PhD in

Educational Sciences and Psychology

CYCLE XXXIV

COORDINATOR Prof. Boffo Vanna

The Development of Non-Suicidal Self-Injury in Adolescence: The Role of Interpersonal and Intrapersonal Risk Factors

Academic Discipline (SSD) MPSI/04

Doctoral Candidate	**Supervisor**
Dr. (De Luca Lisa)	Prof. (Menesini Ersilia)
_____	_____
(signature)	*(signature)*

Coordinator
Prof. (Boffo Vanna)

_____
(signature)

Years 2018/2021

Abstract

The present dissertation aims to improve our knowledge on the longitudinal development of Non-Suicidal Self-Injury (NSSI) and the role of interpersonal and intrapersonal risk factors associated with it. Non-Suicidal Self-injury (NSSI), defined as the direct and deliberate self-inflicted damage of body tissue without suicidal intent, is a serious public health concern worldwide (Kiekens et al., 2018). Adolescents are the most at-risk group, given that the transition into adolescence may represent a critical vulnerability period for the onset of NSSI behaviors (Lloyd-Richardson, 2008). This phenomenon requires attention not only because of its heavy impact in terms of public health and the high incidence within the population, but also for the consequences that engagement in NSSI entails. The long-term effects of self-injurious behavior can be destructive, with consequences for emotional and cognitive development (Baetens et al., 2011). NSSI is used as a maladaptive means of coping with intense emotions. Both interpersonal (e.g., social interaction with peers and family; Brausch & Gutierrez, 2010) and intrapersonal factors (e.g., emotion regulation, self-efficacy, and self-esteem; Baetens et al., 2011) can serve to initiate and maintain NSSI (Nock, 2009; Nock & Prinstein, 2004; Zetterqvist et al., 2013). In the last ten years, the attention given to this issue has become increasingly important. Most of the existing literature has examined this behavior (e.g., prevalence, risks factors) at the cross-sectional level, while few studies have explored the longitudinal development of NSSI, and the role played by interpersonal and intrapersonal factors at the longitudinal level. For these reasons, the general aim of the present dissertation is to analyze the longitudinal development of NSSI and the association with interpersonal and intrapersonal risk factors. Three empirical studies are presented. They cover three main issues: 1) a meta-analysis on the longitudinal development of NSSI; 2) the reciprocal associations between peer problems and NSSI; 3) the mediational role of Covid-19 related stress in the association between pre-existing vulnerabilities and NSSI.

In the first study (Chapter 1), we presented a meta-analysis on the development of NSSI from childhood to young adulthood, using a Bayesian approach. The aim was to examine both the occurrence and the frequency of NSSI over time, considering all studies published up until November 2020. Subsequently, we examined the role of possible moderators, such as gender, mean age during the first wave of data collection, and number of months covered by the assessment. The results show the important role of gender (i.e., females) and age in the explanation of the expected proportion and mean changes of NSSI over time. Specifically, what emerges from the findings is how being female represents an important risk factor for the occurrence of this behavior. As for the frequency of this behavior, a higher percentage of females are associated with higher severity of NSSI, but it tends to decrease over time. The results show that mid-adolescence (i.e., 14/15 years) appears to be the period of highest risk for the occurrence of NSSI over time. Instead, over time, findings suggest that the frequency of this behavior is higher in adolescence, at a mean age of 15-16 years of age, and it decreases in late adolescence (e.g., Plener et al., 2015).

In the second study (Chapter 2), we investigated the reciprocal associations between peer problems (e.g., peer victimization, friendship stress, and loneliness) and NSSI throughout adolescence, distinguishing between- and within-person effects. Participants were 866 adolescents (54.5% females; $M_{age} = 13.12$ years, $SD = 0.78$), who took part in six waves of data collection. Random Intercept Cross-Lagged Panel Models (RI-CLPM) were used to estimate within-person cross-lagged effects between each peer problem and NSSI from Grade 7 to 12. After accounting for between-person associations between peer problems and NSSI, results indicated that higher-than-usual levels of NSSI predicted higher-than-usual levels of adolescents' own friendship stress, loneliness, and peer victimization at the subsequent time point. Yet, sensitivity analyses revealed that most of these effects were strongly attenuated and

explained by within-person fluctuations in depressive symptoms. No within-person cross-lagged effects from peer problems to NSSI were found.

In the third study (Chapter 3), we examined the role of Covid-19 related stress in the association between pre-existing vulnerabilities and the engagement in NSSI during the pandemic. Specifically, the study aimed to examine if adolescents with pre-existing vulnerabilities, including a prior history of NSSI, higher levels of internalizing symptoms, and poorer regulatory emotional self-efficacy, were more likely to show increases in NSSI across the pandemic period through higher levels of Covid-19 related stress. The analysis was conducted on 1061 adolescents (52.4% females; $M_{age} = 15.49$ years, $SD = 0.76$), enrolled in the 9th and 10th grade in Tuscany, Italy, who took part in two waves of data collection. Results showed that adolescents with pre-existing vulnerabilities were at higher risk of engaging in NSSI through the role of Covid-19 related stress. Specifically, adolescents with a prior history of NSSI, higher levels of anxious and depressive symptoms, and poorer regulatory emotional self-efficacy showed a higher level of Covid-19 related stress, which in turn it was associated with an increased risk of occurrence of NSSI.

In the final chapter (Chapter 4), the results of the previous three studies have been discussed highlighting their contribution to the literature on the longitudinal development of NSSI, strengths and limitations, and the implications for future studies.

Keywords: Non-Suicidal Self-Injury; longitudinal studies; peer problems; interpersonal factors; intrapersonal factors; Random Intercept Cross Lagged Panel Model (RI-CLPM); pre-existing vulnerabilities, internalizing symptoms; Covid-19 related stress.

Academical Acknowledgments

During my Phd course, I had the pleasure and the great opportunity to collaborate with different Professors, that I would kindly thank for the important contribution.

I would like to thank the Phd Coordinator, Professor Vanna Boffo, for the educational growth offered by the doctoral course.

A special and warm acknowledgment goes to my supervisor, Professor Ersilia Menesini, from the University of Florence, whose expertise and passion for her work, was extremely inspiring and stimulating both at personal and educational level.

Besides, I would heartily thank Professor Annalaura Nocentini and Dr. Benedetta Emanuela Palladino, from the University of Florence, for the great support and contribution in terms of educational and personal growth.

I have also had the great pleasure to collaborate with external professors belonging to different Universities.

First, Professor Matteo Giletta, from the University of Gent, with whom I have directly worked during my period abroad. I wish to thank him for the further contribution given to me on the topic, thanks to his great knowledge and passion for his work.

Besides, I also want to thank Professor Mitchell Prinstein, from the University of North Carolina, for the opportunity to work on an important longitudinal dataset that significantly contributed to the scientific literature on the topic.

Moreover, I thank Professor Birgit Reims, from the University of Furtwangen, for her in-depth contribution on the analyzed construct.

For the important methodological contribution, a special thank goes to Professor Massimiliano Pastore from the University of Padua.

Table of Content

Table of Figures

Index of Tables

THEORETICAL FRAME OF THE DISSERTATION

"You never start cutting yourself for a single cause, there is not a single thing that triggers you and tells you to do it. There is an internal pain that seems to be about to explode, that is no longer inside, it wants to get out and you don't know how to get it out" (Manca, M. (2017). L'autolesionismo nell'era digitale).

"I did this ... because I was sick, everyone stressed me, I didn't understand anything, my head burst and I had to hurt myself ... before I did it only out of anger, now I do it because I find relief after every injury" (Manca, M. (2017). L'autolesionismo nell'era digitale).

These testimonies of adolescents manifest the profound state of discomfort, which is expressed through hurting their body with intentional and often repetitive attacks. Getting hurt becomes a way to feel better. By focusing on physical sensations, the adolescent distracts attention from psychological pain. Undoubtedly, NSSI has become a major public health concern among adolescents (Jacobson & Gould, 2007), and in particular mid-adolescence represents the period most at risk for the occurrence and the severity of this behavior (e.g., Plener et al., 2015). NSSI requires attention not only because of the high incidence within the population and its impact in terms of adolescents' well-being, but also for the consequences that engagement in NSSI entails. The long-term effects of self-injurious behavior can be destructive, with consequences for emotional and cognitive development (Baetens et al., 2011). This behavior is often associated to poor psychological health, with negative emotional, interpersonal, and physical consequences (e.g., Turner et al., 2014; Whitlock et al., 2013), including suicidal ideations, behaviors and accidental death. Given the serious and negative implications of this behavior over time, it is crucial to investigate the prevalence and the nature of this behavior, how interpersonal and intrapersonal factors might affect the longitudinal development of NSSI, and which mechanisms can be related to the presence and severity of this behavior over time.

1. The construct of Non-Suicidal Self-Injury

Concerning the definition of the construct, Non-suicidal self-injury (NSSI) is defined as a deliberate, direct, destruction of one's body tissue without conscious suicidal intent (Nock, 2010; Nock & Favazza, 2009). Common types of NSSI include behaviors such as cutting, burning, scratching, and self-hitting (Klonsky & Muehlenkamp, 2007; Laye-Gindhu & Schonert-Reichl, 2005; Whitlock et al., 2006) and most adolescents that engage in self-injury report using multiple methods of doing so (Favazza & Conterio, 1988).

Recent work found that rates of NSSI in community samples of adolescents is remarkably high, with approximately 23% of adolescents having reported deliberately injuring themselves at least once in their life, and almost 19% within the previous year (Gillies et al., 2018). As for the onset of the phenomenon, previous researchers reported that self-injury behavior occurs between the ages of 11 and 15 years (Rodav et al., 2014). However, rates of NSSI during adolescence are highly variable. Despite the increasing number of studies over the last decade on the prevalence of self-injury it is difficult to understand the actual extent of the phenomenon. First of all, because of the variability of terms that are used to define the construct (e.g., self-harm, DSH, NSSI); then, because of the differences in sample characteristics (e.g., mean age of participants, percentage of females); and finally, because of certain methodological aspects related to the measurement tools (e.g., binary question vs checklist; Giletta et al., 2012; Gillies et al., 2018; Butler & Malone, 2013; Lofthouse & Yager-Schweller, 2009).

According to interpersonal models of developmental psychopathology (Rudolph et al., 2016), the dynamic and reciprocal exchanges between individuals' own characteristics and the ones of their environments shape the course of youths' development (Rutter, 2014). These transactional models affirm that adolescents are not simply passive receivers of experiences, but they actually have an active role in selecting and modifying their environment (Cicchetti, 1993; Rutter, 2014; Sameroff, 2014). Thus, it is important to consider not only the role of

individuals and contextual factors, but also their interaction in influencing youths' development, and the evolution of a series of maladaptive behaviors, such as Non-Suicidal Self-Injury. Specifically, previous studies emphasize the crucial role of both intrapersonal (e.g., emotional dysregulation, self-efficacy, self-esteem, internalizing problems; Baetens et al., 2011) as well as interpersonal risk factors (e.g., social interaction with family and peers; Brausch & Gutierrez, 2010; Esposito et al., 2019) for the onset and maintaining of NSSI (Nock, 2009; Nock & Prinstein, 2004; Zetterqvist et al., 2013). Notably, intrapersonal factors play an important role for the retention of NSSI, in line with the affect-regulatory role of NSSI (Muehlenkamp et al., 2013), while interpersonal factors are more salient for initial involvement in the phenomenon (Hilt et al., 2008; Muehlenkamp et al., 2013). These factors represent vulnerabilities that lead adolescents to difficulties in managing and coping with struggles or stressful events, putting them at risk of engaging in risky behaviors, such as NSSI, to modulate their experience (Nock et al., 2009). In fact, NSSI may be used as a coping strategy to avoid distressed emotional states (Chapman et al., 2006a) and to down-regulate the arising of negative feelings or communicate their emotions with others (Bentley et al., 2014; Liu et al., 2016).

According to the four-factor model (Nock & Prinstein, 2004), self-injuring behavior may be maintained through intrapersonal ("automatic") as well as interpersonal ("social") processes, which can both reinforce the behavior positively and negatively. Notably, the behavior can be maintained by intrapersonal or automatic negative reinforcement, in which there is an immediate decrease or cessation of aversive feelings, such as tension relief. It can also be maintained by intrapersonal or automatic positive reinforcement, with an increase in desired thoughts or feelings, such as satisfaction from having "punished" themselves. Instead, as regards the interpersonal or social function, the behavior can be maintained by a positive reinforcement, with an increase in a desired social event such as receiving attention or support from others (e.g., family or peers) or via a negative reinforcement, with a consequent decrease

or cessation of negative and stressful events such as peer problems, victimization, and difficulties with parents. Thus, the long-term effects of NSSI can be negative, with consequences for the stability of both emotional and cognitive development.

Therefore, given the crucial role of these factors in the explanation of this behavior and its related consequences, it would be important to investigate its role in the development of the behavior over time, using a longitudinal approach. Indeed, most of the studies have investigated the prevalence and the characteristics of NSSI, at the cross-sectional level, while few longitudinal studies analyzed the development of the behavior over time, using multiple time-points (e.g., Giletta et al., 2015; Plener et al., 2015). Specifically, despite the fact that the last ten years have been characterized by increasing attention for the analysis of the phenomenon at a longitudinal level, most of them used only a few time points (e.g., the majority with only two or three waves of data collection), assessing a short time period (Wu et al., 2019), with a huge variability in the age cohorts involved (e.g., Giletta et al., 2013; Zhu et al., 2020). For these reasons, it is important to continue to examine the development of this behavior in adolescence over time.

2. Dissertation overview

Starting from all these considerations, the aim of the present dissertation is to shed light on the longitudinal development of Non-Suicidal Self-Injury among a normative sample of adolescents, while also examining the role of interpersonal and intrapersonal risk factors associated with this phenomenon. The interaction between individual and contextual factors plays a crucial role in influencing and explaining how NSSI behavior develops, is maintained, and changes over time (e.g., Fox et al., 2015; Tatnell et al., 2014). However, we cannot consider that methodological aspects such as research design and the measure used to assess the construct need more consideration in this type of study (Gillies et al., 2018; Swannell et al., 2014). In

accordance with these premises, three studies have been carried out to give an answer to a series of issues raised from the scientific literature.

Study 1 (Chapter 1) presents a meta-analysis of published longitudinal studies to understand the development of NSSI from childhood to young adulthood. Specifically, the main aim was to analyze the occurrence and the frequency/severity of the behavior over time, from childhood to young adulthood, using a meta-analytic approach. Next, the role of possible factors that can moderate the longitudinal development of the behavior over time was addressed. Notably, we considered the sample characteristics (i.e., mean age of the participants, gender), and the months of data collection.

