al., 2012) and current guidelines (NCCMH, 2012). Taking into consideration the aforementioned issues, for the purposes of this article NSSI will be defined as the deliberate direct destruction or alteration of body tissue or of body's biochemistry without conscious suicidal intent and with no social or cultural approval.

Until now, there have been several risk factors implicated in NSSI behavior, with adverse childhood experiences, attachment and emotion dysregulation being the three most prominent ones (Fox et al., 2015). Childhood adversities and particularly, physical and sexual abuse appear to have a direct and indirect effect on NSSI behavior, such as through distress tolerance and negative urgency (Gladstone et al., 2004; Arens, Gaher, Simons, & Dvorak, 2014; Caron, Lafontaine, & Bureau, 2017a). Additionally, emotion dysregulation has been demonstrated to have a direct effect (Midkiff, Lindsey, & Meadows, 2018) or a mediational role in the association of other risk factors with NSSI (i.e. emotion dysregulation mediated the association between stressful experiences and NSSI; Ewing, Hamza, & Willoughby, 2019). Despite the limited number of studies investigating the association of attachment and NSSI, there is enough evidence to suggest that insecure attachment can be a predictor of it

(Martin et al., 2017; Caron, Lafontaine, & Bureau, 2017b). Consequently, with numerous risk factors being suggested, literature supports the notion of a multifactorial approach to the risk of engaging in NSSI (Christoforou & Ferreira, 2020a). Studies investigating the interplay of these risk factors have demonstrated that emotion dysregulation was a moderator (Tresno, Ito, & Mearns, 2013; Dixon-Gordon, Tull & Gratz, 2014) and a mediator (Gratz & Roemer, 2008; Howard, Karatzias, Power, & Mahoney, 2017) to the association between early life experiences and NSSI. Additionally, studies have found that emotion dysregulation is a significant mediator to the relationship between attachment and NSSI (Tatnell, Hasking, Newman, 2018; Guérin-Marion, Martin, Lafontaine, & Bureau, 2019), further supporting the mediational role of emotion dysregulation. To our knowledge, there is only one study investigating the possible interaction of all these three factors in predicting NSSI. Tatnell, Hasking, Newman, Taffe and Martin (2017) investigated in a sample of 2,637 adolescents whether childhood abuse, attachment anxiety and emotion dysregulation increased the likelihood of NSSI and found that cumulative adversity (i.e. having all these risk factors) was a significant predictor of NSSI. However, the absence of a clear pathway or explanation of their interaction indicates a gap in literature.

Developmental theories and empirical models propose that adverse childhood experiences can interfere with attachment security (Bowlby, 1969/1982; Baer & Martinez, 2006). Additionally, attachment has a fundamental role in the development of emotion regulation strategies (Brumariu, 2015). Consequently, it can be suggested that a serial pathway might exist between adverse childhood experiences and NSSI through attachment and emotion dysregulation. This study aims to investigate whether the proposed pathway exists by examining the serial mediational effect of attachment and emotion dysregulation in the relationship between early life experiences and NSSI. It was hypothesized that: i) attachment would mediate the relationship between early life experiences and emotion

regulation, ii) emotion regulation would mediate the relationship between attachment and

NSSI and iii) attachment and emotion regulation would serially mediate the relationship

between early life experiences and NSSI.

Method

Participants

Participants were recruited online via specific groups on social media platforms (e.g.

the subreddit r/AdultSelfHarm on Reddit). In order to participate, participants were required

to be above 18 years old, to have at least one experience with self-harm, to have good

knowledge of the English language in order to understand the questions and to have no

suicidal thoughts. Individuals who expressed suicidal thoughts were excluded from the study

and encouraged to seek help from their family doctor, mental health professional, or local

health system.

Measures

Adverse Childhood Experiences - International Questionnaire (ACE-IQ; WHO, 2018)

The ACE-IQ is a 45-item self-report measure, which refers to some of the most

intensive and frequently occurring sources of childhood stress, such as multiple types of

abuse, neglect and peer violence. It was developed to take into consideration cultural

differences, which makes it ideal for international use over the Internet. The majority of the

items are rated on a 4-point Likert scale with the exception of seven questions, two which are

rated on a 5-point Likert scale and five, which require a "Yes" or "No" answer. Higher scores

indicate greater exposure to adverse childhood experiences. Its psychometric properties have

not been evaluated within NSSI literature. However, preliminary findings on other

populations, such as prison inmates in Nigeria and adolescents from Malawi, have

demonstrated good reliability (Cronbach's alpha = 0.80; Kazeem, 2015) and validity (Kazeem, 2015; Kidman, Smith, Piccolo & Kohler, 2019). Investigating the reliability of ACE-IQ with the population used for this study, outcomes showed good reliability too (Cronbach's alpha = 0.85).

Adult Attachment Scale (AAS; Collins & Read, 1990)

The AAS is a self-report measure consisting of 18 items scored on a 5-point Likert scale [1 (Not at all characteristic of me) to 5 (Very characteristic of me)]. AAS outcomes can indicate both the total level of attachment security and the individual attachment styles (Secure, Anxious, Avoidant). However, due to the limited literature associating NSSI with specific attachment styles, only the total score was used for the analysis. Higher scores indicated higher levels of insecurity. The psychometric properties of AAS have been investigated in many studies, demonstrating that it is a reliable and valid measure (Collins & Read, 1990; Ravitz, Maunder, Hunter, Sthankiya, & Lancee, 2010). The AAS was found to be a reliable measure for this study too (Cronbach's alpha = 0.81).

Emotion Regulation Questionnaire (ERQ; Gross & John, 2003)

The ERQ is a 10-item self-report measure, which examines two emotion regulation strategies (Cognitive Reappraisal and Expressive Suppression). Total scores were calculated for this study by reversing the cognitive reappraisal items. Items were rated on a 7-point Likert scale, ranging from strongly disagree (1) to strongly agree (7). Higher scores on ERQ indicated reduced ability to regulate their emotions. Examinations of its psychometric properties have demonstrated good internal consistency (0.79 for Reappraisal & 0.73 for Suppression) and a three-month test-retest reliability of about 0.7 (Gross & John, 2003). The psychometric properties of the total scale for this study indicated a similar reliability (Cronbach's alpha = 0.75).

Self-harm Inventory (SHI; Sansone, Wiederman, & Sansone, 1998)

SHI lists 22 different self-harm behaviors and participants are required to respond with a "Yes" or "No", depending on whether they have ever intentionally engaged in those behaviors. SHI was selected because of its wide range of self-harm behaviors compared to other measures (e.g. the Deliberate Self-harm Inventory; Gratz, 2001) that fit the definition of NSSI for this study. However, some of the items (6, 7, 10, 11, 12, 13, 14, 15, 16, 17, 18, 20) were not in accordance to the definition and hence, they were removed from the analysis (see Appendix), leaving a total of 10 items and hence, a maximum score of 10. Higher scores represented greater NSSI. The psychometric properties of this shorten version were explored and findings indicated a Cronbach's alpha score of 0.71, which demonstrated its suitability for use in the analysis.

Procedure

A survey platform was created online via Google Forms, which included the information sheet, the informed consent, questions on demographics and the four measures described above. Convenience and snowball sampling method was used by distributing the link to the study through social media platforms, such as Facebook and Reddit. The link remained active for six months and then all the data was extracted for analysis. The duration of the study was approximately 25-30 minutes for each participant.

Data Preparation & Statistical Analysis

Data was analyzed with the use of Statistical Package for Social Sciences (SPSS version 25; IBM Corp, 2017). A series of one-way between-subjects ANOVA tests were conducted to identify any potential covariates to the analysis based on demographic characteristics. Additionally, a series of Pearson's Correlation tests were used in order to

investigate whether the predictor variables were related to each other. Due to the fact that data was not normally distributed, both series of tests were conducted using 1,000 bootstrapped re-samples (bias corrected 95% confidence intervals are reported) as it was considered superior to non-parametric tests (Dwivedi, Mallawaarachchi, & Alvarado, 2017). Lastly, conditional process analyses, using PROCESS macro (version 3.3; Hayes, 2013) were conducted for the mediational pathways (5,000 bootstrapped re-samples).

Ethical Concerns

Ethical approval was granted by the Social Sciences Ethics Review Board at the University of Nicosia, Cyprus (SSERB 45). Participants were informed about the study before their participation and they were allowed to withdraw at any time. Consent to participate was obtained via Google Forms. No identifying data was collected and hence, confidentiality was maintained throughout.

<center>

Results

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Participant Descriptives

A sample of 284 participants was recruited (220 females, 45 males & 19 identified themselves as being non-binary/genderqueer or transgender). The average age was 23.39 years old (SD = 5.68). The majority of the participants (N=182, 64.1%) reported being diagnosed with a mental health disorder, such as borderline personality disorder, anxiety, depression, schizophrenia, eating disorders, posttraumatic stress disorder and bipolar disorder. One hundred and forty-five individuals reported never attempting to commit suicide (51%), 107 admitted that they have attempted to commit suicide (majority of them only one time [N=34]) and 32 reported that they might have attempted to commit suicide. Regarding

participants' education, 154 completed secondary/high school, 84 completed a University or College course, 25 completed a post-graduate degree and the rest completed other formal qualifications. Only two participants received no formal schooling. The majority of the participants reported engagement in five or more different NSSI behaviors (72.9%) indicating a high degree of NSSI. Five participants (1.8%) reported engagement in all ten NSSI behaviors. The most prominent behaviors were deliberate self-cutting (91.5%), self-scratching (83.1%) and self-hitting (70.8%). All participants reported having an experience of childhood adversity. The most frequent childhood adversities were verbal abuse by a family member (88%), bullying (82.7%) and physical abuse by a parent (67.3%). Sexual abuse was reported by 27.8% of the participants.

Covariates

Gender, age, presence of diagnosis and presence of previous suicide attempts were explored as potential covariates to the analyses. One-way between subjects ANOVA tests were conducted and findings are presented in Table 1. As it is demonstrated in Table 1, early life experiences, attachment and emotion dysregulation showed significant between-subjects differences only with regards to presence of previous suicide attempts. Significant age, presence of diagnosis and previous suicide attempt differences were found with regards to NSSI. Since only the presence of previous suicide attempts showed a significant difference between subjects for all variables, it was the only one considered as a covariate in the analyses to avoid unnecessary interference in pathways not influenced by age and diagnosis.

Early life experiences, Attachment, Emotion Regulation & NSSI

Correlational analyses indicated that all the measures were correlated to each other. Adverse childhood experiences were positively correlated to attachment insecurity [r=0.35,

95% CI (0.24, 0.46)], emotion dysregulation [r=0.19, 95% CI (0.07, 0.29)] and NSSI [r=0.35, 95% CI (0.24, 0.45)]. Attachment insecurity was also positively related to emotion dysregulation [r=0.41, 95% CI (0.31, 0.52)] and NSSI [r=0.26, 95% CI (0.14, 0.37)]. Emotion dysregulation was additionally positively related to NSSI [r=0.24, 95% CI (0.13, 0.35)].

Mediational pathways

Early life experiences associated to emotion dysregulation via attachment

The mediational pathway from early life experiences to emotion dysregulation via attachment was found to be significant [Indirect effect = 0.12, SE = 0.03, 95% CI (0.07, 19)], supporting the first hypothesis. There was a significant effect from early life experiences to attachment [Effect = 0.35, SE=0.06, p < 0.001, 95% CI (0.24, 0.46)] and a significant effect from attachment to emotion dysregulation [Effect = 0.35, SE = 0.05, p < 0.001, 95% CI (0.25, 0.44)]. The direct effect of early life experiences onto emotion dysregulation was not significant [Effect = 0.04, SE = 0.05, p = 0.38, 95% CI (-0.06, 0.14)]. There was no difference in the associations when accounting for previous suicide attempts. The indirect relationship was still significant [Indirect effect = 0.11, SE = 0.03, 95% CI (0.06, 0.17)], supporting the mediational pathway.