Starting from the results and suggestions provided by the meta-analysis, some issues claimed consideration in further research. First, a series of methodological issues such as (1) the importance of using longitudinal designs over several times to grasp the development of the behavior over time (e.g., multiple time points) and (2) the use of a valid, well-defined measure of the construct that would allow to assess the phenomenon accurately in a reliable way (i.e., scale or checklist). Secondly, given that mean age and gender (i.e., being female) seem to moderately explain the longitudinal development of NSSI, it is important to investigate the role of other factors that can better explain the possible development of NSSI. Thus, for example, better understanding the role of interpersonal and intrapersonal factors would be crucial to examine the development of the phenomenon over time.

Following these considerations, the second and third study of the present dissertation are focused on non-suicidal self-injury behavior in adolescents that attend the high school (i.e., community sample). Besides, we have decided to focus only on longitudinal studies in order to understand the development of NSSI over time, using a specific scale (Prinstein, 2008) that assesses how often adolescents engage in NSSI, instead of a single item question (i.e., yes/no). Additionally, in both studies we considered several factors and mechanisms that may explain

the development of NSSI behavior, such as the role of interpersonal factors (i.e., peer problems; Study 2), and intrapersonal factors (i.e., internalizing problems; Study 3). In addition, we paid specific attention to the role played by context, which may have to do with the arrival of negative life events, in determining the association between a series of individual vulnerabilities and the development of risky behaviors. Among these, Covid-19 might be considered as a worldwide stressful life event that has characterized the entire year 2020 (i.e., Covid-19 pandemic) by having a strong impact not only on public health but also on the mental health of individuals, especially for adolescents (Branje & Morris, 2021; Gruber et al., 2020; World Health Organization, 2020a).

Study 2 (Chapter 2) includes a longitudinal study (i.e., multi-wave design) that cover a total of six years in a large sample of US students. The focus of this study concerns both the development of NSSI over time and the reciprocal association with interpersonal factors (i.e., peer problems). Specifically, the main aim was to investigate the reciprocal effects between three indicators of peer problems (i.e., peer victimization, friendship stress, and loneliness) and NSSI, using a six-wave prospective design in which a large community sample of adolescents were followed throughout adolescence and high school, from Grade 7 to 12. We used a Random-Intercept Cross Lagged Panel Models (RI-CLPM; Hamaker et al., 2015), in order to differentiate between-person from within-person effects. Notably, this approach allowed us to examine the extent to which peer problems and NSSI reciprocally influenced each other over time, while considering all stable factors that may have influenced both peer problems and NSSI.

Study 3 (Chapter 3) focuses on the association between intrapersonal factors and NSSI behavior at a longitudinal level (i.e., pre-post the start of the Covid pandemic). In line with a theoretical perspective that considers the interaction between the individual and the

environment (Rutter, 2014), life events that characterized 2020 (i.e., Covid-19 pandemic) were included in the tested model. The main aim was to examine the role of Covid-19 related stress, in the association between pre-existing vulnerabilities (i.e., a prior history of NSSI, higher levels of internalizing symptoms, and poorer regulatory emotional self-efficacy) and engagement in NSSI during the pandemic. According to the suggestion given by the findings of the meta-analysis, we have decided to examine both the occurrence (i.e., presence; yes or no) and the frequency of the behavior, as to account not only for the presence (i.e., occasional behavior), but also the severity of the behavior (i.e., systematic behavior).

CHAPTER 1

The development of Non-Suicidal Self-Injury from childhood to young adulthood: a Bayesian meta-analysis

1.1 Introduction

Non-Suicidal Self-Injury (NSSI) has been identified as a serious public health concern worldwide (Kiekens et al., 2018; Nock et al., 2008). With onset typically in adolescence (Klonsky, 2011; Rodham & Hawton, 2009), NSSI is associated with poor psychological health and an increased risk of suicidal intent (Hasking et al., 2008; Whitlock et al., 2013). Thus, given the growing recognition of the poor outcomes associated with NSSI, it is important to intervene both at the community and individual level to act on potential risk factors, and help the youths involved (Jarvi et al., 2013).

Non-Suicidal Self-Injury (NSSI) is defined as a subcategory of self-injurious behavior that refers to the direct and deliberate destruction of one's body tissue without suicidal intent (e.g., cutting; APA, 2013). While North American studies preferred to use definitions which stress the intentions of the behavior (e.g., non-suicidal self-injury), most of the European studies adopted a more comprehensive definition of self-injury (i.e., deliberate self-harm; DSH), which is independent from the aim and includes a greater variety of self-injurious behaviors, such as self-poisoning or drug overdose (Rodham & Hawton, 2009).

Generally, NSSI is widespread in adolescence, which is a critical vulnerable period (Lloyd-Richardson, 2008). The prevalence of NSSI in community samples of adolescents is remarkably high. Previous studies found that approximately 23% of adolescents reported deliberately injuring themselves at least once in their life, and almost 19% in the previous year (Gillies et al., 2018). However, rates of NSSI during adolescence are highly variable (Muehlenkamp et al., 2012). As for the onset of the phenomenon, previous studies reported that

self-injury occurs between the ages of 11 and 15 years (Rodav et al., 2014), whereas a recent work (Plener et al., 2015) found that NSSI peak in adolescence at around 15 and 17 years old, and wanes/remits in late adolescence/early adulthood. Although there is some evidence of NSSI beginning before puberty (Hanania et al., 2015), other studies found a later increase during adolescence (Marshall et al., 2013), and puberty can be considered a key point in the initiation of self-injury (Gillies et al., 2018). Despite the increasing number of studies on the prevalence of NSSI in the last decade, it is difficult to understand the actual extent of the phenomenon because of the different terms used to define the construct and the differences in methodological aspects (Giletta et al., 2012; Gillies et al., 2018; Butler & Malone, 2013; Lofthouse & Yager-Schweller, 2009).

The increasing attention for this phenomenon is related to the consequences that engagement in NSSI entails. Specifically, it has been associated with a lack of regulation of one's emotion (Nock, 2010), maladaptive strategies for regulating affect (Perez et al., 2012), concurrent and subsequent suicide ideation/attempts (Castellvi et al., 2017; Lundh et al., 2011), psychological symptoms (e.g., depression, anxiety, borderline personality disorders; Baetens et al., 2014), and other psychosocial dysfunctions (e.g., cognitive vulnerability, persistent child sexual abuse, interpersonal distress; Garisch & Wilson, 2015). The long-term effects of self-injurious behavior can be destructive, with consequences for emotional and cognitive development (Buelens et al., 2019). Prior research suggests that adolescents who engage in self-injurious behaviors show a later maladaptive coping cycle in which emotions, cognition, and self-injurious behavior reinforce each other (Buelens et al., 2019). Moreover, Daukantaite and colleagues (2020) showed that adolescents who have engaged in NSSI for reasons of relief, even if not regularly, may be characterized by negative outcomes in young adulthood.

The likelihood of engaging in NSSI varies across developmental phases, but most previous studies addressed NSSI at a static level, focusing on a specific time point (i.e., cross-

sectional study). Despite a surge in research on self-injury in the last decade (Glenn & Klonsky, 2011; Guerry & Prinstein, 2010), there is still a paucity of longitudinal studies focused on the development over time of NSSI from adolescence to young adulthood. The majority of studies addressed self-injury behavior at a cross-sectional level, and thus little is known about the longitudinal growth of this behavior (Glenn & Klonsky, 2011; Guerry & Prinstein, 2010; Plener et al., 2015).

To date, there are no studies that have summarized quantitatively what we know about the development of this behavior at the longitudinal level in relation to community samples (i.e., meta-analysis). In fact, the majority of systematic reviews and meta-analyses focus on the global prevalence of NSSI (Gillies et al., 2018; Swannell et al., 2014) and the risk factors for its development (Tatnell et al., 2014), principally using one-wave studies. To our knowledge, only one systematic review on the longitudinal development of NSSI has been published (Plener et al., 2015). It lacks specific focus on community samples, but also takes into consideration clinical samples, and above all, analyses the literature at a systematic review level, without making a quantitative synthesis that can explain the development of NSSI behavior over time. Moreover, it has not taken into consideration moderators that could influence the development of NSSI over time.

Thus, it is important to examine the development of NSSI from early adolescence to young adulthood, given the impact and consequences of this behavior on mental and physical health. Specifically, it is important to understand the extent to which this behavior naturally decreases over time and how much it increases, leading to more severe situations. A meta-analysis could provide researchers and clinicians with relevant information about critical periods for prevention and interventions and about subgroups of individuals who may engage in different patterns of self-injury at various developmental phases. In the light of these

premises, the main aim of the current meta-analytic study is to analyze the development of NSSI from early adolescence to young adulthood in community samples.

1.1.1 Factors that could impact the development of NSSI over time

Previous systematic reviews and meta-analyses (Gillies et al., 2018; Swannell et al., 2014) showed how NSSI prevalence estimates are influenced by different theoretical and methodological factors. However, existing studies have examined the role of these factors at the cross-sectional level, while it is important to investigate how these factors can influence and affect the longitudinal development of the behavior over time. Among the main factors, we can identify the participants' age, gender, and other methodological aspects related to the measurement tool.

Sample age is a crucial variable on the development of self-injury. Previous meta-analyses found a significant increase in the prevalence of self-injury overtime (e.g., Gillies et al., 2018). In contrast, Swannell and colleagues (2014) did not find significant differences across the ages in their data collection. Additionally, an earlier age of onset was found to be related to higher frequency and more severe methods (Ammerman et al. 2018). Finally, Plener and colleagues (2015) found that NSSI is higher in adolescence, between ages 15 and 17, with a decrease in young adulthood. Considering these contrasting results and the important developmental changes which occur between adolescence and young adulthood, the specific age seems to be an important variable to be considered.

Gender represents another important moderator in the development of NSSI (Abdelraheem et al., 2019). The existing literature is inconsistent about gender differences in the prevalence of NSSI (Bresin & Schoenleber, 2015). Some studies show that girls engaged in NSSI more than boys (Laye-Gindhu & Schonert-Reichl, 2005; Rodham et al., 2004), whereas other studies did not report differences in the prevalence of NSSI between genders (e.g., Muehlenkamp & Gutierrez, 2004; Swannell et al., 2014). Notably, prior work found gender

differences among adolescent samples (e.g., Laye-Gindhu & Schonert-Reichl, 2005) while no difference was found among young adults (Heath et al., 2008). In fact, a review (Heath et al., 2008) showed that gender differences were more pronounced at younger ages (Sornberger et al., 2012), than studies that focused on young adults (e.g., Gratz et al., 2002; Heath et al., 2008). Considering these contrasting results, gender seems to be an important variable that should be considered as a moderator of the development of NSSI over time.

Prior studies found that methodological factors contributed to the heterogeneity in prevalence estimates (Swannell et al., 2014). In fact, as much as definitions for self-injurious behavior have varied over time, the related tools also are characterized by varying methodologies, such as level of standardization. Whereas some studies include single items on the presence or absence of self-injury (i.e., yes vs no), others include the assessment of frequency, functions, body parts injured, along with the likelihood of keeping up these behaviors (i.e., checklist and scales; Gillies et al., 2018; Swannell et al., 2014). Thus, this specific aspect related to the measure could influence the different prevalence rates across studies (Brown & Plener, 2017). Notably, scales may yield more accurate results because the list of items require participants to take more time to process each item while the binary question (e.g., yes or no) is a free recall task and more cognitively labor-intensive (Schaeffer & Presser, 2003), possibly lowering estimates because participants may not immediately recall episodes of NSSI without examples (Swannell et al., 2014).

Overall, given the considerable increase in attention to self-injury behavior in the last ten years, and the numerous publications on this issue, it is important to examine the role of some factors in influencing and modifying prevalence rates and the development over time.

1.2 The current study

The current study aims to investigate the occurrence and the frequency of NSSI over time, from early adolescence to young adulthood, using a meta-analytic Bayesian approach. The Bayesian framework is widely used in meta-analyses on the topic of health care (Egger et al., 2008), and it is enjoying an increasingly frequent use in recent years in the field of developmental psychology (van de Schoot & Depaoli, 2014). It allows using information from previous studies (i.e., prior distribution) and does a comparison between the models to identify the best one (i.e., prior distribution, posterior distribution).

We focus exclusively on studies that assess NSSI longitudinally. Specifically, given the high heterogeneity of the studies caused by the strong difference in tools used to measure NSSI, and the difficulty of using one measure of effect size for all studies, we decided to conduct two different studies. We used the variable coded *type of the scale* (i.e., binary questions vs scales/checklist) to identify two different types of studies. Study 1 examines the occurrence of self-injury over time (i.e., presence), which mostly relates to occasional behavior, using the proportion of youth that engaged in self-injury (i.e., yes or no questions). Study 2 analyzes the frequency of the behavior (i.e., severity), which refers more to the systematic nature of the behavior, using the means and the correlations of NSSI between each wave (i.e., checklist or scales).

In the present meta-analysis, possible factors that can moderate the longitudinal development of the behavior over time are examined. Notably, we included the months covered by the assessment (i.e., time), the mean age of the participants, and gender (i.e., percentage of females).

1.3 Method

The PRISMA guidelines for systematic reviews and meta-analyses (Moher et al., 2014) were followed to conduct a structured review. The stages are summarized in the flowchart in Figure 1.1.

1.3.1 Search strategy

The studies were identified following an Internet-based search of the literature using four electronic databases: SCOPUS, PsycINFO, PubMed, and Web of Science. The search was conducted in March 2020 with an update made in November 2020. The following keywords were used: 'self-harm', 'self-injur*', 'self-cutting', 'self-punishment', 'self-mutilation', 'trajector*', 'continuity', 'discontinuity', 'stage*', 'grow*', 'progress*', 'longitudinal', 'youth', 'teen*', 'adolescen*', 'young*', 'student*'. The search was conducted combining Abstract, Title, Keywords in Scopus, and in Web of Science databases. For the PubMed database, the title and abstract were used and, for the PsycINFO database, only abstract was used, as there was no other option. Notably, 2729 articles in Scopus, 1034 articles in PsycINFO, 1171 articles in PubMed and 2296 articles in Web of Science were identified.

1.3.2 Study inclusion and exclusion criteria

According to PRISMA, the selection phase based on reading the title, keywords, and abstract was done under the following criteria: (1) articles; (2) English language; (3) empirical research articles; (4) topic on non-suicidal self-injury; (5) longitudinal studies (i.e., two or more repeated assessments); (6) adolescent and young adulthood sample (i.e., the age range of participants ranging from 10 to 25 at the first wave of data collection); (8) community samples. Studies were excluded when: (1) they came from book, dissertation theses, congress abstract; (2) they were in languages other than English and Italian; (3) the topic was not on non-suicidal self-injury; (4) they were systematic review or meta-analyses; (5) they were cross-sectional and were not assessed longitudinally; (6) age was not included between 10 to 25 years old; (8) the

sample was clinical or selected. Specifically, as concerns the criteria related to the topic, given the complexity and the differences in the definition of the construct used by the studies, we followed the definition of the construct and of the measure used by the single studies. Therefore, we included only and exclusively those articles that defined the NSSI construct, while consequently we excluded all studies that did not make a precise difference between NSSI and other forms that could also include the suicidal component. The screening was done in parallel by four coders independently: a professor and a group of young scholars (i.e., doctoral level, master degree student). The inter-rater agreement between the coders, computed on the acceptance/rejection criterion, was excellent (Cohen's $K = .84$).