Attachment to NSSI via emotion dysregulation

The mediational pathway from attachment to NSSI via emotion dysregulation was also significant [Indirect effect = 0.01, SE = 0.01, 95% CI (0.003, 0.027)], supporting the second hypothesis. There was a significant effect from attachment to emotion dysregulation [Effect = 0.36, SE = 0.05, p<0.001, 95% CI (0.27, 0.45)] and from emotion dysregulation to NSSI [Effect = 0.04, SE = 0.02, p < 0.05, 95% CI (0.01, 0.07)]. However, there was still a significant direct effect of attachment to NSSI [Effect = 0.04, SE = 0.02, p < 0.05, 95% CI

(0.01, 0.07)]. Controlling for previous suicide attempts, no differences were demonstrated between the associations. The indirect pathway was still significant [Indirect effect = 0.01, SE = 0.01, 95% CI (0.001, 0.022)], in addition to the direct pathway from attachment to NSSI [Effect: 0.03, SE = 0.01, $p < 0.05$, 95% CI (0.004, 0.054)].

Early life experiences to NSSI via attachment and emotion dysregulation

The serial mediational model was also significant [Indirect effect = 0.004, SE = 0.002, 95% CI (0.0007, 0.0090)], supporting the third hypothesis. There was a significant effect from early life experiences to attachment [Effect = 0.35, SE = 0.06, $p < 0.001$, 95% CI (0.24, 0.46)], from attachment to emotion dysregulation [Effect = 0.35, SE = 0.05, $p < 0.001$, 95% CI (0.25, 0.44)] and from emotion dysregulation to NSSI [Effect = 0.04, SE = 0.01, $p < 0.05$, 95% CI (0.007, 0.064)]. No significant effects were demonstrated from early life experiences to emotion dysregulation [Effect = 0.04, SE = 0.05, $p = 0.379$, 95% CI (-0.06, 0.14)] and from attachment to NSSI [Effect = 0.02, SE = 0.01, $p = 0.128$, 95% CI (-0.006, 0.046)]. However, a direct effect from early life experiences to NSSI was also supported [Direct effect = 0.06, SE = 0.01, $p < 0.001$, 95% CI (0.04, 0.08)]. Similarly to the previous models, no difference was observed in the associations after controlling for previous suicide attempts [Indirect effect: 0.003, SE = 0.002, 95% CI (0.0001, 0.0070)]. All the associations are illustrated in Figure 1.
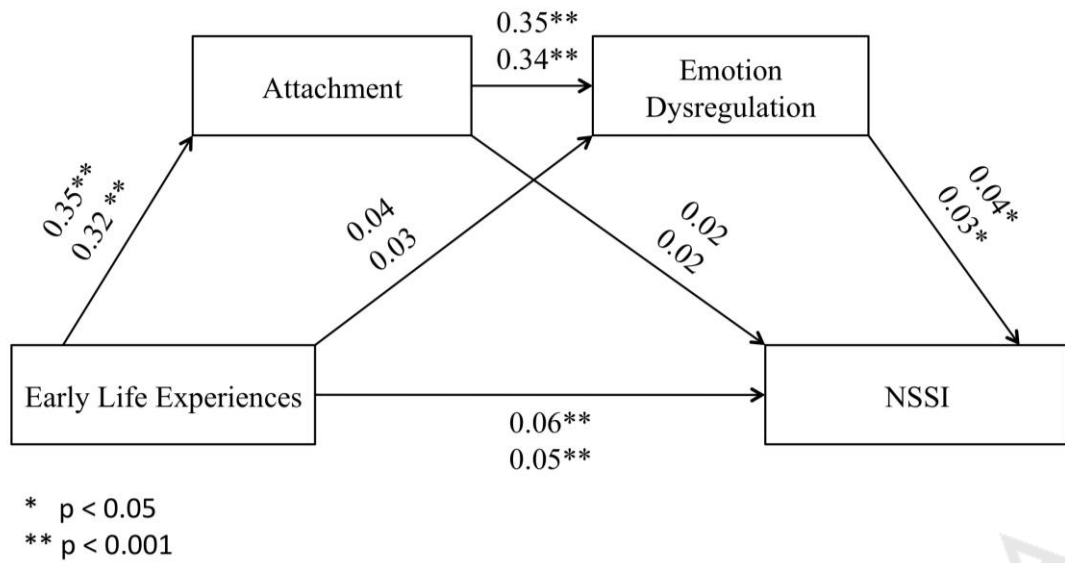
Figure 1. The figure presents the serial mediational effect of attachment and emotion dysregulation on the association between early life experiences and NSSI. Unstandardised effects are illustrated for both analyses (without covariate – first line, with covariate – second line) along with significance levels.

Discussion

Mediational and conditional process analyses have demonstrated a significant pathway from early life experiences to emotion dysregulation through attachment insecurity and a significant pathway from attachment to NSSI via emotion dysregulation. Additionally, the proposed serial mediation model was supported, suggesting that the association between early life experiences and NSSI is serially mediated via attachment and emotion dysregulation. All associations remained the same after controlling for reported previous suicide attempts. Importantly, the serial mediational pathway seemed to explain a larger

proportion of the variance than any of the alternative pathways that looked at a direct relationship between early life experiences and NSSI or that included only one of the mediators. Consequently, it is suggested that the proposed pathway is more likely to be the medium through which individuals engage in NSSI behavior.

These findings are in accordance to empirical and theoretical models, which support the notion that early life experiences can have an impact on attachment style, that attachment can interfere with the development of emotion regulation strategies and that emotion dysregulation could lead to NSSI (Bowlby, 1969/1982; Baer & Martinez, 2006; Brumariu, 2015; Lear & Pepper, 2016). Additionally, findings from this study are in accordance to the Tatnell et al. (2017) study, which demonstrated that all three risk factors are contributing to the development of NSSI behavior. The study also replicated the positive associations of childhood maltreatment, attachment and emotion dysregulation with NSSI (Gratz, 2003) and the mediational pathway from attachment to NSSI via emotion dysregulation (Tatnell et al., 2018; Guérin-Marion et al., 2019).

Taking into consideration these findings, it is suggested that early identification of individuals engaging in NSSI behavior can be achieved by exploring childhood adversity and its impact on attachment style and hence, on the emotion regulation. Related assessment measures could be used, such as the ACE-IQ, AAS and ERQ in order to identify potential risk for NSSI behavior. With regards to treatment, targeting early life experiences or attachment relationships would be ideal for preventing NSSI behavior. However, controlling for adversities and attachment style in every family is very difficult. Therefore, targeting emotion dysregulation might be more fruitful. There are several established models of therapy addressing emotion regulation, such as Emotion Focused Therapy, Dialectical Behavior Therapy, Emotion regulation group therapy, Cognitive therapy, Dynamic deconstructive therapy and Psychoanalytic/Psychodynamic psychotherapy. However, there is

still limited evidence on their effectiveness with NSSI populations (Turner, Austin, & Chapman, 2014; Bentley, Nock, Sauer-Zavala, Gorman, & Barlow, 2017; Briggs et al., 2019). Further research is needed to explore their mechanisms of change and their effectiveness with NSSI.

This study however is not without limitations. The authors adopted a definition, which was not in accordance to available NSSI measures hence, the NSSI measure used was a modified version of an already validated measure. In order to overcome this limitation, the authors investigated the reliability of the modified version before using it. Additionally, the ACE-IQ measure has not been validated within the NSSI population before, although its psychometric properties with other populations have shown good reliability and validity. Generally, the study relied on self-report measures and a retrospective study design, which can introduce biases to the outcomes (Stone, Bachrach, Jobe, Kurtzman, & Cain, 1999). Nevertheless, the study had an appropriate sample size compared to previous studies, which focused on very small samples of NSSI participants and controlled for potential covariates to the proposed pathways. The study also proposed a novel serial mediational model to NSSI, which could form the basis for future treatment developments and assessment of NSSI. Future studies could use the model to identify potentially effective therapies, to develop and explore new therapies specific to individuals engaging in NSSI and to develop new measures for assessing NSSI behavior.

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Table 1.

Results from ANOVA analyses investigating between-subjects differences with regards to gender, age, presence of diagnosis and previous suicide attempts on early life experiences, attachment, emotion dyregulation and NSSI.

		Degrees of Freedom	Mean Square	F-Value	Significance
ACE	Gender	(2, 281)	59.61	0.49	0.61
	Age	(24, 259)	164.54	1.42	0.10
	Diagnosis	(1, 282)	130.73	1.01	0.30
	Suicide attempt	(1, 282)	3096.90	28.20	< 0.001*
AAS	Gender	(2, 281)	268.31	2.22	0.11
	Age	(24, 259)	148.17	1.24	0.21
	Diagnosis	(1, 282)	439.75	3.64	0.06
	Suicide attempt	(1, 282)	1491.39	12.75	< 0.001*
ERQ	Gender	(2, 281)	26.73	0.29	0.75
	Age	(24, 259)	61.11	0.64	0.90
	Diagnosis	(1, 282)	141.43	1.53	0.22
	Suicide attempt	(1, 282)	794.51	8.82	< 0.001*
SHI	Gender	(2, 281)	2.64	0.50	0.61
	Age	(24, 259)	11.68	2.47	< 0.001*
	Diagnosis	(1, 282)	68.53	13.46	< 0.001*
	Suicide attempt	(1, 282)	201.64	43.65	< 0.001*

Excluded items from the SHI and reasons for exclusion

Item	Item description	Reason for exclusion		
		No direct destruction of body tissue or alteration of body's biochemistry	Socially sanctioned behavior	Presence of suicidal intent
6	Abused alcohol		✓	
7	Driven recklessly on purpose	✓		
10	Made medical situations worse on purpose (e.g. skipped medication)	✓		
11	Been promiscuous (i.e. had many sexual partners)	✓		
12	Set yourself up in a relationship to be rejected	✓		
13	Abused prescription medication			✓
14	Distance yourself from God as punishment	✓		
15	Engaged in emotionally abusive relationships	✓		
16	Engaged in sexually abusive relationships	✓		
17	Lost a job on purpose	✓		
18	Attempted suicide			✓
20	Tortured yourself with self-defeating thoughts	✓		

Validation of adverse childhood experiences international questionnaire (ACE-IQ) with

adults engaging in non-suicidal self-injury

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Highlights

- Investigation of psychometric properties of ACE-IQ with non-suicidal self-injury.

- The ACE-IQ demonstrated good internal-consistency (Cronbach's alpha=0.854).

- The ACE-IQ showed good convergent, predictive and discriminant validity.

- A 5-factor structure was suggested, although not all items loaded onto the factors.

<div align="center">**Abstract**</div>

Background: Numerous studies have supported the association of adverse childhood experiences with risk behaviors, chronic diseases and mental health difficulties. Therefore, it is particularly important to assess adverse childhood experiences for prevention purposes. Although several measures have been developed for assessing childhood adversity, the majority of them are limited to basic forms of abuse and neglect. An exception is the Adverse Childhood Experiences – International Questionnaire (ACE-IQ). However, the ACE-IQ questionnaire has not been previously validated with individuals engaging in non-suicidal self-injury. **Objective:** Consequently, the current study investigated ACE-IQ's psychometric properties with individuals engaging in non-suicidal self-injury. **Participants and Setting:** Two hundred eighty-four adult participants were recruited online via specific self-harm groups on social media platforms. **Methods:** Participants were asked to complete an online survey consisting of three self-report measures regarding early childhood experiences and engagement in non-suicidal self-injury. **Results:** The findings of this study supported ACE-IQ's reliability (Cronbach's alpha = 0.854), convergent validity (r= 0.85, p<0.001 with the CTQ-SF), predictive validity (R^2 = 0.12, p=0.001 of the SHI total score) and discriminant validity (F-value = 13.90, p<0.001). An exploration of the factor structure demonstrated a 5-factor solution (physical abuse, sexual abuse, emotional abuse, exposure to violence, family environment). **Conclusions:** It was concluded that ACE-IQ is a reliable and valid measure to be used for research or clinical purposes with individuals engaging in non-suicidal self-injury, although further research is needed on its factor structure. Research and clinical implications are discussed.

Keywords: adverse childhood experiences, ACE, self-harm, reliability, validity, adults

Introduction

Adverse childhood experiences have been associated throughout the years with numerous risk behaviors, chronic diseases and mental health difficulties, which have a huge impact both on a personal and societal level (Dube, Felitti, Dong, Giles, & Anda, 2003; Danese & McEwen, 2012; Merrick et al., 2017). Specifically, adverse childhood experiences have been linked with behaviors and diseases that are considered as leading causes of death in adults, such as smoking, obesity, ischemic heart disease, cancer, stroke and suicide (Rehkopf et al., 2016; Brown, Thacker, & Cohen, 2013; Dong et al., 2004; Campbell, Walker, & Egede, 2016; Dube et al., 2001). Additionally, they have been related to almost all common mental health illnesses, including schizophrenia (Hirt, Schalinski, & Rockstroh, 2019), anxiety (Reiser, McMillan, Wright, & Asmundson, 2014), depression (Chapman et al., 2004), and personality disorders (Battle et al., 2004). Therefore, there is great emphasis on the importance of assessing adverse childhood events for the development of prevention strategies. Although individual incidences of childhood abuse contribute to the development of the above difficulties, the cumulative effect of childhood adversities seems to be detrimental too (Chartier, Walker, & Naimark, 2010). Consequently, it is particularly important to consider a variety of childhood experiences when investigating their contribution.

Although there is not a universally agreed definition, adverse childhood experiences can be described as experiences, which are not expected to occur within a nurturing environment and that require significant adaptation by an average child (under the age of 16 years old) to cope (McLauglin, 2016). The most commonly addressed childhood experiences are sexual, physical and emotional abuse and physical and emotional neglect (Gratz, 2003;

Serafini et al., 2017). However, there are several other experiences, such as bullying, which could also be considered as childhood adversities (Copeland et al., 2014) and are not incorporated into commonly used childhood maltreatment measures, such as the Childhood Trauma Questionnaire (CTQ; Bernstein et al., 1994). A variety of childhood experiences are included though within the Adverse Childhood Experiences International Questionnaire (ACE-IQ), which was developed by the World Health Organization (WHO; World Health Organization, 2018) for international use. The ACE-IQ takes into consideration a wide array of adversities that might be experienced by children (Anda, Butchart, Felitti, & Brown, 2010), such as parental neglect, dysfunctional family environment, loss of a parent, verbal abuse, physical abuse, sexual abuse, peer violence, community violence and exposure to war/collective violence. Although the ACE-IQ has been widely used in research (Almuneef, Qayad, Aleissa, & Albuhairan, 2014; Al-Shawi & Lafta, 2015; Tran, Dunne, van Vo, & Luu, 2015; Soares et al., 2016; Goodman, Martinez, Keiser, Gitari, & Seidel, 2017; Kim, 2017; El Mhamdi et al., 2018; Mall et al., 2018; Chang, Jiang, Mkandarwire, & Shen, 2019), its psychometric properties have only been evaluated by a limited number of studies (Kazeem, 2015; Quinn et al., 2018; Ho, Chan, Chien, Bressington, & Karatzias, 2019; van der Feltz-Cornelis et al., 2019; Kidman, Smith, Piccolo, & Kohler, 2019). The outcomes of these studies demonstrate that ACE-IQ is a reliable measure, with satisfying internal consistency; a concurrent validity with the CTQ questionnaire in a sample of prisoners in Nigeria (Kazeem, 2015); with good test-retest reliability (0.90) in a sample of young adults in Hong Kong (Ho et al., 2019); with moderate predictive validity in a sample of adolescents living in rural Malawi; with individuals diagnosed with anxiety and depressive disorders (Kidman et al., 2019; van der Feltz-Cornelis et al., 2019) and; with adjustable cultural competency for adult residents of Munsieville (Quinn et al., 2018).

However, there is a lack of evaluation of its psychometric properties within high-risk groups, which have already been associated with childhood adversities, such as with individuals engaging in non-suicidal self-injury (NSSI). Non-suicidal self-injury is defined as a non-socially sanctioned deliberate act, which leads to the destruction of body tissue (Favazza, 1998) or an alteration of the biochemistry of one's body without conscious suicidal intent. Numerous studies have associated childhood maltreatment with NSSI (Liu, Scopelliti, Pittman, & Zamora, 2018; Christoforou & Ferreira, 2020a), but the majority of them have used measures with a particular focus on sexual, physical and emotion abuse (Arens, Gaher, & Simons, 2012; Bornovalova, Tull, Gratz, Levy, & Lejuez, 2011), limiting in this way the scope of childhood adversities and their true effect on NSSI behavior. Therefore, the current study aims to explore the psychometric properties of ACE-IQ in a sample of individuals engaging in NSSI in order to demonstrate its reliability and validity for potential use. Specifically, the study aimed to investigate ACE-IQ's factor structure, reliability, convergent validity, predictive validity and discriminant validity.

Method

Participants

Inclusion criteria included being 18 years old or above, have at least one experience of NSSI and have good knowledge of the English language to ensure good understanding of the questions. Participants were excluded from the study if they reported any suicidal thoughts and they were advised to contact their family doctor, mental health professional or local health system to seek help.

Measures

Adverse Childhood Experiences – International Questionnaire (ACE-IQ; WHO, 2018). The ACE-IQ is a self-report measure, consisting of 45 items. Of the 45 items, 14 questions are demographics, 30 items explore adverse childhood experiences and one item is used for clarification purposes regarding bullying. For the purposes of this study, only the items exploring adverse childhood experiences were investigated for their reliability and validity (see Appendix A). The items investigate participants' family environment, parental neglect, parental loss, verbal abuse, physical abuse, sexual abuse and violence within a peer setting, community setting or collective setting. They are rated on a 4-point Likert scale, except for seven items (two rated on a 5-point Likert scale and five require a "Yes" or "No" answer). Higher scores indicate greater exposure to childhood adversities. The psychometric properties of this questionnaire have been discussed in the introduction.

Childhood Trauma Questionnaire – Short form (CTQ-SF; Bernstein et al., 2003). The CTQ-SF is a self-report measure developed by reducing the items of the original Childhood Trauma Questionnaire (Bernstein et al., 1994; Bernstein & Fink, 1998). It consists of 28 items, which have a focus on emotional, physical and sexual abuse and emotional and physical neglect. CTQ and CTQ-SF are very commonly used within the NSSI literature in order to investigate the impact of childhood experiences (Bornovalova et al., 2011; Franzke, Wabnitz, & Catani, 2015; Howard, Karatzias, Power, & Mahoney, 2017). The items are rated on a 5-point Likert scale (from Never True to Very Often True). Higher scores indicate greater exposure to adverse childhood experiences (Range: 28-140). The CTQ-SF has been translated and psychometrically tested in several countries, showing good internal consistency, good criterion-related validity, convergent and concurrent validity (Bernstein et al., 2003; Gerdner & Allgulander, 2009; Kim, Bae, Han, Oh & Macdonald, 2013). It has been

previously used to validate the ACE-IQ measure in Nigeria (Kazeem, 2015) and hence, it will allow a direct comparison to be made.

Self-harm Inventory (SHI; Sansone, Wiederman, Sansone, 1998). The SHI is a self-report measure, consisting of 22 items investigating distinct NSSI behaviors. Participants are required to respond with a "Yes" or "No" in order to report whether they have ever deliberately engaged in those behaviors without having the intention to die. Although the SHI was selected due to its variety of NSSI behaviors, which are not included in other measures (e.g. the Deliberate Self-harm Inventory; Gratz, 2001), some items were deleted (6, 7, 10, 11, 12, 13, 14, 15, 16, 17, 18, 20) in order to match the NSSI definition provided for this study (see Appendix B). A total number of 10 items were included, leaving a maximum total score of 10. Higher scores demonstrate greater engagement in NSSI. Its psychometric properties were investigated before its inclusion in the analysis and findings showed that the revised version of the SHI was a reliable measure to be used (Cronbach's alpha = 0.71).

Procedure

After ethical approval was granted, an online survey was created using Google Forms. Information about the study was placed at the beginning of the survey and was followed with an online informed consent form. The survey included questions on demographic characteristics and the three self-report measures mentioned above (ACE-IQ, CTQ-SF, & SHI). The survey's duration was approximately 10-15 minutes for each participant. The link to the study was distributed through specific NSSI groups on social media platforms (e.g. the subreddit r/AdultSelfHarm on Reddit) and remained active for six months before extracting the data for analysis.

Statistical Analysis

The data was analysed using the Statistical Package for Social Sciences (SPSS version 25; IMB Corp, 2017). Exploratory Factor Analysis (EFA) was performed in order to explore the factor structure of the measure. Since the data was non-parametric, principal axis factors extraction was used with direct oblimin rotation (Delta=0; Costello & Osborne, 2005). Cronbach's alpha scores were calculated in order to determine ACE-IQ's internal consistency. Convergent validity was explored by examining the correlation between ACE-IQ and CTQ-SF using Pearson's Correlation Coefficient test. Simple linear regression was conducted in order to investigate the predictive validity of ACE-IQ on NSSI behavior. One-way between subjects ANOVA test was used to examine differences between individuals scoring low (less than 45), medium (45-65) or high (more than 65) on ACE-IQ for discriminant validity. Due to the presence of non-parametric data, all analyses were run with the 1,000 bootstrapped re-samples method to overcome any normality issues (Field, 2013; Dwivedi, Mallawaarachchi, & Alvarado, 2017).

Ethical considerations

Ethical approval was obtained by the Social Sciences Ethics Review Board at the University of Nicosia, Cyprus (SSERB 45). Participants were informed about the study and provided an informed consent before participating. Withdrawal from the study was allowed at any time. Identification information was not collected and hence, confidentiality was maintained throughout.

Demographic characteristics

A sample of 284 individuals provided usable data for the study. The majority of the participants were females with one or more of the following diagnoses: borderline personality disorder, posttraumatic stress disorder, anxiety-related disorder, depression, schizophrenia, eating disorders and bipolar disorder (see Table 1). None of the participants reported suicidal thoughts at the time of data collection. Participants' scoring on ACE-IQ ranged from 31 to 88 and the average score was 51.7 (SD=10. 97). The childhood adversities reported by most of the participants were verbal abuse by a family member (88%), bullying (82.7%) and physical abuse by a parent (67.3%). The average score on CTQ-SF was 65.9 (SD = 23.28). The majority of the participants (72.9%) reported engagement in more than five different NSSI behaviors. Self-cutting (91.5%), self-scratching (83.1%) and self-hitting (70.8%) were three of the most prominent behaviors.

Table 1.

Participants' demographic characteristics (N=284).

Variable	*M*	*SD*
Age	23.4	5.7
Variable	*N*	*%*
Gender		
Females	220	77.5
Males	45	15.8
Non-binary/Genderqueer or Transgender	19	6.7
Mental health diagnosis		
Yes	182	64.1
No	102	35.9
Previous suicide attempts		
Yes	107	37.7
No	145	51.0
Maybe	32	11.3

Formal education		
Yes	282	99.3
No	2	0.7
ACE-IQ		
Low	81	28.5
Medium	170	59.9
High	33	11.6

Factor Structure

Exploratory Factor Analysis. The Kaiser-Meyer-Olkin Measure of Sampling

Adequacy was 0.79 and the Barlett's Test of Sphericity was significant (p<0.001), indicating

that the data had patterned relationships amongst the variables and was suitable for factor

analysis (Yong & Pearce, 2013). Based on Eigen values (>1) and inspection of the scree plot

(Figure 1), a 5-factor model was suggested (see Table 2). The variance explained by the 5-

factor model was 49%. Factor 1 (5 items) was named physical abuse, since it meant to reflect

experiences that might cause harm to one's body and accounted for 20.7% of the variance.