1.3.3 Selection procedure

Overall, the search in all four databases included 7,230 articles. There was an overlap of 5,571 articles. Duplicated articles were excluded from subsequent searches. Other duplicates were excluded manually, and the final literature search included 1,659 articles (see Fig. 1.1). We reviewed the titles and abstracts of all articles found and we excluded 1,401 under the exclusion criteria reported above (see Figure 1.1). The full-text articles assessed for eligibility were 258. A total of 187 articles were further excluded according to exclusion criteria. Finally, 72 studies were included in the review. Among these, we have checked for the overlap in data collection, and we have therefore selected only a study among those that pertained to the same dataset. Because some studies were (partially) based on the same longitudinal dataset, we included studies that provided more detailed information for estimating mean effect size and moderation effects in our meta-analysis (see Table 1.1 and Table 1.2, these articles are marked with an asterisk; N=38). Finally, 34 studies were included in the review. Specifically, 13 for study 1, and 21 for study 2. Authors have been contacted up to two times to ask for missing information if the paper did not report the values necessary for estimating developmental

changes. Papers that did not had sufficient data were excluded from the analysis (Study 1: N=1, 7.7%; Study 2: N=12, 57.14%).

1.3.4 Data extraction and coding

All eligible studies were coded including the following information: (1) study identification items (e.g., first author, year of publication), (2) sample characteristics (e.g., number of participants, mean age), (3) measure characteristics (e.g., type of measure used, number of items); (4) outcome data for the measure of effect size (e.g., mean, and standard deviation of self-injury). Specifically, to compute the measure of the effect size we extracted data from the proportions of adolescents that engaged in NSSI (i.e., Study 1); and the mean of self-injury behavior, standard deviation (SD) and the correlations of self-injury behavior between each wave and the next (i.e., Study 2). To identify potential variables moderators, we extracted data on months of data collection, mean age of the sample at baseline, and percentage of females. We also extracted data on months of data collection that were calculated as months between one wave and the next, identifying as 0 the months at the first wave.

1.3.5 Quality assessment

To measure the quality of the studies that met the inclusion criteria, we decided to use the *Standard Quality Assessment Criteria* proposed by Kmet et al., (2004). Due to the diversity of approaches applied in the retrieved articles, this tool allows us to examine the quality of papers, using a checklist for quantitative studies that evaluate relevant aspects. Each article was evaluated independently by two of the authors. For each criterion/aspect of the checklist, it was attributed 2 points if the study respected it (YES), 1 point if it partially respected it (PARTIALLY), or 0 if it not respected it (NO). The total quality score was calculated by summing the total score and dividing it by the total possible score for each study. Among the 50 articles, all of them were assessed by the criteria for quantitative studies. To assess the interrater reliability of the summary scores, a random selection of 25% of the papers was double

coded. Interrater reliability was excellent, with an interclass correlation coefficient of .93. For differently rated studies, a mean score was calculated as an average of the two scores. None of the studies had a quality score below 0.55 (liberal cut-off point). Therefore, all studies were used for data analysis. All quality scores are displayed in Table 1.1 (Study 1) and Table 1.2 (Study 2).

Figure 1.1

Flowchart of study identification, screening, eligibility, and inclusion

Records identified through database searching (n =7,230 ; Specific results Psycinfo (EBSCO) = 1,034, Scopus = 2,729, Web of science = 2,296, Pupmed = 1,171).

Records after duplicates (5,571) removed and screened for title and abstract text (n = 1,659)

Records excluded (n=1,401) due to:

- Not articles (n=142)
- Review or meta-analysis (n=121)
- Not NSSI (n=640)
- Not longitudinal study (n=314)
- Language (n=1)
- Out of the age range (n=41)
-No community sample (n=142)

Full-text articles assessed for eligibility (n=258)

Records excluded (n=186) due to:

- Not articles (n=2)
- Review or meta-analysis (n=2)
- Not NSSI (n=51)
- Not longitudinal study (n=82)
- Language (n=1)
- Out of the age range (n=5)
-No community sample (n=43)

Studies included in the quantitative synthesis (n=72) (see Table 1)

38 studies excluded from the meta-analysis for the overlap between data collection

Studies included in quantitative synthesis (meta-analysis) (n=34)

Study1: 13 studies
Study 2: 21 studies

Identification

Screening

Eligibility

Included

1.3.6 Strategy of analysis

Data were analyzed using the statistical software R (Team, 2013). For data analysis frameworks we used the metafor R package (Viechtbauer, 2010), and the Bayesian approach, using the *brms* R package (Plummer, 2014; Bürkner, 2017). The Bayesian framework allows to use (1) prior distribution that is related to information from previous studies proposed by the researcher; (2) the observed evidence that refers to knowledge from the current studies, expressed in terms of the likelihood function; and (3) the posterior distribution that reflect the updated knowledge, derived from comparing data (i.e., the likelihood function) with the prior distribution. The posterior distribution is what is usually referred to as the result of the analysis. Besides, we considered two different levels in the data organization. The first level refers to the different waves of each study (e.g., each line for each study represents a wave). The second level concerns the studies included in the analyzes.

The Bayesian estimation

The current meta-analysis is composed by three different steps. Firstly, we analyzed a null model (M000) which estimates the overall effect size. As a second step, we compared the null model (M000) and two models (M001, M002) with the longitudinal effect expressed by the variable *months*. Specifically, a variable intercept model (M001) which includes the temporal effect by adding the variable *months* and an additional parameter (β) which estimates the differences expected between effects observed at one month of distance and, a model (M002) which introduces the variable slopes in the different studies, which translates into a further parameter that measures the variability between the different lines estimated in the various studies. Finally, in the third step, we introduced the moderators with the aim of identifying the best possible model among a set of proposals (i.e., meta-regression). For the estimation of the parameters, we adopted a *full Bayesian* approach with the *brms* package (Bürkner, 2017) using a *Markov Chain Monte Carlo* (MCMC) procedure via Stan (Stan

Development Team, 2019). The posterior ones were obtained from 4 MCMC chains of 10,000 iterations each for a total ejective of 20,000 replicas. For the comparison between the models, we used the following statistics: *Bayesian R²* (Gelman et al., 2019), *leave-one-out cross-validation information criterion* (LOO; Vehtari et al., 2017) and *model weight* (W; Yao et al., 2018). The latter indicator, normalized in the range 0-1, represented the probability of the model to be the best at predicting of new data conditional on the set of models examined (McElreath, 2018). To find the best model, we have to consider the LOO value and the weight (W), the first should be lower, while the second higher than the other models.

Study 1

The effect size measure, used in this first study, was the *logit transformed proportion* (PLO) of individual that engaged in NSSI on the total. The type of transformation allows us to map on the real numbers of the values between 0 and 1 (e.g., the values between 0 and 0.5 are negative, while those between 0.5 and 1 are positive).

We defined prior knowledge from most relevant studies (e.g., Gillies et al. 2018). Given that the prevalence of the phenomenon varies greatly based on many factors (i.e., methodological factors), we have assumed skeptic prior. Based on the literature, given that the percentages of NSSI vary between 15% and 20%, we expected a value for the proportion of individuals that engage in NSSI around 0.18; transforming this proportion into logit we obtain a value of approximately -1.52. Based on the assigned standard deviation, 0.15, we expected, with a probability 90%, that the logit of the proportion is between -1.87 and -1.17 and consequently that the proportions fall between 0.13 and 0.24 approximately. For the variability parameter (τ) we choose a Student's t (3, 0, 0.2), constraining it to assume only positive values. This is a priority which assumes a variability between included studies, with a probability of 90%, between 0 and about 0.47. Translated in proportions means to expect values between 0.12 and 0.26 in studies. These same priorities were also used in the second model (M001) in which

it was added a third priority that serves to model the regression coefficient associated with the months. This parameter expressed the expected average change in effect size between two subsequent months. The priority for this parameter was Student's t (3, 0, 0.5). This priority, rather wide, admits that the differences in logit between two consecutive months fall, with the usual probability of 90%, between -1.18 and 1.18, that is, translated into proportions, between 0.24 and 0.76. In the third model we used the same priorities, assuming an identical a priori variability for intercepts and slopes. As for the parameters associated with the moderators, we used some priority skeptics always centered on zero.

Study 2

The effect size measure used in this second study was the *standardized mean change* using the *raw score standardization* (SMCR; Roberts, et al., 2006; Viechtbauer, 2010), always considering the differences compared at the first time point. For the first parameter of the null model (M00) we adopted a skeptical priority, centered on zero and with little variability, assuming that 90% of the expected changes were between -0.94 and 0.94. For the variability parameter (τ), we choose a Student's t (3, 0, 0.2), constraining it to assume only positive values. This prior assumed a variability between included studies, with a probability of 90%, between 0 and about 0.47. The same priorities were also used in the second model (M001) in which it was added a third priority that serves to model the regression coefficient associated with the months. This parameter expressed the expected average change in effect size between two subsequent months, that is Student's t (3, 0, 0.5). This prior admitted that the differences between two consecutive months fall, with the usual probability of 90%, between -1.18 and 1.18. In the third model we used the same priorities, thus the assumption was identical a priori variability for intercepts and slopes. The same priorities were used for parameters associated with models with moderators.

Table 1.1

Study 1. Characteristics of included studies

ID	References	Country	Overlapping data-set	Period prevalence measure	N of participants (1st Assess.)	Number of waves	Time span (in months)	Mean age (1st Assess.)	QA
1	***Andrews et al., (2013)***	Australia	Hasking et al., (2013); Hasking, et al., (2015); Hielscher et al., (2020); Martin et al., (2015); Tatnell et al., (2014); Voon et al., (2014)	Lifetime	_	_	_	_	_
2	Baetens et al., (2014) *	Belgium	Baetens et al., (2015); Cassels et al., (2019)	Lifetime	1397	3	12	12	0.95
3	***Baetens et al., (2015)***	Belgium	Baetens et al., (2014); Cassels et al., (2019)	Lifetime	_	_	_	_	_
4	Buelens et al., 2019*	Belgium	Gandhi et al., (2017)	Lifetime	528	3	12	15	0.95
5	***Cassels et al., (2019)***	Belgium	Baetens et al., (2014); Baetens et al., (2015)	Lifetime	_	_	_	_	_
6	*Chiodo et al., (2009)*	Canada	_	3 months	1734	2	30	n.a.	0.77
7	***Gandhi et al., (2017)***	Belgium	Buelens et al., 2019	Lifetime	_	_	_	_	_
8	Gandhi et al., (2019)	Belgium	_	Lifetime	384	3	12	15	0.69
9	***Hasking et al., (2013)***	Australia	Andrews et al., (2013); Hasking et al., (2015); Hielscher et al., (2020); Martin et al., (2015); Tatnell et al., (2014); Voon et al., (2014); Voon et al., (2014)	Lifetime	_	_	_	_	_

10	*Hasking et al., (2015)*	Australia	Andrews et al., (2013); Hasking et al., (2013); Hielscher et al., (2020); Martin et al., (2015); Tatnell et al., (2014); Voon et al., (2014); Voon et al., (2014)	Lifetime	_	_	_	_	_
11	Heilbron & Prinstein (2010) *	USA	Hilt et al., (2008); Prinstein et al., (2010)	12 motnhs	493	3	12	12.60	1
12	*Hielscher et al., (2020)*	Australia	Andrews et al., (2013); Hasking et al., (2013); Hasking et al., (2015); Martin et al., (2015); Tatnell et al., (2014); Voon et al., (2014); Voon, et al., (2014)	Lifetime	_	_	_	_	_
13	*Hilt et al., (2008)*	USA	Heilbron & Prinstein (2010); Prinstein et al., (2010)	12 motnhs	_	_	_	_	_
14	Liu et al., (2019) *	China	Wang et al., (2020)	Lifetime	7072	2	12	14.59	0.95
15	Marin et al., (2020)	Iran	-	Lifetime	6229	2	12	15.78	0.59
16	*Martin et al., (2015)*	Australia	Andrews et al., (2013); Hasking et al., (2013); Hasking et al., (2015); Hielscher et al., (2020); Tatnell et al., (2014); Voon et al.,. (2014); Voon et al., (2014)	Lifetime	_	_	_	_	_
17	Polek et al., (2020)	UK	-	12 months	2403	3	12	18.90	1
18	*Prinstein et al., (2010)*	USA	Heilbron & Prinstein (2010) Hilt et al., (2008)	12 motnhs	_	_	_	_	_
19	Roberts et al., (2019)	England	-	Lifetime	1282	_	_	0.95	
20	Robinson et al., (2019)	New Zealand	_	12 months	489	3	12	13.60	1

ID	Author	Country	Dataset overlap		N	Waves	Time-span	Mean age	Quality Assessment
21	*Tatnell et al., (2014)*	Australia	Andrews et al., (2013); Hasking et al., (2013); Hasking et al., (2015); Hielscher et al., (2020); Martin et al., (2015); Voon et al., (2014); Voon et al., (2014)	Lifetime	_	_	_	_	_
22	*Voon et al., (2014)*	Australia	Andrews et al., (2013); Hasking et al., (2013); Hasking et al., (2015); Hielscher et al., (2020); Martin et al., (2015); Tatnell et al., (2014); Voon et al., (2014)	Lifetime	_	_	_	_	_
23	Voon et al., (2014)*	Australia	Andrews et al., (2013); Hasking et al., (2013); Hasking et al., (2015); Hielscher et al., (2020); Martin et al., (2015); Tatnell et al., (2014); Voon et al., (2014)	Lifetime	1424	3	12	13.9	0.95
24	Wan et al., (2015)	China	_	12 months	17662	4	3	16.1	1
25	*Wang, L., Liu, X., Liu, Z. Z., & Jia, C. X. (2020)*	China	Liu et al., (2019)	Lifetime	_	_	_	_	_
26	Whitlock et al., (2013)	USA	_	Lifetime	1466	3	about 12	n.a.	0.95

*Reference used in analyses when datasets overlap (data about number of waves, time-span covered by the assessment, mean age and the Quality Assessment are reported only for the study used as reference). Bold and italics are used for studies with dataset overlap that are excluded from the analysis. Italics is used for studies with missing data, that are not included in the analysis. ID stand for Identification number; n.a. stand for "data not available" in the paper and authors did not shared information when contacted by email.

.