Factor 2 (4 items) was named sexual abuse, since it reflected unwanted sexual contact and

accounted for 9.9% of the variance. Factor 3 (6 items) accounted for 7.7% of the variance and

was named exposure to violence. It reflected several events of violence that someone might

experience within a community or during war. Factor 4 (5 items) accounted for 5.4% of the

variance and was named dysfunctional family environment, since it meant to reflect

description of individuals living in the house and their behavior. Lastly, factor 5 (4 items)

reflected experiences that could cause high emotional distress and hence, it was named as

emotional abuse. Factor 5 accounted for 5.3% of the variance. All the factors showed weak

associations with each other (see Table 3), indicating low overlap between them and hence,

possible independence of the constructs. However, six items did not load on either factor.

Items 1, 2, 9, 10, and 23 reflected important adversities, such as insecure attachment, parental

separation or death and bullying, which have significant impact on mental health in adulthood and in engaging in NSSI behavior (Egeland & Carlson, 2004; Maier & Lachman, 2000; Takizawa, Maughan, & Arseneault, 2014; Buckmaster, McNulty, & Guerin, 2019; Trujillo & Servaty-Seib, 2018; Esposito, Bacchini, & Affuso, 2019). Additionally, item 29 (being beaten up by soldiers, police, militia, or gangs) had a very low endorsement (N=1) and this might have interfered with its loading on Factor 3. Consequently, due to their importance and the low endorsement of item 29, all items were retained for the following analyses, since none of the other items examined the same adversities. Item 16 loaded on both Factor 1 and Factor 5, but it was placed under Factor 1, since its correlation with the factor was stronger (see Table 2).
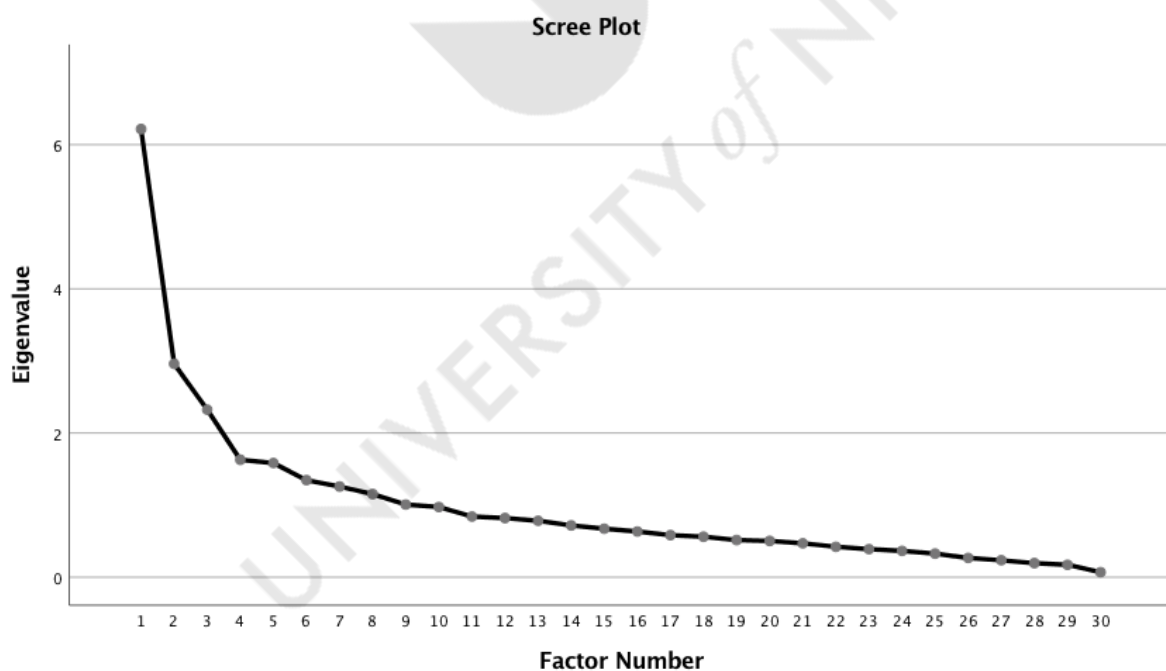
Figure 1. Scree Plot for Principal Axis Factor Analysis.

Table 2.

Five Factor model loadings by Principal Axis Factor Analysis.

Items	Factor 1: Physical Abuse	Factor 2: Sexual Abuse	Factor 3: Exposure to Violence	Factor 4: Dysfunctional Family Environment	Factor 5: Emotional Abuse
1. Parental understanding	-	-	-	-	-
2. Parental knowledge of activities	-	-	-	-	-
3. Not given enough food even when they could	0.416	-	-	-	-
4. Parents too drunk or intoxicated to take care of you	-	-	-	0.693	-
5. Not sent to school even if available	-	-	-	0.391	-
6. Lived with a household member who was alcoholic, or misused drugs	-	-	-	0.815	-
7. Lived with someone who was depressed or mentally ill or suicidal	-	-	-	0.361	-
8. Lived with someone sent to jail or prison	-	-	-	0.424	-
9. Parental separation or divorce	-	-	-	-	-
10. Death of a parent/guardian	-	-	-	-	-
11. Experience of seeing/hearing someone being yelled at, screamed at, sworn at etc in the house	-	-	-	-	0.718
12. Experience of seeing/hearing someone being slapped, kicked, punched or beaten up in the house	0.469	-	-	-	-
13. Experience of seeing/hearing someone being hit or cut with an object in the house	0.784	-	-	-	-
14. Experience of being yelled, screamed etc by a parent	-	-	-	-	0.814
15. Being threatened or actually abandoned being a parent/guardian	-	-	-	-	0.388

16. Being spanked, slapped, kicked etc by a parent/guardian	0.458	-	-	-	0.344
17. Being hit or cut with an object by a parent/guardian	0.723	-	-	-	-
18. Touched or fondled by someone in a sexual way without wanting to	-	0.758	-	-	-
19. Made to touch someone's body in a sexual way without wanting to	-	0.827	-	-	-
20. Someone attempted oral, anal, vaginal intercourse without you wanting it	-	0.937	-	-	-
21. Someone had oral, anal, or vaginal intercourse without you wanting it	-	0.891	-	-	-
22. Bullied	-	-	-	-	0.359
23. Involved in a physical fight	-	-	-	-	-
24. Seen or heard someone being beaten up	-	-	0.422	-	-
25. Seen or heard someone being stabbed or short in real life	-	-	0.552	-	-
26. Seen or heard someone being threatened with a knife or gun in real life	-	-	0.582	-	-
27. Forced to go and live in another place	-	-	0.645	-	-
28. Experience of deliberate destruction of home	-	-	0.548	-	-
29. Being beaten up by soldiers, police, militia, or gangs	-	-	-	-	-
30. Family member or friend being killed or beaten up by soldiers, police, militia or gangs	-	-	0.334	-	-

Table 3.

Correlations between factors.

Factor	1: Physical Abuse	2: Sexual Abuse	3: Exposure to Violence	4: Dysfunctional Family Environment	5: Emotional Abuse
1	1.00	-	-	-	-
2	0.09	1.00	-	-	-
3	0.08	0.09	1.00	-	-
4	0.26	0.16	0.23	1.00	-
5	0.32	0.22	0.03	0.33	1.00

Reliability

Internal consistency. The ACE-IQ's Cronbach's alpha for the total scale (i.e. including all items) was 0.854, indicating a generally good internal consistency within the scale. Two items were found to increase the Cronbach's alpha score once deleted, but the change would be minimal (0.857 if the item 1 referring to parental understanding is removed and 0.855 if the item 10 referring to parental death is removed; see Table 4), suggesting that all items can be retained within the measure. Nevertheless, inter-item correlations ranged from 0 to 0.92, which demonstrated that not all items were homogenous and not all items had sufficiently unique variance (see Appendix C). Item-total correlations ranged from 0.02 to 0.62 (see Table 4). Almost half of the items (47%) were correlated with the total of the scale for more than 0.40 and two items barely correlated with the total (item 10 examining parental death and item 29 examining being beaten up by soldiers, police, militia or gangs). Taking into consideration only the items loaded on the previously extracted factors, the Cronbach's alpha scores for each factor were: Factor 1 = 0.814, Factor 2 = 0.918, Factor 3 = 0.599, Factor 4 = 0.676 and Factor 5 = 0.748, indicating poor internal consistency for Factors 3 and 4.

Table 4.

Item-total correlations and items' impact on Cronbach's alpha score.

Item	Item-Total Correlation	Cronbach's alpha if item deleted
1	0.199	0.857
2	0.272	0.854
3	0.457	0.847
4	0.488	0.846
5	0.400	0.849
6	0.422	0.850
7	0.377	0.850
8	0.316	0.852
9	0.303	0.852
10	0.037	0.855
11	0.515	0.845
12	0.619	0.841
13	0.568	0.843
14	0.556	0.843
15	0.574	0.842
16	0.510	0.845
17	0.523	0.845
18	0.471	0.846
19	0.473	0.846
20	0.408	0.848
21	0.381	0.849
22	0.298	0.853
23	0.360	0.850
24	0.332	0.851
25	0.166	0.854
26	0.353	0.850
27	0.137	0.854
28	0.162	0.854
29	-0.019	0.855
30	0.113	0.854

Validity

Convergent validity. Findings from the Pearson Correlation Coefficient test indicated that the ACE-IQ and CTQ-SF were highly positively related to each other [$r=0.850$, $p < 0.001$, 95% CI (0.80, 0.89), SE = 0.02]. This strong correlation between the two measures, demonstrates an overlap in concepts, and hence, a good convergent validity of ACE-IQ.

Predictive validity. The findings from simple Linear Regression analysis showed a significant effect of ACE-IQ on SHI total score [$F(1, 282) = 39.10$, $p=0.001$, 95% CI (0.05, 0.09), SE = 0.01] with an $R^2 = 0.12$. The significant effect demonstrated in this analysis, suggests that ACE-IQ has a predictive utility with individuals engaging in NSSI. Specifically, the ACE-IQ accounts for approximately 12% of the variability of the revised SHI total score, which is a substantial amount of explained variance to suggest predictive validity. When compared to the effect of CTQ on SHI total score [$F(1, 282)=45.95$, $p=0.001$, 95% CI (0.03, 0.05), SE = 0.005, $R^2 = 0.14$], findings reveal a similar effect, further supporting ACE-IQ's predictive validity with individuals engaging in NSSI.

Discriminant validity. The sample was separated into three groups based on their ACE-IQ total score in order to investigate whether there is a meaningful and significant difference in the outcomes of the revised SHI total score between the ACE-IQ groups (low, medium and high exposure to adverse childhood experiences). Findings from the one-way between subjects ANOVA test demonstrated that there was a significant difference between the groups, which suggests a significant discriminant validity (see Table 5).

Table 5.

ACE-IQ group comparisons based on SHI total score for discriminant validity (ANOVA test).

ACE-IQ groups	N	Mean (SD)	Standard Error	95% Confidence Intervals		F-Value (df)	Significance
				Lower	Upper		
Low	81	4.9 (2.3)	0.3	4.4	5.4	13.90	p < 0.001
Medium	170	5.6 (2.2)	0.2	5.3	6.0	(2, 281)	
High	33	7.3 (1.9)	0.3	6.6	8.0		

<center>**Discussion**</center>

Overall the findings of this study suggest that the ACE-IQ is a reliable and valid measure to be used with NSSI populations. However, its proposed 5-factor structure appeared to have some issues, since not all items loaded onto the factors. It might be the case that the six items, which did not load onto the factors, need revision to match the suggested factors. Or, it might be the case that more items might be needed in order to form new factors, since two of the five proposed factors did not demonstrate good internal consistency. Nevertheless, the general internal consistency of the questionnaire is good, which demonstrates that almost all items are measuring the same concept (Tavakol & Dennick, 2011). Inter-item correlations indicated that the majority of items were correlated to each other, but the strength of their association was not as strong to suggest an overlap in concepts. There was only one combination, which showed a very strong association (Item 20 and Item 21: r=0.92). This was expected since all individuals who were exposed to inappropriate sexual contact are more likely to report an attempt of inappropriate sexual contact too, indicating a natural overlap.