Table 1.2

Study 2. Characteristics of included studies

ID	References	Country	Overlapping data-set	Period prevalence measure	N of participants (1st Assess.)	Number of waves	Time span (in months)	Mean age (1st Assess.)	QA
1	*Barrocas et al., (2015)*	China	Giletta et al., (2015)	3 months	_	_	_	_	_
2	*Bjärehed et al., (2012)*	Sweden	Daukantaitė et al., (2019); Lundh, et al., (2011); Lundh, et al., (2011); Lundh, et al., (2013); Viborg et al., (2018); Daukantaité et al., (2020); Zhou et al., (2020)	6 months	_	_	_	_	_
3	*Calvete et al., (2017)*	Spain	_	12 months	1257	2	12	15.33	0.86
4	*Daly & Willoughby (2019)*	Canada	Heffer & Willoughby (2018); Good et al., (2017); Hamza et al., (2014); Hamza et al., (2019); Ewing et al., (2019); Willoughby et al., (2015)	12 months	_	_	_	_	_
5	*Daukantaitė et al., (2019)*	Sweden	Bjärehed et al., (2012); Daukantaitė et al., (2019); Lundh et al., (2013); Lundh et al., (2011); Viborg et al., (2018); Lundh et al., (2011); Daukantaité et al., (2020); Zhou et al., (2020)	6 months	_	_	_	_	_
6	Daukantaité et al., (2020)*	Sweden	Bjärehed et al., (2012); Daukantaitė et al., (2019); Lundh et al., (2013) Lundh et al., (2011); Viborg et al., (2018); Lundh et al., (2011);	6 months	982	3	12, 120	13.70	0.91

			Daukantaitė et al., (2019); Zhou et al., (2020)						
7	*Duggan et al., (2015)*	Montreal	Emery et al., (2017)	n.a.	_	_	_	_	_
8	*Emery et al., (2017)**	Montreal	Duggan et al., (2015)	n.a.	730	2	12	13.43	0.86
9	*Ewing et al., (2019)*	Canada	Daly et al., (2018); Good et al., (2017); Hamza et al., (2014); Hamza et al., (2019); Willoughby et al., (2015); Willoughby et al., (2015); Heffer & Willoughby (2018)	12 months	_	_	_	_	_
10	*Garisch & Wilson (2015)*	New Zealand	_	n.a.	1162	2	5	16.35	0.90
11	Giletta et al., (2015)*	China	Barrocas et al., (2015)	3 months	546	8	3	16.03	1
12	Giletta et al., (2013)	USA	_	12 months	348	4	6	15.02	1
13	Glenn et al., (2016)	USA	_	12 Months	662	3	12, 24	13.14	1
14	*Good et al., (2017)*	Canada	Daly et al., (2018); Hamza & Willoughby (2014); Ewing et al., (2019); Hamza & Willoughby (2019); Willoughby et al., (2015); Heffer & Willoughby (2018)	12 months	_	_	_	_	_
15	*Hamza & Willoughby (2014)*	Canada	Daly & Willoughby (2019); Heffer & Willoughby (2018); Good et al., (2017); Ewing et al., (2019); Hamza et al., (2018); Willoughby et al., (2015)	12 months	_	_	_	_	_
16	*Hamza & Willoughby (2019)*	Canada	Daly & Willoughby (2019); Heffer & Willoughby (2018); Good et al., (2017); Hamza & Willoughby (2014);	12 months	_	_	_	_	_

			Hamza et al., (2018); Ewing et al., (2019)						
17	*Hanking & Abela (2011)*	America	_	n.a.	103	2	18	12.63	0.95
18	*Heffer & Willoughby (2018)**	Canada	Good et al., (2017); Hamza, & Willoughby (2014); Hamza & Willoughby (2019); Ewing et al., (2019); Daly & Willoughby et al., (2019); Willoughby et al., (2015)	12 months	782	4	12	19.11	0.95
19	***Jiang et al., (2016)***	China	Wu et al., (2019)	6 months	_	_	_	_	_
20	***Jutengren et al., (2011)***	Sweden	Marshall et al., (2013); Marshall et al., (2013); Martínez-Ferrer & Stattin (2019)	12 months	_	_	_	_	_
21	*Kang et al., (2018)*	China	_	6 months	3555	3	6, 12	15.63	0.91
22	*Larsson & Sund (2008)*	Norway	_	Lifetime	2464	2	12	13.70	0.91
23	***Latina et al., (2020)***	Sweden	Tilton-Weaver et al., (2019)	6 months	_	_	_	_	_
24	***Lundh et al., (2013)***	Sweden	Bjärehed et al., (2012); Daukantaitė et al., (2019); Lundh et al., (2011); Lundh et al., (2011); Viborg et al., (2018); Daukantaité et al., (2020); Zhou et al., (2020)	6 months	_	_	_	_	_
25	***Lundh et al., (2011)***	Sweden	Bjärehed et al., (2012); Daukantaitė et al., (2019); Lundh et al., (2013); Lundh et al., (2011); Viborg et al., (2018); Daukantaité et al., (2020); Zhou et al., (2020)	6 months	_	_	_	_	_
26	***Lundh et al., (2011)***	Sweden	Bjärehed et al., (2012); Daukantaitė et al., (2019); Lundh et al., (2013);	6 months	_	_	_	_	_

			Lundh et al., (2011); Viborg et al., (2018); Daukantaité et al., (2020); Zhou et al., (2020)						
27	Marshall et al., (2013)*	Canada and Sweden	Marshall et al., (2013); Martínez-Ferrer & Stattin (2019); Jutengren et al., (2011)	12 months	161,513	2, 3	12	13.82; 13.23	0.91
28	***Marshall et al., (2013)***	Sweden	Marshall et al., (2013); Martínez-Ferrer & Stattin (2019); Jutengren et al., (2011)	12 months	_	3	12	13.21	_
29	***Martínez-Ferrer & Stattin (2019)***	Sweden	Marshall et al., (2013); Marshall et al., (2013); Jutengren et al., (2011)	12 months	_	2	12	13.94	_
30	*Riley et al., (2015)**	USA	Riley et al., (2016)	Lifetime	1158	2	8	18.04	0.91
31	***Riley et al., (2016)***	USA	Riley et al., (2015)	Lifetime	_	_	_	_	_
32	*Tilton-Weaver et al., (2019)**	Sweden	Latina et al., (2020)	6 months	2769	2	12	13.65	0.91
33	***Viborg et al., (2018)***	Sweden	Bjärehed et al., (2012); Daukantaité et al., (2019); Lundh et al., (2013); Lundh et al., (2011); Lundh et al., (2011); Daukantaité et al., (2020) Zhou et al., (2020)	6 months	_	_	_	_	_
34	Wang et al., (2017) *	Hong Kong	You et al., (2016); You et al., (2015) Zhang et al., (2017); You & Lin (2015)	6 months	3381	3	6	14.5	1
35	***Willoughby et al., (2015)***	Canada	Good et al., (2017); Hamza & Willoughby (2014); Hamza et al., (2018); Ewing et al., (2019); Daly et al., (2019); Heffer & Willoughby (2015)	12 months	_	_	_	_	_

36	Wu et al., (2019) *	China	Jiang et al., (2016)	6 months	738	2	12	13.2	1
37	*Xavier et al., (2017)*	Portugal	_	Lifetime	418	2	6	15.12	0.95
38	***You et al., (2016)***	Hong Kong	You & Lin (2015); You et al., (2015) Zhang et al., (2017); Wang et al., (2017)	6 months	_	_	_	_	_
39	***You & Lin (2015)***	Hong Kong	You et al., (2016); You et al., (2015); Zhang et al., (2017); Wang et al., (2017)	6 months	_	_	_	_	_
40	***You et al., (2015)***	Hong Kong	You et al., (2016); You et al., (2015); Zhang et al., (2017); Wang et al., (2017)	6 months	_	_	_	_	_
41	You et al., (2012)	Hong Kong	_	12 months	2345	2	6	n.a.	0.95
42	*You et al., (2012)*	Hong Kong	_	24 months	4782	2	6	n.a.	0.91
43	*Zelkowitz & Cole (2020)*	USA	-	1 month	251	2	2	19.07	0.86
44	***Zhang et al., (2017)***	Hong Kong	You et al., (2016); You & Lin (2015); You et al., (2015); Wang et al., (2017)	6 months	_	_	_	_	_
45	Zhu et al., (2020)	China	-	6 months	1987	3	6	12.32	1
46	***Zhou et al., (2020)***	Sweden	Daukantaitė et al., (2019); Lundh et al., (2011); Lundh et al., (2011); Lundh et al., (2013); Viborg et al., (2018); Daukantaité et al., (2020) Bjärehed et al., (2012)	6 months	_	_	_	_	_

*Reference used in analyses when datasets overlap (data about number of waves, time-span covered by the assessment, mean age and the Quality Assessment are reported only for the study used as reference). Bold and italics are used for studies with dataset overlap that are excluded from the analysis. Italics is used for studies with missing data, that are not included in the analysis. ID stand for Identification number; n.a. stand for "data not available" in the paper.

1.4 Results

Table 1.1 (i.e., Study 1) and Table 1.2 (i.e., Study 2) summarize the main characteristics of all the articles selected for the meta-analysis.

1.4.1 Study 1

Overview of effects' distribution

This study includes 12 final papers with available data (see Table 1.1). Specifically, 1 study (ID=6) was excluded from the initial 13 articles, as it did not have sufficient and available data to conduct the analyses. Table 1.3 summarizes the effect size computed for each study included. The number of waves that make up the studies is ranged between a minimum of 2 to a maximum of 4.

Table 1.3

Effect size of the included studies (Study 1)

ID	Reference	Wave	Months	ni	yi	vi	1st M_{age}	% of females
2	Baetens et al., (2014)	1	0	1397	-2.91	0.014	12	54.70
		2	12	827	-3.65	0.049	-	57.20
		3	30	748	-2.26	0.016	-	57.60
4	Buelens et al., (2019)	1	0	528	-1.83	0.016	15	50.60
		2	12	384	-2.51	0.016	-	53.40
		3	24	326	-2.29	0.037	-	55.20
8	Gandhi et al., (2019)	1	12	384	-2.51	0.037	15	52.70
		2	24	326	-2.29	0.043	-	54.90
11	Heilbron et al., (2010)	1	0	493	-2.70	0.034	12.6	51
		2	12	493	-3.46	0.069	-	51
		3	24	493	-3.46	0.069	-	51
14	Liu et al., (2019)	1	0	7072	-1.08	0.001	14.59	50
		2	12	7072	-2.34	0.002	-	50
15	Marin et al., (2020)	1	0	6229	-2.71	0.003	15.78	53.10
		2	12	6629	-3.44	0.005	-	53.10
17	Polek et al., (2020)	1	0	2403	-2.28	0.005	18.9	54
		2	12	1815	-2.09	0.006	-	56
		3	24	1245	-1.67	0.006	-	59
19	Roberts et al., (2019)	1	0	1282	-1.62	0.005	-	100
20	Robinson et al., (2019)	1	0	489	-1.41	0.013	13.56	64.21
		2	12	489	-1.53	0.014	-	64.21
		3	24	489	-1.56	0.014	-	64.21
23	Voon et al., (2014)	1	0	1424	-2.42	0.009	13.9	73.40

		2	12	1424	-1.95	0.006	-	73.40
		3	24	1418	-1.66	0.005	-	73.40
24	Wan et al., (2015)	1	0	17622	-1.58	0.0004	16.1	51.20
		2	3	16170	-2.14	0.006	-	52.50
		3	9	14407	-2.47	0.0010	-	51.20
		4	18	13923	-2.43	0.0007	-	51.10
25	Whitlock et al., (2015)	1	0	1466	-1.84	0.006	20.3	59.90
		2	12	1466	-2.89	0.014	-	59.90
		3	24	1466	-4.89	0.092	-	59.90

Note. ID=identification number; ni=sample size; yi=difference between the averages of two successive survey; vi=variance of effect sizes; 1st Mean Age= Mean age at the first assessment

Comparing the null model (M000) with the model 1 (M001) and model 2 (M002), the model that provided the best fit was Model 2 (M002), which included the variables intercept and slope. Table 1.4 reports the goodness of fit indices of the three tested models. Notably, the model M002 had a weight (W) of about 0.87, greater than the weight of the model M001 (W=0.062), and the model M002 (W=0.071). This model therefore suggests that it is very plausible that the studies differ not only in the observed estimates (random intercepts) but also in the trajectories detected during the waves (random slopes). The parameter estimates of the model M002 with the related 90% Credibility Intervals are μ= -1.98 [-2.30, -1.62], β= -0.01 [-0.05, 0.03], τ = 0.62 [0.43, 0.88] and σ_β= 0.06 [0.02, 0.04].

As the posterior distributions of the parameters, in comparison with the null model (M000), the estimate of the intercept is similar. The general slope is quite low, probably because the various positive and negative changes observed in the different studies tend to cancel out. Also, there is variability of the intercepts which remained like that of the null model. Given, however, that this model has a much higher plausibility than the null one, we can conclude that, although it is rather limited, the variability of the slopes seems to have a significant weight.

Table 1.4

Model comparison results (Study 1)

	R^2	CI	LOO	se	W
M002	0.88	[0.84;0.91]	421.56	189.83	0.87
M001	0.53	[0.49;0.56]	1576.76	383.91	0.06
M000	0.41	[0.36;0.45]	2248.51	803.56	0.07

Note. R^2 = Bayesian R-square, CI= 90% Credibility Interval, LOO = leave-one-out cross-validation information criterion, se = standard error, W =model weight. On the right, graphical representation of log-relative evidence.

Figure 1.2 displays the forest plot (panel [A]) and the funnel plot (panel [B]). The Forest Plot displays the posterior distributions of the intercepts, showing that the studies are not very close to the estimated average value (μ= -.006). The funnel plot shows no important asymmetries in the distribution of values; therefore, we can assume that there has not been a very marked publication bias.