Additionally, certain items (N=13 combinations) demonstrated no correlation between them. Interestingly, the majority of item-combinations showing no correlation were with Item 29 (N=9), which refers to being beaten up by soldiers, police, militia, or gangs. This form of adversity is prevalent only in certain countries, which are exposed to war or collective violence. Therefore, the absence of a correlation could be due to the absence of experiences of these types of adversities within the sample. The sample itself was biased due to socio-economic status, since the majority of the participants were educated and had access to Internet, and hence, it is unlikely that they might be living in the circumstances in which this

<div align="right">148</div>

type of violence can occur. Item 29 was barely correlated to the total score too. Consequently, it is suggested that it might be more beneficial to include item 29 only when considering adverse childhood experiences in countries experiencing war or where collective violence exists.

Despite the inclusion of more diverse adversities within the ACE-IQ, the findings demonstrated a strong association with the CTQ-SF, as it is proposed by their theoretical underpinnings. These findings support ACE-IQ's convergent validity. Regarding ACE-IQ's predictive and discriminant validity, the findings of this study suggest that ACE-IQ is a valid measure to be used to predict NSSI and its score has a meaningful impact on the prediction (i.e. different scores have distinct impact on NSSI).

The findings are in accordance to previous studies investigating the psychometric properties of ACE-IQ, which demonstrated good reliability and validity. When compared to the study conducted by Kazeem (2015), the outcomes revealed similar reliability and convergent validity. However, both the Cronbach's alpha score and the association between ACE-IQ and CTQ-SF were stronger in this study [Cronbach's alpha = 0.80, r=0.72 in Kazeem, (2015)]. This difference in findings could be attributed to the five items on marriage, which were included in Kazeem's (2015) analysis, but excluded for this study, since they were not measuring childhood adversities. Limiting the items specifically to childhood adversities (i.e. exclude all demographic items) increases the reliability of the scale and its association with other measures on childhood adversities, which might not include any demographic questions. Although according to our knowledge, no studies have previously investigated the predictive validity of ACE-IQ with individuals engaging in NSSI, the findings of this study demonstrated a very similar positive and moderate predictive

validity. A comparable study would be that of Kidman et al. (2019), who found a similar pattern of results in their investigation of the predictive utility of ACE-IQ on depression in an adolescent cohort in Malawi. However, when compared to the predictive validity of ACE-IQ with regards to somatic comorbidity and adverse life events in adulthood in a sample of outpatients with anxiety or depression (van der Feltz-Cornelis et al., 2019), the current study supports a stronger predictive validity. This could be explained by the use of age and gender as covariates in the analysis by van der Feltz-Cornelis et al. (2019). Van der Feltz-Cornelis et al. (2019) used age and gender as covariates in an attempt to investigate their differential effects on the variables being investigated, although no significant difference was reported for age and gender. Consequently, including them in the analysis might have introduced unnecessary interference to the analysis, which reduced the effect of ACE-IQ and hence, its predictive validity. Regarding the factor structure of the questionnaire, Kidman et al. (2019) also reported some issues, since some of the items were excluded from the analysis and not all factors made theoretical sense (i.e. bullying loaded on "neglect"). Therefore, it is suggested that some of the items might need revision in order to improve the factor structure of the ACE-IQ.

Taking into consideration the findings of this study, it is suggested that ACE-IQ can be a reliable and valid measure to use with individuals engaging in NSSI, when it is considered as a whole and not based on its subscales. Studies investigating the impact or association between adverse childhood experiences and NSSI can use this measure to explore a variety of adversities. Additionally, prevention of NSSI behaviors could lead to a reduction in suicides and improvement in the quality of life (e.g. by eliminating the shame and guilt felt following NSSI) of individuals belonging in the high-risk groups. Therefore, given the predictive validity of the measure, ACE-IQ could be used by clinicians as part of early identification

measures to predict potential risk in engaging in NSSI behaviors. Consequently, early prevention strategies, such as providing psychoeducation or psychotherapeutic treatment, can be more effectively employed. Previous studies supported the mediational role of emotion dysregulation in the association between early life experiences and NSSI (Guérin-Marion, Martin, Lafontaine, & Bureau, 2019; Howard et al., 2017), hence, established models of therapy targeting emotion regulation, such as Emotion Focused therapy and Dialectical Behavioral Therapy could form a fruitful prevention strategy.

Nevertheless, the study is not without limitations and hence, the results should be interpreted in light of these. The measure used to evaluate NSSI was a modified version of a previously validated measure and its psychometric properties have not been formally investigated. The study was limited to individuals engaging in NSSI and hence, the outcomes might not be generalizable to other populations. Additionally, the use of self-report measures might have introduced biases to the outcomes of the study (Stone, Bachrach, Jobe, Kurtzman, & Cain, 1999). However, due to the fact that the psychometric properties of ACE-IQ were evaluated in comparison to other self-report measures (CTQ-SF & SHI), the impact of these biases might have been reduced.

In conclusion, this study provided support for the reliability and validity of ACE-IQ with individuals engaging in NSSI, suggesting that it can be used for clinical assessment and research purposes. These findings were in accordance to previous studies investigating the psychometric properties of ACE-IQ with other populations. Therefore, future studies and clinicians might benefit from using ACE-IQ in order to evaluate adverse childhood experiences. However, further research is needed with regards to its factor structure.

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Appendices

Appendix A. ACE-IQ's items (WHO, 2018) used to test its psychometric properties.

Item number	Item description
1	Did your parents/guardians understand your problems and worries?
2	Did your parents/guardians really know what you were doing with your free time when you were not at school or work?
3	How often did your parents/guardians not give you enough food even when they could easily have done so?
4	Were your parents/guardians too drunk or intoxicated by drugs to take care of you?
5	How often did your parents/guardians not send you to school even when it was available?
6	Did you live with a household member who was a problem drinker or alcoholic, or misused street or prescription drugs?
7	Did you live with a household member who was depressed, mentally ill or suicidal?
8	Did you live with a household member who was ever sent to jail or prison?
9	Were your parents ever separated or divorced?
10	Did your mother, father or guardian die?
11	Did you see or hear a parent or household member in your home being yelled at, screamed at, sworn at, insulted or humiliated?
12	Did you see or hear a parent or household member in your home being slapped, kicked, punched, or beaten up?
13	Did you see or hear a parent or household member in your home being hit or cut with an object, such as a stick (or cane), bottle, club, knife, whip etc.?
14	Did a parent, guardian or other household member yell, scream or swear at you, insult or humiliate you?
15	Did a parent, guardian or other household member threaten to, or actually, abandon you or throw you out of the house?
16	Did a parent, guardian or other household member spank, slap, kick, punch or beat you up?
17	Did a parent, guardian, or other household member hit or cut you with an object, such as a stick (or cane), bottle, club, knife, whip etc?
18	Did someone touch or fondle you in a sexual way when you did not want them to?
19	Did someone make you touch their body in a sexual way when you did not want them to?
20	Did someone attempt oral, anal, vaginal intercourse with you when you did not want them to?
21	Did someone actually have oral, anal or vaginal intercourse with you when you did not want them to?
22	How often were you bullied?
23	How often were you in a physical fight?
24	Did you see or hear someone being beaten up in real life?
25	Did you see or hear someone being stabbed or shot in real life?

26	Did you see or hear someone being threatened with a knife or gun in real life?
27	Were you forced to go and live in another place due to any of these events?
28	Did you experience the deliberate destruction of your home due to any of these events?
29	Were you beaten up by soldiers, police, militia, or gangs?
30	Was a family member or friend killed or beaten up by soldiers, police, militia or gangs?

Appendix B. SHI items that were excluded and the reasons for their exclusion.

Item	Item description	Reason for exclusion		
		No direct destruction of body tissue or alteration of body's biochemistry	Socially sanctioned behavior	Presence of suicidal intent
6	Abused alcohol		✓	
7	Driven recklessly on purpose	✓		
10	Made medical situations worse on purpose (e.g. skipped medication)	✓		
11	Been promiscuous (i.e. had many sexual partners)	✓		
12	Set yourself up in a relationship to be rejected	✓		
13	Abused prescription medication			✓
14	Distance yourself from God as punishment	✓		
15	Engaged in emotionally abusive relationships	✓		
16	Engaged in sexually abusive relationships	✓		
17	Lost a job on purpose	✓		
18	Attempted suicide			✓
20	Tortured yourself with self-defeating thoughts	✓		

Source: Christoforou & Ferreira (2020b)

Appendix C. Inter-item correlations.

Item	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	0.40	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	0.12	0.08	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	0.06	0.21	0.41	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	0.11	0.08	0.41	0.39	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6	0.12	0.19	0.23	0.64	0.36	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7	0.05	0.18	0.19	0.26	0.26	0.34	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8	-0.01	0.03	0.17	0.27	0.25	0.35	0.26	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9	-0.01	0.03	0.22	0.21	0.13	0.16	0.25	0.17	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	0.01	0.06	-0.02	0.05	-0.13	0.01	0.02	0.07	-0.07	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	0.17	0.18	0.27	0.26	0.23	0.27	0.25	0.19	0.29	-0.10	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	0.20	0.13	0.43	0.40	0.32	0.30	0.15	0.28	0.23	-0.03	0.48	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	0.09	0.15	0.45	0.56	0.37	0.21	0.18	0.21	0.15	-0.07	0.51	0.58	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	0.15	0.18	0.23	0.27	0.23	0.25	0.29	0.16	0.31	-0.00	0.71	0.43	0.29	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	0.12	0.12	0.31	0.33	0.26	0.21	0.29	0.20	0.24	-0.01	0.37	0.43	0.36	0.50	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16	0.10	0.17	0.27	0.21	0.22	0.14	0.22	0.16	0.23	-0.05	0.33	0.52	0.42	0.43	0.41	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17	0.11	0.12	0.39	0.51	0.30	0.21	0.17	0.21	0.08	-0.02	0.26	0.45	0.72	0.30	0.36	0.54	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-
18	0.13	0.15	0.13	0.24	0.08	0.23	0.24	0.15	0.14	0.14	0.22	0.17	0.15	0.22	0.26	0.14	0.15	1.00	-	-	-	-	-	-	-	-	-	-	-	-
19	0.10	0.07	0.16	0.23	0.03	0.14	0.24	0.10	0.17	0.11	0.17	0.22	0.20	0.29	0.15	0.16	0.15	0.77	1.00	-	-	-	-	-	-	-	-	-	-	-
20	0.10	0.08	0.05	0.09	0.01	0.02	0.15	0.08	0.16	0.08	0.14	0.15	0.14	0.24	0.14	0.09	0.08	0.69	0.75	1.00	-	-	-	-	-	-	-	-	-	-
21	0.06	0.06	0.01	0.08	0.02	-0.00	0.13	0.08	0.16	0.09	0.13	0.17	0.17	0.11	0.21	0.13	0.07	0.64	0.70	0.92	1.00	-	-	-	-	-	-	-	-	-
22	0.11	0.08	0.09	0.09	0.10	0.11	0.13	0.03	0.15	0.05	0.22	0.18	0.10	0.30	0.30	0.21	0.10	0.20	0.18	0.15	0.12	1.00	-	-	-	-	-	-	-	-
23	0.01	0.12	0.18	0.16	0.21	0.15	0.10	0.11	0.05	0.05	0.13	0.21	0.32	0.20	0.27	0.23	0.30	0.12	0.11	0.07	0.08	0.21	1.00	-	-	-	-	-	-	-
24	-0.05	0.14	0.22	-0.18	-0.26	0.17	0.16	0.21	0.06	-0.00	0.22	0.24	0.20	0.24	0.20	0.17	0.17	0.04	0.04	0.05	0.04	0.10	0.34	1.00	-	-	-	-	-	-
25	-0.18	-0.03	0.19	0.10	0.11	0.08	-0.01	0.90	-0.00	0.21	-0.01	0.08	0.10	-0.00	0.08	0.07	0.15	0.06	0.07	0.06	0.03	-0.05	0.21	0.27	1.00	-	-	-	-	-
26	-0.07	0.09	0.22	0.22	0.21	0.24	0.10	0.24	0.02	0.08	0.10	0.27	0.30	0.12	0.20	0.21	0.30	0.07	0.09	0.05	0.04	0.07	0.28	0.41	0.51	1.00	-	-	-	-
27	0.06	0.02	0.10	-0.00	0.05	0.00	-0.10	-0.10	-0.01	0.06	0.08	0.11	0.08	0.04	-0.00	0.08	-0.02	-0.04	0.02	0.06	0.04	0.04	0.15	0.21	0.37	0.32	1.00	-	-	-
28	0.08	0.10	0.09	0.021	0.05	0.15	0.03	-0.01	0.01	-0.03	0.05	0.08	0.05	0.03	-0.01	0.06	0.04	0.03	0.06	0.07	0.05	0.12	0.09	0.21	0.22	0.28	0.44	1.00	-	-
29	-0.04	0.07	-0.09	0.00	0.00	0.09	0.00	0.13	0.00	0.13	-0.04	-0.04	-0.09	-0.04	-0.04	-0.04	0.00	-0.08	-0.13	0.00	0.00	-0.04	-0.05	0.13	0.00	0.07	0.00	0.17	1.00	-
30	-0.03	0.05	0.05	0.07	0.04	0.10	-0.00	0.01	-0.04	0.08	0.06	0.07	0.03	0.03	0.08	0.03	0.07	-0.01	0.02	0.06	0.03	0.04	0.20	0.07	0.08	0.15	0.18	0.24	0.38	1.00

Conclusion

Summary of Findings

In conclusion, reviewing the evidence from previous studies in the first paper of this thesis, it seems there is enough evidence to support an overall small-to-medium significant effect of adverse childhood experiences on NSSI (d = 0.271, p < 0.001) and a small significant effect of emotion dysregulation on NSSI (d = 0.198, p < 0.001). Both childhood experiences and emotion dysregulation demonstrated distinct associations. For example, adverse childhood experiences were associated both directly and indirectly (e.g. via emotion dysregulation) with NSSI, while the majority of studies have used emotion dysregulation as a mediator or moderator to the association of NSSI with other risk factors (e.g. adverse childhood experiences and insecure attachment). Although the studies investigating the effect of attachment on NSSI were very limited to find a significant pooled effect (d = 0.015, p = 0.392), findings from those limited studies suggested that preoccupied insecure attachment could be a risk factor of NSSI. Studies investigating the interaction of some of the aforementioned risk factors and previous theoretical models demonstrated that investigating a serial mediational model might be more fruitful for explaining the underlying processes leading to NSSI (Howard, Karatzias, Power, & Mahoney, 2017; Johnstone et al., 2015; Nock, 2009). Therefore, investigating the interaction of the proposed risk factors in the second paper of this thesis, it showed that adverse childhood experiences were serially associated to NSSI via insecure attachment and emotion dysregulation [Indirect effect = 0.004, SE = 0.002, 95% CI (0.0007, 0.0090)]. The serial mediational pathway was found to provide a higher level of explained variance than alternative models that looked at a direct association between adverse childhood experiences and NSSI or that included only one of the mediators, suggesting that it might provide the best fit for predicting NSSI. Taking into consideration

165

that the measure used to investigate adverse childhood experiences in the second paper of this thesis was not validated within an NSSI population, the third paper focused on the evaluation of its psychometric properties. The outcomes of the validation study demonstrated that the measure is valid (Convergent validity – r = 0.85, p<0.001 with the CTQ-SF; Predictive validity – R^2 = 0.12, p=0.001 of the SHI total score; Discriminant validity – F-value = 13.90, p<0.001) and reliable (Cronbach's alpha = 0.854) to be used with NSSI populations and hence, the findings with regards to adverse childhood experiences from paper two were reliable and valid. However, due to several issues with its factor structure, it was proposed that it is best to use it without considering its subscales, as it was utilized in paper two.

Findings in Accordance to Previous Theories and Empirical Models

The aforementioned findings are in accordance to the developmental models proposed by Nock (2009), which were presented in the introduction of this thesis. More specifically, they provided evidence for the regulatory path and indirectly, for the representational path, since negative representation of the self could be influenced by the attachment style (Mikulincer, 1995). As previously mentioned the biological processes were beyond the scope of this thesis and hence, the proposed serial mediational model could not provide evidence for the reactive path.

In addition to the theoretical models, the findings from this study supported previous empirical models, such as the model suggested by Kimball and Diddams (2007), who found that emotion dysregulation was a mediator to the relationship between attachment and NSSI. Although a direct association between early life experiences and emotion dysregulation was not supported when accounting for attachment style, the general serial mediational model suggests that emotion dysregulation is a mediator to the relationship of adverse childhood experiences and NSSI, just not the only one. Therefore, one could argue that the findings

166

support previous empirical findings, which provided evidence of the mediational role of emotion dysregulation on the relationship between early life experiences and NSSI, such as the study conducted by Titelius et al. (2018).

Furthermore, the validity outcomes of the ACE-IQ questionnaire were similar to previous validations of the questionnaire with other populations (Kazeem, 2015; Kidman, Smith, Piccolo, & Kohler, 2019), indicating that the measure is consistently reliable and valid across several samples. Despite the expectations that ACE-IQ would demonstrate higher effect sizes on NSSI outcomes due to its more inclusive nature, findings from the third paper of this thesis, indicated that ACE-IQ and CTQ-SF had a similar effect on NSSI. In particular, in contrast to the expectations, the CTQ-SF had greater effect on NSSI than ACE-IQ ($R^2 =$ 0.14 and $R^2 = 0.12$ respectively), but the difference was very small. This unexpected finding could be attributed to the impact of standard deviation on the effect sizes. Smaller standard deviations yield stronger effect sizes than larger standard deviations (Field, 2018) and due to the high number of questions included in the ACE-IQ, it is expected that ACE-IQ will have a larger standard deviation than CTQ-SF. However, both ACE-IQ and CTQ-SF demonstrated greater effect on NSSI than the suggested pooled effect size from paper one. This could be attributed to the fact that the pooled effect size was calculated while taking into consideration numerous studies with a variety of outcomes. It could also be due to the modification of the NSSI measure to match the definition of NSSI adopted for this thesis. It could be the case that this definition is more accurate and hence, the impact of adverse childhood experiences on NSSI is more clearly illustrated.

Research Implications

The use of a different definition for this thesis, which was based on previous research and guidelines, could be utilized as a food for thought for future research. Widening the scope of Favazza's (1998) definition and increasing the specificity of the European definition for DSH, could provide a universally agreed definition, which could be more representative of the actual presentation of this newly conceptualized diagnosis. Having a universally agreed definition will potentially allow direct comparison to be made between studies, which will in turn allow the processing of more information on the concept and hence, enhance our knowledge of NSSI based on more solid grounds.

In addition to providing a new definition of the concept, this thesis has several other research implications. The first paper of this thesis provided an updated review of the most prominent risk factors related to NSSI and indicated areas that require further research before reaching to any conclusions, such as the role of attachment on NSSI; and areas that need improvement in order to allow comparison between studies, such as adopting a more homogenous study design. This is the first study that provided meta-analytic data for all three risk factors, which can be used for future studies. However, when considering the pooled effect of attachment on NSSI, findings should be interpreted with caution due to the limited number of studies exploring the effect of attachment on NSSI and their high heterogeneity in the study design.

Furthermore, validating the ACE-IQ with individuals engaging in NSSI provides the opportunity for future studies exploring the effect of adverse childhood experiences and NSSI to use it as one of their measures. However, it is important to take into consideration that the outcomes of the psychometric assessment of ACE-IQ, particularly with regards to its factor structure and convergent validity with CTQ-SF suggest that the measure mainly operates as a close proxy to CTQ-SF. Therefore, future studies should consider whether ACE-IQ or CTQ-

SF is more suitable for their analyses. The ACE-IQ may have utility in more general populations, where a focus on "adversity" rather than "trauma" could be preferable, although further validation of the ACE-IQ measure appears to be needed. The validation from this thesis indicated problems with the factor structure of the ACE-IQ, which can inform researchers on how it is best to use the ACE-IQ in the future and which areas of the questionnaire need improvement in order to ensure that analyses using its subscales are reliable and valid too.

Lastly, the second paper of this thesis provided empirical support for the serial mediational model between early life experiences and NSSI, which was previously proposed by developmental theorists (Nock, 2009). Although the proposed pathway was suggested many years ago, researchers focused only on the evaluation of more simplified mediational models, hence, this study is filling an important gap in the literature. With empirical evidence now supporting the proposed developmental model, researchers could explore how this pathway is related to the different functions of NSSI and how the pathway can be broken in order to develop prevention strategies for NSSI behaviors.

Clinical Implications

The main findings of this thesis could be significantly helpful in the development of prevention/intervention strategies for NSSI. Since a clear pattern is observed between early life experiences and NSSI via insecure attachment and emotion dysregulation, intervening with the process at any point is expected to influence the outcome (i.e. the engagement in NSSI behaviors). Since it is very difficult to alter the experiences of every child and his/her attachment with the primitive attachment figures, it makes more sense to target the individual's emotion regulation strategies. Emotion regulation strategies can be targeted at any time in someone's life and hence, it can be used both as a prevention strategy and as a

treatment. To our knowledge, there are many established therapeutic models already targeting emotion dysregulation, such as Emotion Focused Therapy, Dialectical Behavior Therapy, Emotion regulation group therapy, Cognitive therapy, Dynamic deconstructive therapy and Psychoanalytic / Psychodynamic psychotherapy (Greenberg, 2006; Goodman et al., 2014; Gratz & Gunderson, 2006; Kumar, Feldman, & Hayes, 2008; Gregory & Remen, 2008; Chlebowski & Gregory, 2012; Lindqvist et al., 2020). Therefore, examining the effect of these established models on high-risk groups and on individuals engaging in NSSI might be beneficial, since there are only limited studies investigating their effectiveness with NSSI populations (Turner, Austin, & Chapman, 2014; Bentley, Nock, Sauer-Zavala, Gorman, & Barlow, 2017; Briggs et al., 2019).

Given the evidence provided from the systematic review and meta-analysis on the effects of early life experiences, insecure attachment and emotion dysregulation on NSSI, clinicians could use related measures in order to identify individuals who might be more at risk of engaging in NSSI behaviors. One of these measures could be the ACE-IQ, since it demonstrated its validity and reliability within an NSSI population. Using the ACE-IQ instead of the CTQ will aid clinicians to collect more information that might be beneficial during the therapeutic process, since more adversities are being discussed.

However, it is interesting to observe that the proposed pathway leading to NSSI is very similar to the pathway leading to symptoms of Borderline Personality Disorder and suicidal behavior (Sabo, 1997; Twomey, Kaslow, & Croft, 2000), hence, distinguishing NSSI as a separate disorder based on its risk factors might not be possible. It is suggested that it might be more fruitful to explore resiliency factors that might interfere with the process, differentiating the outcome, such as perceived meaning in life, which was previously suggested to be a resiliency factor of suicidal behavior (Kleiman & Beaver, 2013). Although resiliency factors might be helpful in distinguishing NSSI behavior from suicidal behavior,

Muehlenkamp and Brausch (2019) found that protective factors do not moderate the risk of suicide attempts conferred by recent NSSI behaviors, something that should be taken into consideration during a clinical evaluation.