Figure 1.2

Forest plot (Panel [A]) and funnel plot (Panel [B]) of model M002 (Study 1).
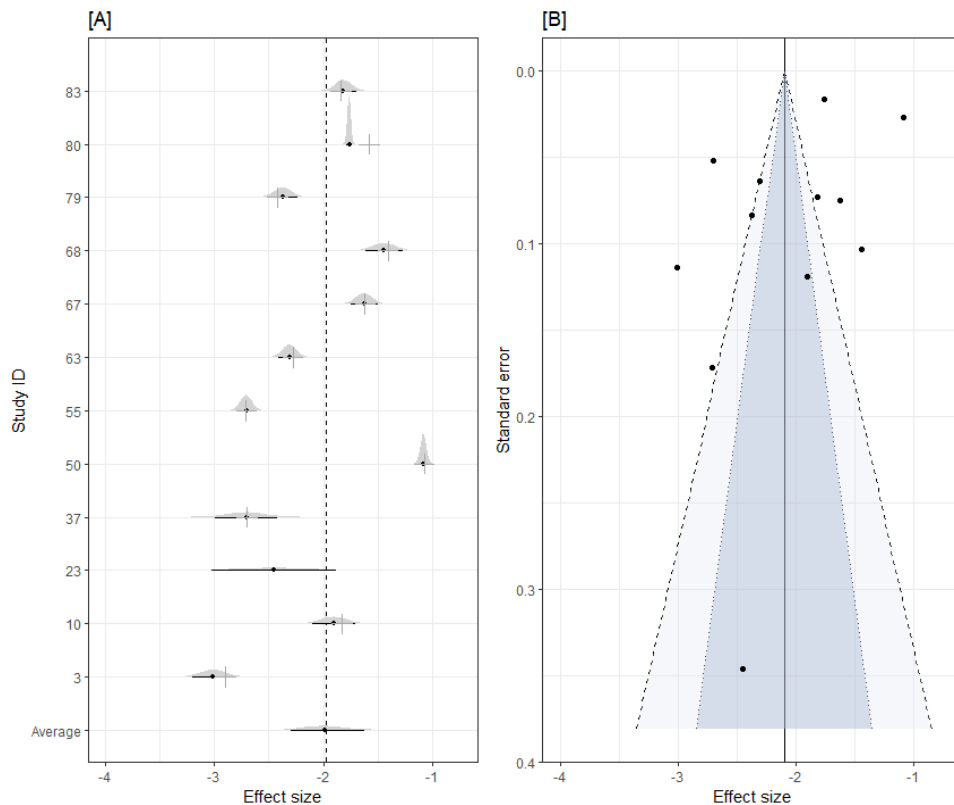
Meta-regression with moderators

To evaluate the effects of potential moderators we used the best model *(M002: months + (months | ID)),* that includes the temporal effect and variable intercepts and slopes. Considering that there were no differences in the number of observations available (i.e., studies with missing data on the moderator variables), we were able to carry out an overall comparison between all the models examined. The sample size of waves was 21[1], and thus we compared the models included. The models include the variables months, mean age and percentage of females. The best and most informative model is M009, which includes the main effect of percentage of females and the interaction between months and mean age of participants (i.e., *pc females + months * 1st Mean age*). Specifically, Model M009 results as the best model of a total of 9 models[2] that differ in their main effect and interaction between the different variables (see Appendix 1 for the whole models tested). Of these, 5 have not reached convergence (i.e., M003, M005, M007, M010, M011). So, the final models were 4 (i.e., M004, M006, M008, M009). Model M009 was the best model with a weight higher than that of the other third models (W=1.00).

Main effect of percentage of female and interaction between months and mean age (Model M009)

Table 1.5 displays the estimated parameters for the model with the main effect of percentage of females and the interaction between months and mean age (M009).

Table 1.5

Estimates of the parameters of the M009 model (N=21)

Parameter	Estimate	SE	Q5	Q95
Intercept	-15.78	3.60	-22.12	-10.38
Months	0.27	0.11	0.10	0.46

---

[1] The corresponding studies (N=11) have the following IDs: 2, 4, 8, 11, 14, 15, 17, 20, 23, 24, 25.
[2] The 9 models are: M003, M004, M005, M006, M007, M008, M009, M010, M011.

Percentage of females	0.17	0.05	0.09	0.26
Mean age	0.25	0.15	-0.00	0.50
Months x mean age	-0.02	0.01	-0.03	-0.01

As we can see from Figure 1.3, results show in the abscissa the percentage of females and in the ordinate the expected proportion of the behavior. Findings show an increase in the expected proportions of NSSI (i.e., occurrence) according to the increasing of the percentage of females. Thus, as the percentage of females increases, the occurrence/presence of NSSI increases too ($\beta = 0.17$, 90% CI [0.09, 0.26]; SE= 0.05).

Figure 1.3

Main effect of the percentage of females

Percentage of females
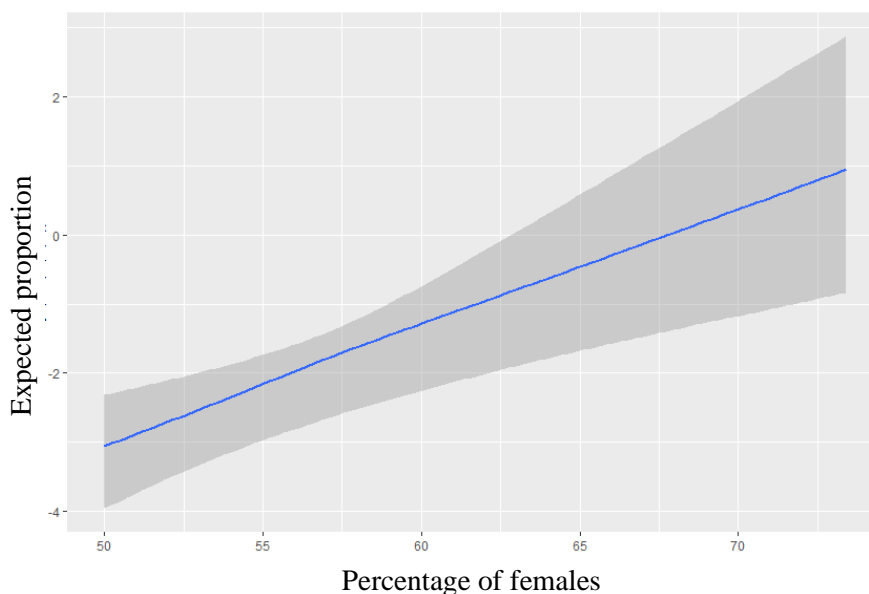
Figure 1.4 displays the interaction between the variables months and 1st mean age of participants. Findings show in the abscissa the months, while the three lines refer to the average age which has been categorized on three levels (i.e., +/- 1 SD from the mean; M=12.79; M=15.29; M=17.80). As the months of data collection increase, there is a change in the expected proportions of NSSI according to the average age of the participants. Specifically, results show that as months of assessment increase (i.e., time), the expected proportions of NSSI behavior (i.e., occurrence) decrease for adolescents that have an average age of 17.8 years,

increase slightly for adolescents with a mean age of 15 years, and increase for adolescents with a mean age of 12.79 years (β = -0.02, 90% CI [-0.03, - 0.01]; SE= 0.01).

Figure 1.4

Interaction between months and mean age at the first wave
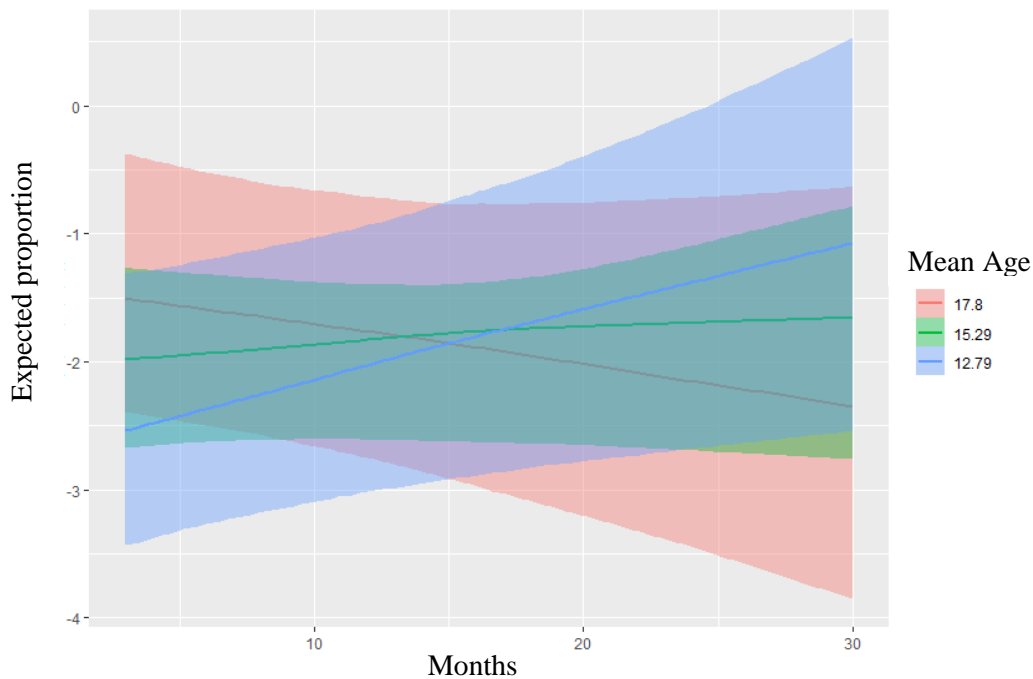
1.4.2 Study 2

Overview of effects' distribution

This study includes 9 papers with available data (see Table 1.6). Specifically, 12 were excluded from the 26 selected articles, as they did not have sufficient and available data to conduct the analysis (i.e., we have not received the data from the authors). The excluded studies are those with the identification number 3, 8, 10, 17, 18, 21, 22, 30, 32, 37, 42, 43.

Table 1.6 summarizes the effect size computed for each study. The number of waves that make up the studies is ranged between a minimum of 2 to a maximum of 8.

Table 1.6

Effect size of the studies included (Study 2)

ID	Reference	wave	months	ni	ri	yi	vi	1st M$_{age}$	% of female
6	DaukantaitÃ et al., (2020)	1	0	982	1	0	1	13.7	50.21
		2	12	979	0.37	-0.04	0.001	-	51
		3	132	556	0.37	0.25	0.002	-	59.20
11	Giletta et al., (2015)	1	0	546	1	0	1	16.19	52.20
		2	3	519	0.43	0.21	0.002	-	54
		3	6	503	0.43	0.19	0.002	-	52.30
		4	9	468	0.43	0.33	0.003	-	54.70
		5	12	559	0.43	0.28	0.002	-	51.50
		6	15	397	0.43	0.30	0.003	-	52.90
		7	18	439	0.43	0.30	0.003	-	52.80
		8	21	441	0.43	0.33	0.003	-	53.70
12	Giletta et al., (2013)	1	0	348	1	0	1	15.02	56
		2	6	348	0.55	-0.10	0.003	-	56.30
		3	12	348	0.55	0.15	0.003	-	56.30
		4	18	335	0.55	0.25	0.003	-	57.40
13	Glenn et al., (2016)	1	0	662	1	0	1	13.14	57.60
		2	12	891	0.53	-0.06	0.001	-	-
		3	36	662	0.53	-0.03	0.001	-	-
27	Marshall et al., (2013)**	1	0	161	1	0	0	13.82	59.63
		2	12	161	0.72	0.23	0.003	-	-
		1	0	513	1	0	0	-	47
		2	12	513	0.44	-0.10	0.002	-	-
		3	24	513	0.45	-.017	0.002	-	-
34	Wang et al., (2017)	1	0	3381	1	0	1	14.50	56.20
		2	6	3381	0.51	0.12	0.0003	-	56.20
		3	12	3381	0.51	0.16	0.0003	-	56.20
36	Wu et al., (2019)	1	0	738	1	0	1	13.20	39.60
		2	12	515	0.42	0.05	0.002	-	43.30
41	You et al., (2012)	1	0	2435	1	0	1	14.63	57.40
		2	6	2435	0.45	0.23	0.0005	-	57.40
45	Zhu et al., (2020)	1	0	1987	1	0	1	12.32	43.90
		2	6	1846	0.45	0	0.0006	-	54.70
		3	12	1819	0.45	-0.04	0.0006	-	54.40

*Note. ID=identification number; ni=sample size; ri=average correlation between measures; yi=difference between the averages of two successive survey; vi=variance of effect sizes. ** It contains two studies (i.e., Study 1 and Study 2)*

Comparing the null model (M000) with the model 1 (M001) and model 2 (M002), the model that provided the best fit was Model 2 (M002), which included the variables intercept and slope. Table 1.7 reports the goodness of fit indices of the three tested models. Notably, the

model M002 had a weight (W) of about 0.81, greater than the weight of the model M001 (W=0.19), and the model M002 (W=<.001). This model therefore suggests that it is very plausible that the studies differ not only in the observed estimates (random intercepts) but also in the trajectories detected during the waves (random slopes). The parameter estimates of the model M002 with the related 90% Credibility Intervals are $\mu = 0.05$ [-0.05, 0.15], $\beta = -0.01$ [-0.01, 0], $\tau = 0.16$ [0.05, 0.09] and $\sigma_\beta = 0.01$ [0, 0.02].

As the posterior distributions of the parameters, in comparison with the null model (M000), the estimate of the intercept is similar. Compared to the null model, the parameter μ is lowered, consistent with the fact that at time 0 we expect a change equal to zero. Also, the average change, estimated with the parameter, is rather low, probably because of the various positive and negative changes observed in the different studies tend to cancel out. The variability of the intercepts is like that of the null model while the variability of the slopes is not present before does not seem very marked.

Table 1.7

Model comparison results (Study 2)

	R^2	CI	LOO	se	W
M002	0.61	[0.50;0.70]	-22.63	16.36	0.81
M001	0.45	[0.35;0.54]	11.10	26.30	0.20
M000	0.28	[0.20;0.36]	38.64	31.43	<.001

Note. R^2 = Bayesian R-square, CI= 90% Credibility Interval, LOO = leave-one-out cross-validation information criterion, se = standard error, W =model weight. On the right, graphical representation of log-relative evidence.

Figure 1.5 displays the forest plot (panel [A]) and the funnel plot (panel [B]). The Forest Plot displays the posterior distributions of the intercepts, showing that the studies are very close to the estimated average value ($\mu = 0.01$). The funnel plot shows no important asymmetries in the distribution of values; therefore, we can assume that there has not been a very marked publication bias.

Figure 1.5

Forest plot (Panel [A]) and funnel plot (Panel [B]) of model M002 (Study 2)
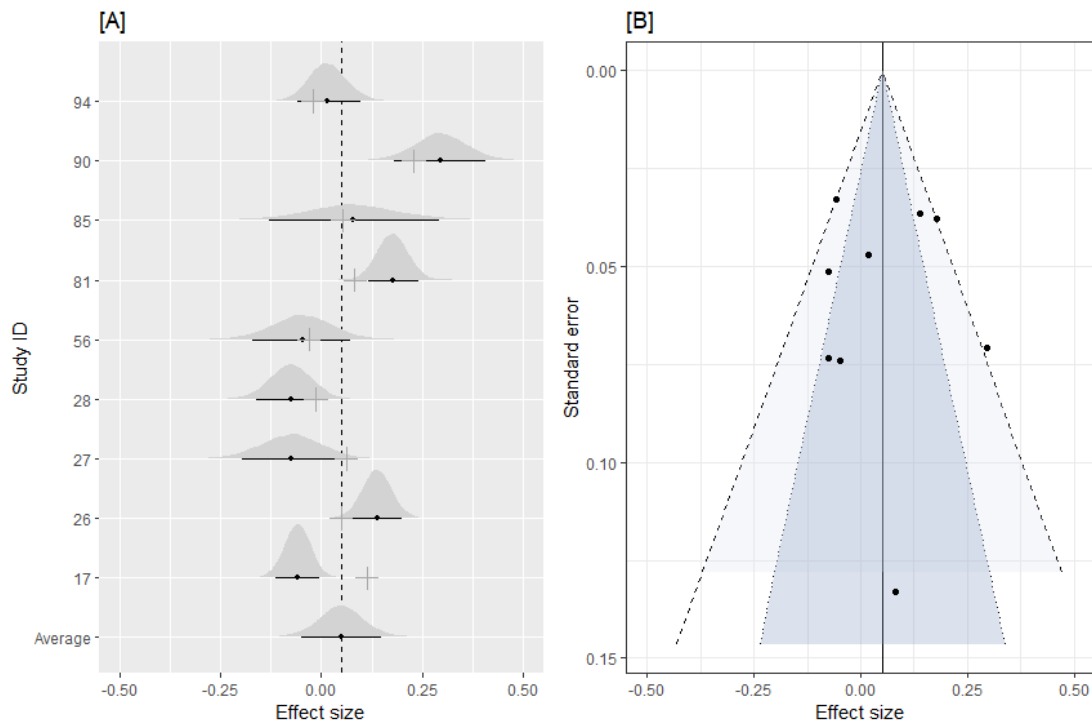
Meta-regression with moderators

To evaluate the effects of potential moderators we used the best model *(M002: months + (months | ID))*, that includes the temporal effect and variable intercepts and slopes. Considering the difference in the number of observations available, we cannot carry out an overall comparison between all the models examined. Thus, we created 2 groups of models with equal sample size, of respectively 23[3] and 18[4] waves included in the analyses, and consequently we compared the models of each group separately. We show the best and most informative models of the groups; N=23 (M006) and N=18 (M008). Specifically, we analyzed the main effects and/or the interactions of the following variables: for the group with N=23 (M006), the interaction between months and mean age, and for the group with N=18 (M008),

---

[3] The corresponding studies (N=9) have the following IDs: 6, 11, 12, 13, 27, 34, 36, 41, 45.
[4] The corresponding studies (N=7) have the following IDs: 6, 11, 12, 34, 36, 41, 45.

the main effect of the mean age, and the interaction between months and percentage of females. Specifically, Model M006 resulted as the best out of a total of 2^5 models; model M005 did not reach the convergence and therefore we have excluded it from the comparison. Instead, the model M008, resulted as the best model of a total of 7^6 models. For more details about the models tested, see Appendix 1.

Interaction between months and mean age (Model M006)

Table 1.8 displays the estimated parameters for the model with the interaction between months and mean age (M006).

Table 1.8

Estimates of the parameters of the M006 model (N=23)

Parameter	Estimate	SE	Q5	Q95
Intercept	-0.76	0.75	-1.98	0.47
Months	0.02	0.06	-0.07	0.10
Mean age	0.06	0.05	-0.03	0.14
Months x mean age	-0.00	0.00	-0.01	0.01

As we can see from Figure 1.6, results show in the abscissa the months and in the ordinate the expected mean change of the behavior, while the three lines refer to the mean age that has been categorized on three levels (i.e., +/- 1 SD from the mean; M=13.15, M=14.51, M=15.87). Findings show that at the baseline the frequency of NSSI is higher for adolescents with a mean age of 15.87 years than the other two groups with a mean age of 14.51 and 13.15 years respectively. Specifically, as the months increase over time, the frequency of NSSI decrease over time both for the students with a mean age of 15.87 and 14.51 years, while it remains stable for adolescents with a mean age of 13.15 years.

---

[5] The 2 models are: M005, M006.
[6] The 7 models are: M003, M004, M007, M008, M009, M010, M011.

Figure 1.6

Interaction between months and mean age at the first wave

Main effect of Mean age and interaction between months and percentage of females (Model

M008)

Table 1.9 displays the estimated parameters for the model with the main effect of months

and the interaction between months and percentage of females (M008).

Table 1.9

Estimates of the parameters of the M008 model (N=18)

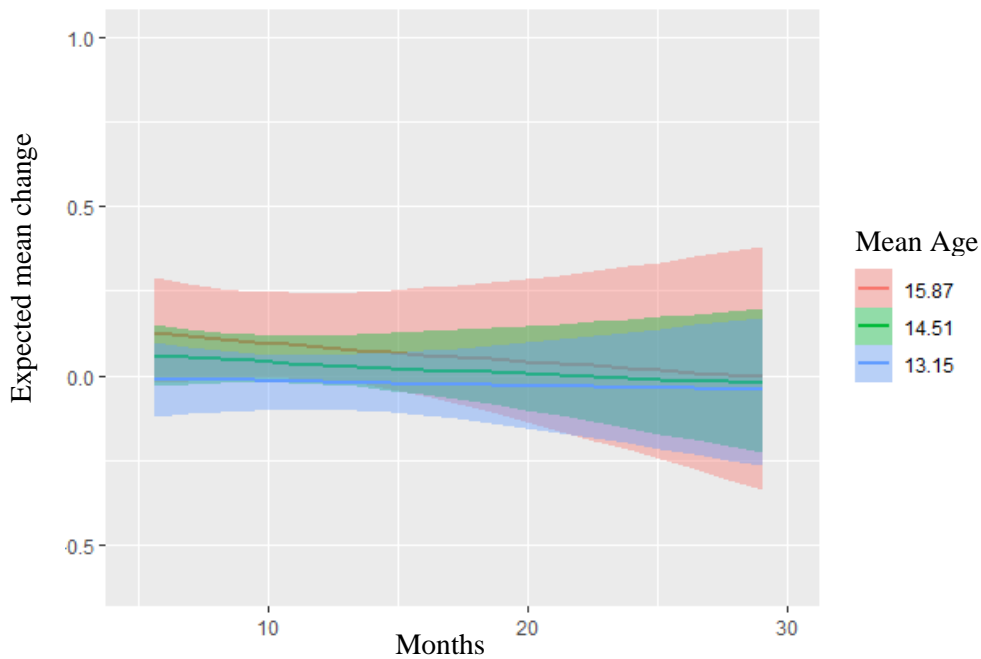| Parameter	Estimate	SE	Q5	Q95
Intercept	-3.97	2.57	-8.53	-0.14
Months	0.16	0.18	-0.10	0.49
Percentage of females	0.07	0.04	0.01	0.15
Mean age	-0.00	0.07	-0.13	0.11
Months x percentage of females	-0.00	0.00	-0.01	0.00

As we can see from Figure 1.7, results show in the abscissa the mean age and in the

ordinate the expected mean change of the behavior. Findings show a stability of the frequency

of NSSI in accordance with increasing age. Specifically, we can see an increase in the variability in the most extreme faces (i.e., 13 and 16 years old) compared to the central one (i.e., 14 and 15 years old).

Figure 1.7

Main effect of Mean age
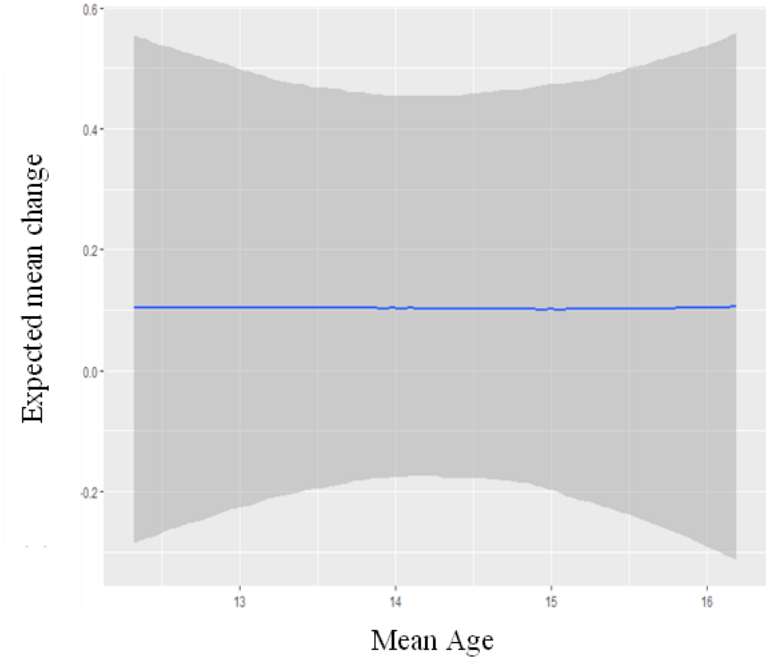
Figure 1.8 displays the interaction between the months and the percentage of females. Findings show in the abscissa months, while the three lines refer to the percentage of females which has been categorized on three levels (50.64%, 54.13%, 57.61%). Findings show that at the baseline, the frequency of NSSI is higher when there is a higher percentage of females (i.e., 57.61%). Specifically, as the months increase over time, the frequency (i.e., severity) of NSSI gradually decreases when there is a high percentage of females (i.e., 57.61%), there is a very slight increase for the percentage of female of 54.13%, and a slight increase for the percentage of females of 50.64%. Overall, we can see how in each group the frequency of NSSI tends towards 0.

Figure 1.8

Interaction between months and percentage of females
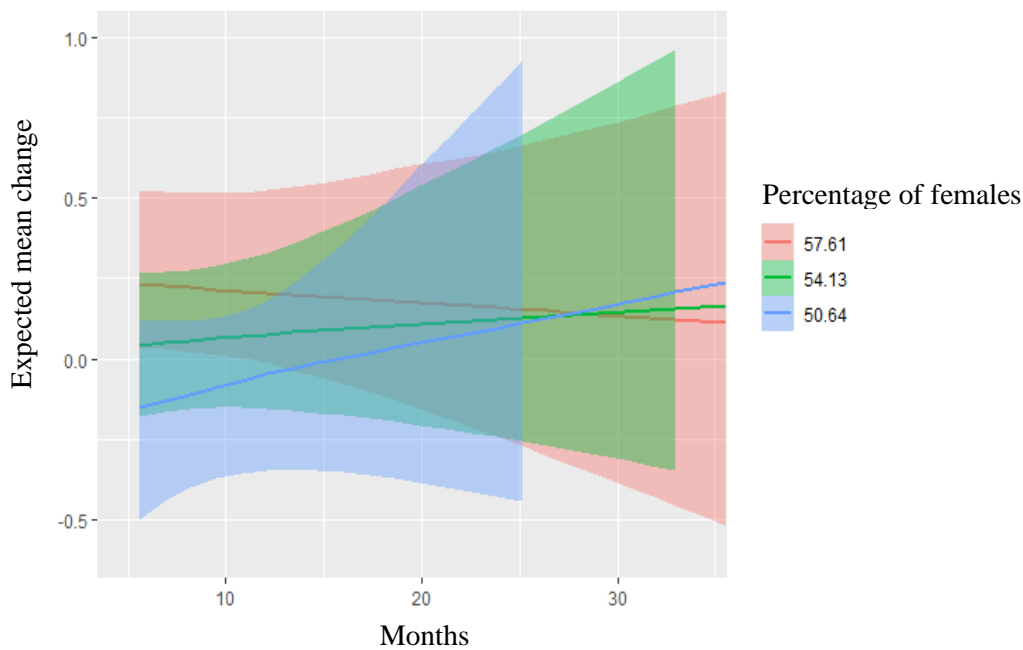
1.5 Discussion

In the last ten years, the attention given to the longitudinal development of non-suicidal self-injury has increased (e.g., Gillies et al., 2018). To date, most of the existing systematic reviews and meta-analyses on this topic have examined this behavior (e.g., prevalence, risks factors) at the cross-sectional level, while no meta-analytic syntheses have explored the longitudinal development of NSSI over time. Therefore, this meta-analysis aims to summarize the empirical literature on the occurrence (i.e., proportions, Study 1) and the frequency (i.e., severity, Study 2) of NSSI over time. Specifically, we included in the analysis all longitudinal studies published up until 2020 on NSSI behavior in adolescence and young adulthood, in community samples. Overall, we included 21 studies (i.e., Study 1=12; Study 2=9) in the final analysis that estimated the expected proportions, the expected mean changes and moderation effects. The number of final studies is greatly reduced because a portion of them were excluded for overlap of data collection and for missing values on the variable of interest. Results across

both meta-analyses showed huge variability between the studies included, that can be partially explained by different factors (i.e., moderators).

The meta-analysis is divided into three different steps. First, we analyzed a null model which estimates the overall effect size. Second, we compared the null model with two models that contain the longitudinal effect expressed by the variable *months* and the analysis of the best model among the three. Third, we introduced the different moderators with the aim of identifying the best possible model among a set of proposals (i.e., meta-regression).

Study 1 is focused on the occurrence of NSSI (i.e., the presence/occurrence of the behavior over time). Findings showed that the model that provided the best fit was the one with the variable intercepts and slopes, suggesting that it was very plausible that the studies differed not only in the estimates observed at the outset (i.e., random intercepts), but also in the trajectories detected during the waves (i.e., random slopes). Notably, the posterior distributions showed that the studies were not very close to the estimated average value but seemed to aggregate into two different groups. Thus, these results suggested a variability between the studies, even if reduced.

The meta-regression showed that the variability between the studies was explained by the main effect of the percentage of females and by the interaction between the months of survey and the mean age of the participants of the first data collection. Specifically, the expected proportion of NSSI increase with the increased percentage of females in the sample. So, being female represents a risk factor for a higher occurrence of NSSI. These findings could be explained considering gender differences in mental illness. In fact, females are more likely to experience internalizing problems such as depression (Nolen-Hoeksema, 1990; Weissman et al., 1984) and anxiety than males (e.g., Kessler et al., 2005). Additionally, among the risk factors that predict self-injurious behavior, mood disorders, which are more common among females, are most strongly associated with engagement in this risky behavior (Kessler et al.,

1999). Thus, the higher prevalence of affective disorders among females may explain the higher presence of NSSI.

Concerning the interaction between months and mean age of participants, findings show that as the months of assessment increase (i.e., time), the expected proportions of NSSI behavior decrease for adolescents that have an average age of 17.8 years, increase slightly for adolescents with a mean age of 15 years, and increase for adolescents with a mean age of 12.79 years. In accordance with the relevant literature (e.g., Gillies et al., 2018; Plener et al., 2015), these results suggest that mid-adolescence represents the highest risk period for the engagement in NSSI. In fact, findings suggest that the occurrence of the phenomenon increases over time for adolescents with a mean age of about 13-years-old at the baseline. This means that, over time, at about 15/16-years there is a greater presence of the phenomenon. Instead, on the contrary, the occurrence of the behavior decreases over time for adolescents with a mean age of about 17.8 years, underlying a decrease of NSSI in late adolescence and young adulthood. These longitudinal findings confirm the prior studies, according to which the behavior begins in early adolescence, grows during mid-adolescence and then declines in young adults (e.g., Brown & Plener, 2017; Plener et al., 2015). In fact, adolescence represents a transition and vulnerable period that includes different developmental tasks (Havighurst, 1948) oriented to defining one's personal identity (Kroger & Marcia, 2011) and developing one's autonomy (Alonso-Stuyck et al., 2018). For these reasons, it may be characterized by high levels of impulsivity and struggle to regulate one's emotions, which represent a risk factor for occasional engagement in NSSI (Andover, 2014). In fact, NSSI may be used as a coping strategy to avoid distressed emotional states (Chapman et al., 2006a) and to down-regulate arising negative feelings or to communicate with others (Bentley et al., 2014; Liu et al., 2016).