Strengths & Limitations

Despite the numerous research and clinical implications of the aforementioned findings, the thesis is not without any limitations. Although it was observed from the systematic review and meta-analysis that a cross-sectional study design with self-report measures was a general limitation across the NSSI literature, the empirical papers of this thesis did not overcome this limitation. Adopting a cross-sectional design limits our ability to infer causality, which is particularly important when investigating the effect of risk factors on NSSI. However, since childhood experiences and attachment formation happen before adulthood, one could argue that adopting a longitudinal study design would not make particular difference to the outcomes, since the order of the events cannot be altered. Self-report measures though can introduce several biases to the results, such as recall bias, which is also another limitation for not using a longitudinal study design (Stone, Bachrach, Jobe, Kurtzman, & Cain, 1999).

The use of self-reports within attachment literature has been especially controversial, since experts on the field suggest that the defenses of participants, who are insecurely attached, might lead to misleading outcomes or the interpretation of outcomes might differ due to the absence of clinical judgment in self-reports (Jacobvitz, Curran & Moller, 2002). For example, adults acknowledging difficulties in forming close relationships might be considered as insecure-avoidant on a self-report measure, while in an interview the acknowledgement and openness of the adult to share these difficulties might place him/her in the secure category (Jacobvitz et al., 2002). Self-report measures developed to explore adult

attachment styles are grounded in Bowlby's (1969/1982) theory of attachment. However, they constitute an elaboration of this theory, which suggests that adult romantic relationships share similar characteristics with the infant-caregiver relationship, such as the feeling of safety when the other person is present and responsive and the feeling of insecurity when the other is inaccessible (Mikulincer & Shaver, 2007). Studies have found a modest overlap between the attachment style formed with a primitive attachment figure and with a romantic partner, suggesting that the two schools of thought in attachment literature (the representational/developmental approach by Bowlby (1969/1982), Ainsworth, Blehar, Waters, & Wall (1978), Main & Weston (1981) and the social psychology/romantic approach by Hazan & Shaver (1987)) might not be as similar as originally perceived (Fraley, 2002). This has an impact on the conceptualization of attachment in the different studies and on the measures used to explore this distinct association, influencing the conclusions drawn from reviews including both types of attachment, such as the systematic review and meta-analysis of this thesis. It could be that the relative lack of association for attachment as a factor in NSSI observed in the systematic review is an outcome of the variation in measurement models and the position of attachment, rather than a "true" lack of association. Given that the association of attachment with NSSI was significant in the serial mediational model, one could argue that the serial mediational model presents a potentially more useful avenue for understanding the role of attachment in NSSI as a potential precipitant of other emotion (dys)regulation strategies.

Although the definition adopted for this study was based on empirical evidence and clinical guidelines, it was different to previous studies on NSSI. This led to the use of a shorter version of a previously validated measure, which has not been previously psychometrically assessed. In order to overcome this limitation, a reliability assessment was conducted before its use. Furthermore, the use of a different definition limits the opportunity

of direct comparison to be made with previous studies. However, it introduces a definition that might be more fruitful in the future.

One of the main strengths of this thesis in comparison to previous studies is that it collected information only from individuals engaging in NSSI. A very small cohort of participants recruited for the purposes of previous studies engaged in NSSI, leading to over-reliance on very small NSSI samples to observe any effects. Although it was good to have a comparison group, their findings lacked the power that might have been necessary in order to observe the actual effect sizes. Consequently, since there are many studies confirming the effect of childhood experiences, attachment and emotion dysregulation on NSSI (Liu, Scopelliti, Pittman, & Zamora, 2018; Wrath & Adams, 2019; Wolff et al., 2019), a comparison group was considered unnecessary at this stage.

Another strength of this thesis is that it attempted to provide a more comprehensive view of the risk factors of NSSI both within the systematic review and with the empirical assessment of the developmental pathway leading to NSSI. Although simplified empirical models form the basis of our understanding, more complex analyses are also needed to grasp the complexity of reality. In this way, all three papers of this thesis were able to enhance our knowledge in areas, in which gaps within NSSI literature have been observed.

Recommendations for Future Research

Although several gaps in literature have been addressed with this thesis, the outcomes raised new questions that could be addressed in future research. For example, researchers could examine whether the definition of NSSI used for this thesis is more informative with regards to conceptualizing the presenting difficulty, distinguishing it from other mental health difficulties and identifying the most appropriate treatment compared to previous definitions. Additionally, researchers could explore whether this definition can enhance the

communication between clinicians, who are currently divided into two schools of thought. In the case that the definition adopted for this study is helpful, then the development of new measures reflective of the definition might be necessary. Particularly beneficial in distinguishing NSSI from other mental health difficulties, could be the exploration of a pathway combining both risk and resiliency factors.

With regards to the risk factors leading to NSSI, more studies investigating the effect of attachment on NSSI are required, with a more homogenous study design in order to determine a more realistic effect size. Comparison studies using longitudinal and cross-sectional study designs might also provide fruitful insights into the proposed pathway. Given the different functions of NSSI, future research could attempt to correlate the risk factors included in the proposed pathway, to the different functions, in order to determine which part of the pathway might need more attention, developing in this way more personalized treatments. With regards to prevention strategies, more research on the effectiveness of already established therapeutic models targeting emotion regulation might be beneficial within the NSSI literature. Lastly, despite ACE-IQ's reliability and validity within an NSSI sample, it is important to examine how it can be modified in order to improve its factor structure. Sometimes being more specific on the adversities is paramount in the development of personalized therapies.

Concluding Remarks

To conclude, the current thesis provided a systematic review and meta-analysis of three of the most prominent risk factors of NSSI (adverse early life experiences, insecure attachment and emotion dysregulation), supported a serial mediational pathway between these risk factors and assessed the psychometric properties of ACE-IQ within an NSSI population. The findings supported a significant pooled effect for adverse childhood

experiences and emotion dysregulation on NSSI. However, there was not enough evidence to find a significant pooled effect for insecure attachment. As it was proposed adverse childhood experiences were associated to NSSI via insecure attachment and emotion dysregulation. Adverse childhood experiences were evaluated using the ACE-IQ, which was found to be a reliable and valid measure within an NSSI population. However, some issues with regards to its factor structure were indicated, suggesting that further research is required. The outcomes were in accordance to previous studies. Some of the research and clinical implications of this study were discussed, such as the use of the proposed pathway in order to develop new prevention strategies, which are focusing on modifying emotion regulation strategies. Additionally, it provided several research recommendations, such as to explore the definition of NSSI used in this study, to provide more evidence on the effect of insecure attachment on NSSI and to examine the effectiveness of established models of therapy targeting emotion dysregulation with high-risk individuals. Finally, future studies could expand the current model, by combining both risk and resiliency factors in order to develop a model, which might distinguish NSSI from suicidal behavior and borderline personality disorder.

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176

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Appendices

Appendix A. Ethical Approval Letter.

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20 June 2019

Supervisor: Dr. Nuno Ferreira

Investigator: Rania Christoforou

Research Proposal title:

A conceptual model of Deliberate Self-Harm: The contribution of Early Life Experiences, Attachment, Emotional Regulation and the Interplay between them.

The Social Sciences Ethics Review Board (SSERB) has reviewed your revised application and decided that the project can now be approved.

Your approval number is SSERB 45.

Please feel free to contact us if you have any questions.

Yours sincerely,

Mark Sullman, Ph.D.
Chair

Maria Koushiou, Ph.D.
Co-chair

Appendix B. Adverse Childhood Experiences International Questionnaire (ACE-IQ).

2	RELATIONSHIP WITH PARENTS/GUARDIANS	
	When you were growing up, during the first 18 years of your life . . .	
2.1 [P1]	Did your parents/guardians understand your problems and worries?	Always · · Most of the time · · Sometimes · · Rarely · · Never · · Refused
2.2 [P2]	Did your parents/guardians **really** know what you were doing with your free time when you were not at school or work?	Always Most of the time · · Sometimes · · Rarely · · Never · · Refused
3		
3.1 [P3]	How often did your parents/guardians **not** give you enough food even when they could easily have done so?	Many times A few times Once Never Refused
3.2 [P4]	Were your parents/guardians too drunk or intoxicated by drugs to take care of you?	Many times A few times Once Never Refused
3.3 [P5]	How often did your parents/guardians **not** send you to school even when it was available?	Many times A few times Once Never Refused
4	FAMILY ENVIRONMENT	
	When you were growing up, during the first 18 years of your life . . .	
4.1 [F1]	Did you live with a household member who was a problem drinker or alcoholic, or misused street or prescription drugs?	Yes No Refused
4.2 [F2]	Did you live with a household member who was depressed, mentally ill or suicidal?	Yes No Refused
4.3 [F3]	Did you live with a household member who was ever sent to jail or prison?	Yes No Refused
4.4 [F4]	Were your parents ever separated or divorced?	Yes No Not applicable Refused
4.5 [F5]	Did your mother, father or guardian die?	Yes No Don't know / Not sure Refused

These next questions are about certain things you may actually have heard or seen IN YOUR HOME. These are things that may have been done to another household member but not necessarily to you.

Adverse Childhood Experiences International Questionnaire (ACE-IQ)   B1.2
Section B: Questionnaire

When you were growing up, during the first 18 years of your life . . .		
4.6 [F6]	Did you see or hear a parent or household member in your home being yelled at, screamed at, sworn at, insulted or humiliated?	Many times
		A few times
		Once
		Never
		Refused
4.7 [F7]	Did you see or hear a parent or household member in your home being slapped, kicked, punched or beaten up?	Many times
		A few times
		Once
		Never
		Refused
4.8 [F8]	Did you see or hear a parent or household member in your home being hit or cut with an object, such as a stick (or cane), bottle, club, knife, whip etc.?	Many times
		A few times
		Once
		Never
		Refused

These next questions are about certain things YOU may have experienced.		
When you were growing up, during the first 18 years of your life . . .		
5		
5.1 [A1]	Did a parent, guardian or other household member yell, scream or swear at you, insult or humiliate you?	Many times
		A few times
		Once
		Never
		Refused
5.2 [A2]	Did a parent, guardian or other household member threaten to, or actually, abandon you or throw you out of the house?	Many times
		A few times
		Once
		Never
		Refused
5.3 [A3]	Did a parent, guardian or other household member spank, slap, kick, punch or beat you up?	Many times
		A few times
		Once
		Never
		Refused
5.4 [A4]	Did a parent, guardian or other household member hit or cut you with an object, such as a stick (or cane), bottle, club, knife, whip etc?	Many times
		A few times
		Once
		Never
		Refused
5.5 [A5]	Did someone touch or fondle you in a sexual way when you did not want them to?	Many times
		A few times
		Once
		Never
		Refused
5.6 [A6]	Did someone make you touch their body in a sexual way when you did not want them to?	Many times
		A few times
		Once
		Never
		Refused
5.7 [A7]	Did someone attempt oral, anal, or vaginal intercourse with you when you did not want them to?	Many times
		A few times
		Once

		Never
		Refused
5.8 [A8]	Did someone actually have oral, anal, or vaginal intercourse with you when you did not want them to?	Many times
		A few times
		Once
		Never
		Refused

6	PEER VIOLENCE

These next questions are about BEING BULLIED when you were growing up. Bullying is when a young person or group of young people say or do bad and unpleasant things to another young person. It is also bullying when a young person is teased a lot in an unpleasant way or when a young person is left out of things on purpose. It is not bullying when two young people of about the same strength or power argue or fight or when teasing is done in a friendly and fun way.

When you were growing up, during the first 18 years of your life . . .

6.1 [V1]	How often were you bullied?	Many times
		A few times
		Once
		Never (Go to Q.V3)
		Refused
6.2 [V2]	How were you bullied most often?	I was hit, kicked, pushed, shoved around, or locked indoors
		I was made fun of because of my race, nationality or colour
		I was made fun of because of my religion
		I was made fun of with sexual jokes, comments, or gestures
		I was left out of activities on purpose or completely ignored
		I was made fun of because of how my body or face looked
		I was bullied in some other way
		Refused

This next question is about PHYSICAL FIGHTS. A physical fight occurs when two young people of about the same strength or power choose to fight each other.

When you were growing up, during the first 18 years of your life . . .

6.3 [V3]	How often were you in a physical fight?	Many times
		A few times
		Once
		Never
		Refused

7	WITNESSING COMMUNITY VIOLENCE

These next questions are about how often, when you were a child, YOU may have seen or heard certain things in your NEIGHBOURHOOD OR COMMUNITY (not in your home or on TV, movies, or the radio).

When you were growing up, during the first 18 years of your life . . .

7.1 [V4]	Did you see or hear someone being beaten up in real life?	Many times
		A few times
		Once
		Never
		Refused
7.2	Did you see or hear someone being stabbed	Many times

[V5]	or shot in real life?	A few times
		Once
		Never
		Refused
7.3 [V6]	Did you see or hear someone being threatened with a knife or gun in real life?	Many times
		A few times
		Once
		Never
		Refused
8	**EXPOSURE TO WAR/COLLECTIVE VIOLENCE**	

These questions are about whether YOU did or did not experience any of the following events when you were a child. The events are all to do with collective violence, including wars, terrorism, political or ethnic conflicts, genocide, repression, disappearances, torture and organized violent crime such as banditry and gang warfare.

When you were growing up, during the first 18 years of your life . . .

8.1 [V7]	Were you forced to go and live in another place due to any of these events?	Many times
		A few times
		Once
		Never
		Refused
8.2 [V8]	Did you experience the deliberate destruction of your home due to any of these events?	Many times
		A few times
		Once
		Never
		Refused
8.3 [V9]	Were you beaten up by soldiers, police, militia, or gangs?	Many times
		A few times
		Once
		Never
		Refused
8.4 [V10]	Was a family member or friend killed or beaten up by soldiers, police, militia, or gangs?	Many times
		A few times
		Once
		Never
		Refused

Adverse Childhood Experiences International Questionnaire (ACE-IQ)
Section B: Questionnaire

B1.5

Source: WHO (2018)

216

Appendix C. Childhood Trauma Questionnaire – Short Form (CTQ-SF).

Child Trauma Questionnaire (CTQ) – Short form

Directions: These questions ask about some of your experiences growing up as a child and a teenager. For each question, circle the number that best describes how you feel. Although some of these questions are of a personal nature, please try to answer as honestly as you can. Your answers will be kept confidential.

When I was growing up, ….	Never true	Rarely true	Some times true	Often true	Very often true
1. I didn't have enough to eat.	1	2	3	4	5
2. I knew that there was someone to take care of me and protect me.	1	2	3	4	5
3. People in my family called me things like "stupid", "lazy", or "ugly".	1	2	3	4	5
4. My parents were too drunk or high to take care of the family.	1	2	3	4	5
5. There was someone in my family who helped me feel important or special.	1	2	3	4	5

When I was growing up, …

	Never true	Rarely true	Some times true	Often true	Very often true
6. I had to wear dirty clothes.	1	2	3	4	5
7. I felt loved.	1	2	3	4	5
8. I thought that my parents wished I had never been born.	1	2	3	4	5
9. I got hit so hard by someone in my family that I had to see a doctor or go to the hospital.	1	2	3	4	5
10. There was nothing I wanted to change about my family.	1	2	3	4	5

When I was growing up, …

	Never true	Rarely true	Some times true	Often true	Very often true
11. People in my family hit me so hard that it left me with bruises or marks.	1	2	3	4	5
12. I was punished with a belt, a board, a cord (or some other hard object).	1	2	3	4	5
13. People in my family looked out for each other.	1	2	3	4	5
14. People in my family said hurtful or insulting things to me.	1	2	3	4	5
15. I believe that I was physically abused.	1	2	3	4	5

		Never true	Rarely true	Some times true	Often true	Very often true
	When I was growing up, ….					
16.	I had the perfect childhood.	1	2	3	4	5
17.	I got hit or beaten so badly that it was noticed by someone like a teacher, neighbor, or doctor.	1	2	3	4	5
18.	Someone in my family hated me.	1	2	3	4	5
19.	People in my family felt close to each other.	1	2	3	4	5
20.	Someone tried to touch me in a sexual way or tried to make me touch them.	1	2	3	4	5
	When I was growing up, …					
21.	Someone threatened to hurt me or tell lies about me unless I did something sexual with them.	1	2	3	4	5
22.	I had the best family in the world.	1	2	3	4	5
23.	Someone tried to make me do sexual things or watch sexual things.	1	2	3	4	5
24.	Someone molested me (took advantage of me sexually).	1	2	3	4	5
25.	I believe that I was emotionally abused.	1	2	3	4	5
	When I was growing up, …					
26.	There was someone to take me to the doctor if I needed it.	1	2	3	4	5
27.	I believe that I was sexually abused.	1	2	3	4	5
28.	My family was a source of strength and support.	1	2	3	4	5

Source: Bernstein et al. (2003)

Appendix D. Adult Attachment Scale.

Adult Attachment Scale Items and Factor Loadings

Item	Factor 1	Factor 2	Factor 3
Depend			
1. I find it difficult to allow myself to depend on others.[a] (Av)	.54	−.18	.06
2. People are never there when you need them.[a] (Av)	.48	.26	.09
3. I am comfortable depending on others. (S)	−.58	.24	−.09
4. I know that others will be there when I need them. (S)	−.66	−.18	.03
5. I find it difficult to trust others completely.[a] (Av)	.38	.13	.12
6. I am not sure that I can always depend on others to be there when I need them.[a] (Ax)	.71	.14	−.10
Anxiety			
7. I do not often worry about being abandoned.[a] (S)	.03	−.48	−.19
8. I often worry that my partner does not really love me. (Ax)	.09	.64	.21
9. I find others are reluctant to get as close as I would like. (Ax)	.10	.47	−.13
10. I often worry my partner will not want to stay with me. (Ax)	.10	.62	.15
11. I want to merge completely with another person. (Ax)	−.11	.49	−.14
12. My desire to merge sometimes scares people away. (Ax)	.05	.55	−.14
Close			
13. I find it relatively easy to get close to others. (S)	−.16	.02	−.45
14. I do not often worry about someone getting too close to me. (S)	.07	.01	−.46
15. I am somewhat uncomfortable being close to others.[a] (Av)	.05	.04	.71
16. I am nervous when anyone gets too close.[a] (Av)	−.02	.20	.77
17. I am comfortable having others depend on me. (S)	−.03	.08	−.40
18. Often, love partners want me to be more intimate than I feel comfortable being.[a] (Av)	.07	−.03	.29
Eigenvalue before rotation	3.49	1.80	1.01
Percentage of variance after rotation[b]	11.30	11.50	10.80

Note. (S) Indicates items that originated from the "secure" description; (Av), items that originated from the "avoidant" description; and (Ax), items that originated from the "anxious" description.

Source: Collins & Read (1990)

219

Appendix E. Emotion Regulation Questionnaire (ERQ).

Emotion Regulation Questionnaire (ERQ)
Gross & John
9/03

The Emotion Regulation Questionnaire is designed to assess individual differences in the habitual use of two emotion regulation strategies: cognitive reappraisal and expressive suppression.

Citation

Gross, J.J., & John, O.P. (2003). Individual differences in two emotion regulation processes: Implications for affect, relationships, and well-being. Journal of Personality and Social Psychology, 85, 348-362.

Instructions and Items

We would like to ask you some questions about your emotional life, in particular, how you control (that is, regulate and manage) your emotions. The questions below involve two distinct aspects of your emotional life. One is your emotional experience, or what you feel like inside. The other is your emotional expression, or how you show your emotions in the way you talk, gesture, or behave. Although some of the following questions may seem similar to one another, they differ in important ways. For each item, please answer using the following scale:

1----------------2----------------3----------------4----------------5----------------6----------------7
strongly   neutral   strongly
disagree   agree

1. _____ When I want to feel more *positive* emotion (such as joy or amusement), I *change what I'm thinking about*.
2. _____ I keep my emotions to myself.
3. _____ When I want to feel less *negative* emotion (such as sadness or anger), I *change what I'm thinking about*.
4. _____ When I am feeling *positive* emotions, I am careful not to express them.
5. _____ When I'm faced with a stressful situation, I make myself *think about it* in a way that helps me stay calm.
6. _____ I control my emotions by *not expressing them*.
7. _____ When I want to feel more *positive* emotion, I *change the way I'm thinking* about the situation.
8. _____ I control my emotions by *changing the way I think* about the situation I'm in.
9. _____ When I am feeling *negative* emotions, I make sure not to express them.
10. _____ When I want to feel less *negative* emotion, I *change the way I'm thinking* about the situation.

Note

Do not change item order, as items 1 and 3 at the beginning of the questionnaire define the terms "positive emotion" and "negative emotion".

Scoring (no reversals)

Reappraisal Items: 1, 3, 5, 7, 8, 10; Suppression Items: 2, 4, 6, 9.

Source: Gross & John (2003)

Appendix F. Self-harm Inventory (SHI).

SELF-HARM INVENTORY

Instructions: Please answer the following questions by checking either, "Yes," or "No." Check "yes" only to those items that you have done intentionally, or on purpose, to hurt yourself.

Yes   No   Have you ever intentionally, or on purpose, done any of the following:

___   ___   1. Overdosed? (If yes, number of times____)
___   ___   2. Cut yourself on purpose? (If yes, number of times____)
___   ___   3. Burned yourself on purpose? (If yes, number of times____)
___   ___   4. Hit yourself? (If yes, number of times____)
___   ___   5. Banged your head on purpose? (If yes, number of times____)
___   ___   6. Abused alcohol?
___   ___   7. Driven recklessly on purpose? (If yes, number of times____)
___   ___   8. Scratched yourself on purpose? (If yes, number of times____)
___   ___   9. Prevented wounds from healing?
___   ___   10. Made medical situations worse on purpose (e.g.,skipped medication)?
___   ___   11. Been promiscuous (i.e., had many sexual partners)? (If yes, how many?____)
___   ___   12. Set yourself up in a relationship to be rejected?
___   ___   13. Abused prescription medication?
___   ___   14. Distanced yourself from God as punishment?
___   ___   15. Engaged in emotionally abusive relationships? (If yes, number of relationships?____)
___   ___   16. Engaged in sexually abusive relationships? (If yes, number of relationships?____)
___   ___   17. Lost a job on purpose? (If yes, number of times____)
___   ___   18. Attempted suicide? (If yes, number of times____)
___   ___   19. Exercised an injury on purpose?
___   ___   20. Tortured yourself with self-defeating thoughts?
___   ___   21. Starved yourself to hurt yourself?
___   ___   22. Abused laxatives to hurt yourself? (If yes, number of times____)

Have you engaged in any other self-destructive behaviors not asked about in this inventory? If so, please describe below.

Source: Sansone, Sansone, & Wiederman (1995)

Appendix G. Journal of Clinical Psychology Review – Author Guidelines

CLINICAL PSYCHOLOGY REVIEW

ELSEVIER

TABLE OF CONTENTS

DESCRIPTION

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223

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227

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231

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232

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233

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234

Appendix H. Journal of Suicide and Life-Threatening Behavior – Author Guidelines.

Journal of Suicide and Life-Threatening Behavior

Author Guidelines

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Appendix I. Journal of Child Abuse and Neglect – Author Guidelines.

CHILD ABUSE & NEGLECT
The International Journal

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AUTHOR INFORMATION PACK

TABLE OF CONTENTS

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DESCRIPTION

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240

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241

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242

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243

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