Study 2 examined the frequency (i.e., severity) of NSSI over time, showing the average changes between one wave and the next. Consistent with the results of Study 1, findings showed

that the model that provided the best fit was the one with the variable intercepts and slopes, suggesting that it was very plausible that the studies differed not only in the estimates observed (random intercepts) but also in the trajectories detected along the waves (random slopes). Specifically, the average change was rather low, probably because the various positive and negative changes observed in the different studies tend to cancel out. Notably, the posterior distributions showed that the studies were very close to the estimated average value. This could be explained by the high variability between the different studies, which leads to conflicting results. In fact, the increase in self-injury behavior in some studies and the decrease in others suggested a more complex association between the development of the behavior and the months of data collection. This could be due to the presence of other possible factors that may explain the association. Besides, there is also the possibility that there is no linear association between the variables considered, thus suggesting a curvilinear distribution that fluctuates over time.

The meta-regression analyses showed two different types of results. The first shows that the variability between the studies was explained by the interaction between the months and mean age of participants. The second one shows the main effect of the mean age and the interaction between months and the percentage of females.

As concerns the first set of results, looking at the development over time, findings suggested that as the months of assessment (i.e., time) increase over time, the frequency (i.e., severity) of NSSI decreases both for the students with a mean age of 14.51 years and 15.87, while it remains stable for adolescents with a mean age of 13.15 years. Specifically, we can note a slight decrease or even near stability in the frequency of NSSI for adolescents with a mean age of 13.15. While for adolescents who had an average age of about 15 and 16 years, and who started from higher values, they show a greater decrease. These results suggest that the frequency of the behavior is higher during mid-adolescence (i.e., average age of about 15 and 16 years old) and then decreases in late adolescence (e.g., Plener et al., 2015). In line with

the previous results of Study 1, adolescence represents a crucial period for the development of self-injury behavior, probably because it is characterized by interpersonal and intrapersonal stressors that are difficult to manage, thus leading to a higher frequency of maladaptive behavior (Garisch & Wilson, 2015). It may be possible that this period is characterized by greater individual vulnerabilities (i.e., interpersonal, and intrapersonal vulnerabilities) that expose adolescents to a higher risk of engagement in NSSI (i.e., severity). Finally, the high uncertainty and variability linked above all to adolescents with an average age of 16 years must be taken into consideration. This could suggest how, although there is a decrease in the frequency as the months increase, specific trajectories can worsen over time, thus underlining how some adolescents can continue to have maladaptive behavior and pain. In fact, there may be several concomitant factors related to individual difficulties and the presence of underlying pathologies that may maintain or aggravate the severity of NSSI (e.g., internalizing problems such as anxiety and depressive symptomology).

The second set of results show how, as regards the main effect of the mean age, there is a stability of the expected mean change of NSSI in accordance with the increasing mean age of participants. However, it's important to consider the variability in the extreme values, that are 13 and 16 years old, compared to the center values, between 14 and 15 years old. The high variability may be due to the wide age ranges considered in the different studies (Giletta et al., 2013; You et al., 2012; Zhu et al., 2020) that does not allow to fully grasp the development of self-injury behavior over time. Future studies are needed to better understand the development of behavior over time as a function of the average age. Furthermore, it would also be important to consider a series of individual trajectories that can influence and grasp the changes over time more precisely.

Finally, regarding the interaction between the months and the percentage of females, findings show that as the months of assessment increase over time, the frequency (i.e., severity)

of NSSI decreases when there is a high percentage of females (i.e., 57.61%), remains stable for the percentage of females of 54.13, and increases for the percentage of females of 50.64. Overall, we can see how there is a tendency of the expected mean change to be equal to 0. Thus, at the increasing of the months there is a stability of the frequency of the behavior according to the percentage of the females in the sample. These results seem to be in line with prior work (Heath et al., 2008), that found how gender differences (i.e., the prevalence of females) were more pronounced at younger ages (Sornberger et al., 2012), than studies that focused on young adults (e.g., Gratz et al., 2002; Heath et al., 2008). Moreover, it's important to consider another aspect for the interpretation of the results. Being longitudinal studies with multiple time points, there may have been a drop out of the participants in the studies (e.g., Daukantaitė et al., 2020; Wu et al., 2019), thus probably leading over time to a reduction of subjects. This could be attributed not only to the normal loss of subjects due to absences, change of class, or school, but it could be assumed that female adolescents, who are more vulnerable and live in a situation of greater risk in terms of mental health (i.e., individual vulnerabilities and higher severity of NSSI), have a greater probability of dropping out of the school. In addition, it is important to point out that, in all studies included, the percentage of females is higher than that of males. It is therefore considered important to interpret these results with caution. In sum, we can conclude how it is recommended, in future studies, to continue to examine the differences between being female and male more in depth, as it is a predisposing factor for the severity of the behavior over time.

Overall, the current meta-analysis tries to analytically synthesize the studies present in the literature to examine the longitudinal development of NSSI over time. The results show the important role of gender (i.e., females) and age in explaining the expected proportion and mean changes over time. Specifically, what emerges from the findings is how being female represents an important risk factor for the occurrence/presence of the behavior. As regards the frequency

of the behavior, a higher percentage of females is associated with higher severity of NSSI, but it tends to decrease over time, underling how gender differences were more pronounced at younger ages, than studies that focused on young adults . Undoubtedly, it is important to deepen the role of gender in the longitudinal development of NSSI and attempt to understand if there are other aspects that can influence their associations (e.g., interpersonal factors).

As for the average age, the results show that mid-adolescence (i.e., 14 and 15 years old) seems to be the most-at-risk period (i.e., peak) for the occurrence of the behavior over time. This could be explained considering that adolescence is a period of vulnerability, probably characterized, in specific cases, by high levels of difficulties in emotion regulation that could represent a risk factor for the engagement on NSSI (Andover, 2014). Instead, as regards the frequency of NSSI behavior over time, findings suggest that the frequency of the behavior is higher in adolescence at a mean age of 15-16 years old, and it then decreases in late adolescence (e.g., Plener et al., 2015). The greater frequency and therefore severity of the behavior could be more associated with a series of individual difficulties and the presence of underlying pathologies that may maintain or aggravate the severity of NSSI (e.g., internalizing problems such as anxiety and depressive symptomology).

In conclusion, it is important to have caution in interpreting the results and the related conclusions due to both the small number of studies included and the high variability between studies both in terms of instruments used and age range.

1.5.1 Strengths, limitations, and future directions

To date, only a systematic review on the longitudinal development of self-injury has been published (Plener et al., 2015), but it analysed the literature at a systematic review level, without making a quantitative synthesis that can explain the development of this behavior over time. Thus, this study represents the first meta-analyses which tries to shed light in the literature about the longitudinal development of self-injury behavior from early adolescence to young

adulthood, considering some moderators that could explain changes over time. It also has the strength to examine both the occurrence and the frequency/severity of NSSI behavior over time. Besides, it uses a meta-analytic Bayesian approach that allows to use information from previous studies (i.e., prior distribution) and to do a comparison between the models to identify the best (i.e., prior distribution, posterior distribution).

Behind the strengths of the study, we cannot avoid discussing the limitations that drive us to interpret the findings cautiously. Specifically, we can divide the limits in two different macro categories: the first refers to methodological aspects, whereas the second to the availability of data. As regards methodology, the first issue concerns the different instruments used to assess the behavior across the studies. In fact, the strong heterogeneity of the measurement of the NSSI construct did not allow for a unique method of synthesis of the effect size measurement, thus leading us to carry out two separate studies. Specifically, the first study includes studies that used dichotomous measures (i.e., proportion), thus expressing the presence of the phenomenon, while the second study includes studies that used continuous measures (i.e., frequency), thus expressing the severity of the phenomenon. Then, the high variability of the age range of the target population considered in the included studies, does not allow to fully grasp the development of self-injury behavior. For example, in some studies the age is between 11 and 16 years old (e.g., You et al., 2012), one study considers an age range from 10 to 14 years old (Zhu et al., 2020), and another between 14 and 18 years old (Giletta et al., 2013). Future studies should carry out surveys considering more homogeneous cohorts with a more limited age range and follow the participants repeatedly over time. Finally, it was not considered, in the analyses, the reference period of the measure (e.g., lifetime history), because of the high variabilities between studies. As concerns the second category, the lack of availability of data did not allow the use of a more sophisticated analysis. Notably, the mean age at baseline has been used as a moderator in the meta-regression, as there was not enough

data to estimate it at all time points (e.g., You et al., 2012; Marshall et al., 2013). The limited number of studies included did not allow to explore other moderating variables such as country. In fact, more attention should be devoted to the possible influence of cultural and/or contextual factors, because of the high variability of self-injury across countries and ethnicity. Finally, we used the percentage of females as a moderator, instead of examining the development of self-injury behavior over time separately for males and females, thus not delving into the trend of the phenomenon in females and males respectively.

Findings from this study provide important suggestions for future research in non-suicidal self-injury behavior. Our results suggest the importance of continuing and expanding longitudinal research on this topic, considering different aspects. Specifically, according to prior work (Gillies et al., 2018; Swannell et al, 2014), it may be important to dedicate more attention to certain methodological aspects. Mainly, the construct of self-injury should be defined and measured consistently across different studies to produce reliable and comparable results over time and across countries. Additionally, it would be preferable to use a scale (i.e., checklist) that measures the different types of self-injury, clearly defining the type of construct to examine. A scale rather than a series of yes or no questions would allow one to detect the frequency and severity of the behavior in order to examine the extension of the phenomenon. Furthermore, it would be important to define age ranges that are not too broad, in order to capture all the different stages of the development of self-injury behavior. Also, future studies should analyze the changes in self-injury behavior over time, using a longitudinal research design over several and constant time points of assessment to cover a large period and to capture the development of the behavior over time. Finally, future studies should explore the role that certain factors (i.e., individual, and contextual factors) may have in changing and modifying both the occurrence and development of NSSI over time.

CHAPTER 2

Reciprocal associations between peer problems and Non-Suicidal Self-Injury throughout adolescence

2.1 Introduction

Non-Suicidal self-injury (NSSI), defined as the direct and deliberate self-inflicted damage of body tissue without suicidal intent (Klonsky, 2011), is a serious public health concern worldwide (Kiekens et al., 2018). The onset of NSSI typically occurs between the ages of 11 and 15 years (Rodav et al., 2014), which makes adolescence a critical vulnerability period for NSSI development (Lloyd-Richardson, 2008). Indeed, recent meta-analytic work revealed that the prevalence of NSSI in community samples of adolescents is remarkably high, with approximately 23% of adolescents who reported deliberately injuring themselves at least once in their life, and almost 19% in the previous year (Gillies et al., 2018).

Previous work has emphasized the crucial role of both intrapersonal (e.g., emotional dysregulation) as well as interpersonal risk factors (e.g., stressful life events) for the occurrence of NSSI (e.g., Baetens et al., 2011; Nock, 2010). Among the latter, peer problems, such as peer victimization and friendship difficulties, have emerged as powerful predictors of NSSI development during adolescence (Fisher et al., 2012; Heilbron & Prinstein, 2010; Jutengren et al., 2011). Yet, the possibility that adolescents who engage in NSSI may in turn be at increased risk for experiencing difficulties with their peers has rarely received empirical attention (You et al., 2012). This is surprising given extensive theoretical work from developmental psychopathology posing possible transactional effects between social environmental factors and individual mental health problems (Rudolph et al., 2016). Understanding whether peer problems and NSSI mutually reinforce one another over time has significant practical relevance, for example, to prevent that these effects intensify and result in a negative vicious cycle difficult to break. Thus, this study aimed to investigate the reciprocal associations

between peer-related problems (i.e., peer victimization, friendship stress, and loneliness) and NSSI, using a six-wave prospective design in a large community sample of adolescents.

2.1.1 Peer problems as antecedents of NSSI

Interpersonal models of NSSI identify stressful and adverse life events as important risk factors for the development and maintenance of NSSI (Prinstein et al., 2009). For individuals who experience stressful events, NSSI may represent a maladaptive coping strategy, for example to down-regulate arising negative feelings or to communicate with others (Bentley et al., 2014; Liu et al., 2016). Notably, peer problems may be powerful stressors for adolescents. With the transition to adolescence, youth become highly oriented towards their peers and they show increased sensitivity to both positive as well as negative peer cues (Nelson et al., 2016). These developmental changes help adolescents to independently establish and maintain positive relationships with their peers; yet, for those who struggle with this task, heightened sensitivity to peers may negatively impact socio-emotional development (Blakemore & Mills, 2014; Fuhrmann et al., 2015; Somerville, 2013). Accordingly, peer problems have also been found to predict NSSI engagement during adolescence (Fisher et al., 2012; Wang & Liu, 2019).

In this study, we focused on three distinct forms of peer problems: peer victimization, friendship stress, and loneliness. Peer victimization, referring to being the target of episodes of aggression by peers, is among the most stressful experiences youth may be exposed to, and not surprisingly have been linked to NSSI (Jutengren et al., 2011; Van Geel et al., 2015). Although the vast majority of prior research examined the concurrent associations between peer victimization and NSSI, existing longitudinal studies suggest that adolescents exposed to experiences of peer victimization are also at increased risk for NSSI engagement over time (Jiang et al., 2016; You et al., 2012; Cheek et al., 2020).

Not only more extreme forms of peer difficulties such as victimization, but also problems within positive dyadic relationships may predict NSSI engagement. For example, experiencing difficulties with friends, not feeling supported, or lacking close, intimate friendships may also be a source of interpersonal stress, that could therefore precipitate NSSI (Giletta et al., 2015; Spirito et al., 1989). For instance, adolescents experiencing conflicts with friends have been shown to engage in NSSI to reduce this emotional distress (Chapman et al., 2006b; Nock & Prinstein, 2004). Consistently, lower levels of perceived support by friends and higher negative interactions within close relationships (e.g., with romantic partners, friends, and parents) have been both found to predict longitudinally NSSI occurrence (Baetens et al., 2015; Giletta et al., 2015; Hankin & Abela, 2011). Therefore, given the importance of friendship for adolescent well-being (Furman & Rose, 2015), high levels of stress with friends may increase the risk for NSSI.

Another relevant interpersonal factor that may more broadly reflect adolescents' difficulties with their peers is loneliness. Loneliness is a negative experience, indicating a general dissatisfaction with ones' social relationships. Notably, loneliness is related to the quality and quantity of friendship relationships (Lodder et al., 2017); in fact, adolescents who struggle with forming and maintaining positive relationships with their peers, or who are unsatisfied with their peer relationships, tend to report higher feelings of loneliness (Lasgaard et al., 2011; Lodder et al., 2017). This can be highly stressful, especially in a developmental period when peer inclusion and satisfaction are remarkably important. Prior work revealed that loneliness is associated with higher levels of NSSI engagement (e.g., Giletta et al., 2012; Prinstein et al., 2009; Wang & Liu, 2019), although evidence from longitudinal studies is lacking (de Oliveira Costa et al., 2020).

In sum, because peer problems can be highly stressful in adolescence, they may pose risk for subsequent NSSI engagement. Although existing research provided initial evidence

supporting these hypotheses, still relatively few longitudinal studies have examined the extent to which peer problems may contribute to the development and maintenance of NSSI over time.

2.1.2 NSSI as antecedent of peer problems

Whereas peer problems have been often conceptualized and examined as antecedents of NSSI development, little is known about the possible reciprocal effects of NSSI on subsequent peer problems. According to interpersonal models of developmental psychopathology (Rudolph et al., 2016), the dynamic and reciprocal exchanges between individuals' own characteristics and the ones of their environments shape the course of youth development (Rutter, 2014). These transactional models posit that adolescents are not simply passive receivers of experiences but they have an active role in selecting and modifying their environment (Cicchetti, 1993; Rutter, 2014; Sameroff, 2014). For example, whereas environmental stressors elicit a reaction from individuals, at the same time, individuals actively contribute to their social contexts with certain attitudes and behaviors that in some cases may further increase their (interpersonal) stress levels (Hammen, 1991). Thus, engaging in NSSI may have consequences for adolescents' social relationships, including the ones with their peers.

Although NSSI engagement may be driven by (perceived) interpersonal benefits (e.g., facilitate help-seeking), these behaviors may also elicit negative reactions from others (You et al., 2012). Recent work has revealed that NSSI is often viewed as a stigmatized behavior (e.g., Burke et al., 2019; Piccirillo et al., 2020) which could not only have negative consequences for mental health, but also for poor social relationships (Burke et al., 2019; Piccirillo et al., 2020). Specifically, NSSI could become a trigger for relationship problems as it may be perceived by others as a deviant behavior, leading to avoidance, isolation or even rejection (You et al., 2012). Previous work found evidence for negative implicit as well as

explicit biases toward NSSI (Burke et al., 2019); for example, individuals with no history of NSSI were less likely to accept others with a history of NSSI as friends or classmates, as compared to others with tattoos or non-intentional scars (Burke et al., 2019). These reasons may also explain why adolescents who engage in NSSI may be at higher risk for experiencing subsequent peer problems.

Adolescents who self-injure may be more likely to be victimized, perhaps because they are perceived as different, more vulnerable, and are viewed with prejudice by their peers. Moreover, NSSI may be considered as a sign of vulnerability, leading to subsequent peer victimization. This hypothesis is consistent with interpersonal scar models (or symptom-driven models) showing that greater levels of internalizing distress (e.g., depression) may represent antecedents of relationships difficulties, leading to adverse reactions from others, including peer victimization (Kochel et al., 2012; Rudolph, 2017). Second, consistent with stress generation models (e.g., Hammen, 1991), adolescents who self-injury may contribute to create a stressful environment, for example within their friendships. Accordingly, a few studies revealed that among college students and adolescents, especially girls, NSSI predicted higher levels of interpersonal stress over time (e.g., Burke et al., 2015; Ewing et al., 2019).

Finally, learning that a friend engages in NSSI also may result in negative reactions, perhaps due to stigma, prejudice or lack of understanding, which consequently could lead to social distancing and deceases in perceived social support (Hasking et al., 2015). For example, a recent review (Simone & Hamza, 2020) highlighted the possible negative impact of disclosing NSSI, which was often associated with loss of peers, threaten to end relationships and eventually subsequent increases in NSSI. Even if adolescents do not disclose NSSI, they may still be at risk for experiencing loneliness, perhaps because they feel different, ashamed or because they cannot share this with anyone (Gandhi et al., 2018).

In sum, existing work suggests that youth who engage in NSSI could be at increased risk for experiencing social relationship difficulties; yet, to date no study investigated the extent to which NSSI may predict subsequent peer problems during adolescence, a susceptible period for both NSSI as well as peer relationship development.

2.2 The current study

The present study aimed to investigate the reciprocal associations between three indicators of peer problems (i.e., peer victimization, friendship stress, and loneliness) and NSSI, using a six-wave prospective design in which a large community sample of adolescents were followed throughout adolescence. These associations were investigated using Random-Intercept Cross Lagged Panel Models (RI-CLPM; Hamaker et al., 2015), in order to differentiate between-person from within-person effects. RI-CLPMs allowed us to control for all unmeasured stable confounders that may explain the associations between peer problems and NSSI (e.g., genetic vulnerabilities), by removing the variance that is due to time-invariant between-person differences. In this way, the reciprocal effects between peer problems and NSSI were examined at the within-person level and referred to intra-personal deviations from individuals' own expected levels, allowing us to know whether changes in adolescents' own NSSI were related to subsequent deviations in their own peer problems, and vice versa. Notably, to date these models offer the closest possible approximation to identify "causal effects" using observational data (Lervåg, 2020).

The study hypotheses and the analytic approach were preregistered (https://osf.io/n67kp/?view_only=2eaa905205c540cd9df929d771f7fedc). Based on transactional models (Rudolph et al., 2016), we expected reciprocal longitudinal associations between peer problems and NSSI. Specifically, at the within-person level we expected that when adolescents experienced higher than usual peer relationship problems (i.e., higher levels of peer victimization, friendship stress and loneliness), they reported higher than usual NSSI

engagement at the subsequent time point and, vice versa. Moreover, we also hypothesized between-person associations, indicating that adolescents with more peer problems also reported higher levels of NSSI engagement than their peers.

Gender differences in the (within-person) reciprocal associations between peer problems and NSSI were also explored. Past research has shown that, as compared to boys, girls are more likely to engage in NSSI (Bresin & Schoenleber, 2015), report higher levels of interpersonal stress within close relationships (e.g., friendships), and tend to have greater sensitivity to social stress (Rose & Rudolph, 2006; Burke et al., 2015). Thus, NSSI and peer problems may influence each other over time more strongly for adolescent girls than boys. Finally, in sensitivity analyses, we explored whether the reciprocal associations between peer problems and NSSI held while also accounting for within-person fluctuations in depressive symptoms, given that high levels of depressive symptoms have been found to predict both peer problems (e.g., Rudolph, 2017) and NSSI (Fox et al., 2015).

2.3 Methods

2.3.1 Participants and procedures

Participants were 866 adolescents (54.5% females), aged between 12 and 15 years old at baseline (M_{age} = 13.12 years, SD = 0.78). Adolescents were part of two cohorts (53.9% in Grade 7 and 46.1% in Grade 8 at baseline) and attended three rural, low-income middle schools in a single county in southeastern United States[7]. The sample was ethnically diverse, with 47.2% of adolescents identifying themselves as Caucasian, 23.1% as Latinx, 22.1% as African American and 7.6% as belonging to other ethnic minority groups. Most participants lived in a two-household family, either with both biological parents (50.4%) or a biological parent and another adult (e.g., stepparent, grandparent; 20.8%); the remaining 24.3% lived in

---

[7] Data collection began in the year 2012/2013 in American schools that were randomly selected. The longitudinal dataset was kindly provided by Professor Mitchell Prinstein and Professor Matteo Giletta within a collaboration undertaken during my scientific training abroad at the University of Ghent.

single-parent household and 4.5% with others from parents (e.g., adopted mother). Based on census trac data of street addresses, participants' household income was in the lower-middle class range (M = \$40,759.59; SD = \$15,491.39) (www.census.gov).

All seventh- and eighth-grade students in regular classrooms (n = 1,463) were invited to participate in the study and 59.20% of them took part in the baseline assessment (n = 866). Subsequently, participants were followed through high school, with assessments occurring at a year interval. Thus, in total students in the younger cohort (i.e., Grade 7 at baseline) participated in a maximum of six waves of data collection, while students in the older cohort (i.e., Grade 8 at baseline) in five. Retention rates between consecutive assessments ranged between 88.7% and 97.7% and was 67% between Time 1 and Time 6. All participants with available data at one time point at least were included in the analyses. Study attrition was due to participants' moving from the area, absenteeism, incomplete data, and declining to continue participation. To compare participants with and without missing data, Little's (1988) Missing Completely at Random (MCAR) tests were performed. Because the associations between NSSI and each of the peer problems variable were examined in separate models (see Analysis plan), three different tests were conducted. Although all tests emerged to be significant (friendship stress: χ^2 (449) =536.071, p=.003; loneliness: $\chi2$ (297) =363.266, p=.005; peer victimization: $\chi2$ (403) =628.442, p<.001), the normed χ^2/df, ranging between 1.19 and 1.56, suggests that data were likely missing at random (Bollen, 1989). Thus, all participants with available data at one time point at least were included in the analyses.

Questionnaires were administered at school following the same procedures at all time points, using computer-assisted self-interviewing (CASI) with dividers between students to ensure privacy. Participants were compensated with a \$10 gift card at each assessment. The study received ethical approval of the relevant University's Institutional Review Board.

2.3.2 Measures

Non-suicidal self-injury (NSSI). At each time point, NSSI was measured with six items, each rated on a five-point Likert scale from "never" to "10+times", with a possible total score ranging from 6 to 30 (Prinstein, 2008). The scale assessed how frequently, during the past year, adolescents had engaged in six different types of non-suicidal self-injurious behavior, including cutting/carving, burning, hitting, scraping/picking skin to the point of bleeding, biting and inserting objects under skin/nails, without suicidal intent. This measure is commonly used to assess NSSI in non-clinical samples of adolescents (e.g., Giletta et al., 2012) and prior work reported its good concurrent validity (Prinstein, 2008). A total NSSI score was calculated by summing the six items, with higher scores indicating higher NSSI engagement in the previous year. Internal consistency (Cronbach's α) ranged between .79 (at Time 1) and .86 (at Time 6) across time points.

Friendship stress. At each time point, friendship stress was assessed using a self-report measure developed based on standardized questions from the Youth Life Stress Interview (YLSI; Rudolph & Flynn, 2007). The scale included eleven items (e.g., "A friend stopped talking to you without clear reasons"; "A friend talked behind your back"; "A friend started to date someone you had a crush on") asking about common stressful events that adolescents may have experienced during the past year in the context of their friendships. Each item was rated on a five-point Likert-type scale from 1 ('never') to 5 ('very often'). This scale has been previously used to assess friendship stress among adolescents and evidence supporting its concurrent validity has been reported (Massing-Schaffer et al., 2020). Responses to the 11 items were averaged, with higher scores indicating higher levels of friendship stress in the past year. Internal consistency (Cronbach's α) ranged between 0.92 (at Time2) and 0.93 (at Time 6) across time points.

Loneliness. From Time 2, loneliness was assessed by asking participants to rate five items on a five-point Likert scale ranging from 1 ('never') to 5 ('very often'). Those items were selected to attempt to compose a pure measure of loneliness (Weeks & Asher, 2012); three items were an adaptation of the Loneliness and Social Dissatisfaction Questionnaire (Cassidy & Asher, 1992) (i.e., I felt alone; I felt left out of things; I was lonely) and two items were previously developed by Ladd and Burgess (1999) (i.e., School was a lonely place for me; I was sad and alone). Answers to all items were averaged to obtain an overall measure of loneliness. Although most items included in this scale did not directly tapped into peer-related loneliness, research has been showing that generic measures of loneliness tend to reflect loneliness within the peer environment (see Goossens et al., 2009). Internal consistency (Cronbach's α) ranged between 0.94 (at Time2) and 0.95 (at Time 6) across time points.

Peer victimization. From Time 2, a measure of peer victimization was added to the study. Specifically, participants took part in a peer nomination procedure to assess both overt and relational victimization (Grotpeter & Crick, 1996; Helms et al., 2015). Students were asked to nominate an unlimited number of peers within their grade, in response to the following questions: "Who gets threatened or physically hurt by others?" (i.e., over victimization) and "Who gets left out of activities, ignored by others because one of their friends is mad at them, gossiped about, or has mean things said behind their backs?" (i.e., relational victimization). For each student, the total number of nominations received were summed and standardized within grade for both the overt and relational victimization item separately. Subsequently, given the moderate to strong correlation between the items (from $r=.42$ at Time 2 to $r=.82$ at Time 6) a total peer victimization score was computed by averaging across the standardized scores of relational and overt peer victimization. Peer victimization was highly skewed, therefore before analyses a $\log_{10}$ transformation was applied and extreme outliers (i.e., values higher the $3SD$ above the mean) were winsorized to the highest value in

the distribution within 3*SDs* from the mean (Grade 8, n= 9; Grade 9, n=12; Grade 10, n=7; Grade 11, n=8 and Grade 12, n=6).

Depressive symptoms. At each time point, depressive symptoms were assessed using the Short Mood and Feeling Questionnaire (SMFQ; Angold et al. 1995). This scale includes thirteen items (e.g., "I felt miserable or unhappy"), describing depressive symptoms that participants may have experienced during the previous two weeks. Each item was rated on a three-point Likert scale from 0 (*'not true'*) to 2 (*'true'*). Reponses to the 13 items were averaged (Cronbach's αs .92-.95).

2.3.3 Analysis plan

Analyses were carried out consistent with our preregistration (see https://osf.io/n67kp/?view_only=2eaa905205c540cd9df929d771f7fedc), unless differently indicated. First, descriptive statistics were examined, and intra-class correlations (ICCs) were computed to evaluate the proportion of variance at the within- and between-person level of each study variable. Second, Random-Intercept Cross-Lagged Panel Models (RI-CLPM; Hamaker et al., 2015) were used to examine the bi-directional associations between peer problems and NSSI. By extracting stable between-person differences, these models decompose the variance into stable factors that are invariant over time, reflecting between-person differences, and multiple time-variant latent factors reflecting within-person deviations from the person's own expected score (i.e., trait-like), taking into account the sample mean level across time and the individual's time-invariant factor (Hamaker et al., 2015). Specifically, between-person effects would indicate that peer problems and NSSI are associated due to unmeasured trait-like individual differences, for instance because adolescents with poorer emotion regulation are more likely to engage in NSSI as well as experience peer problems, as compared to their peers with better emotion regulation skills. While within-person effects would indicate that the possible reciprocal association between

peer problems and NSSI is more likely given by a prospective relationship that approaches a cause-effect. Therefore, these models really allow us to test the theoretical models we previously discussed (interpersonal/scar models), which really assume within-person effects. For example, they assume that because a person may start engaging in NSSI, this could increase their own risk for peer problems.

Separate models were fitted for each of the three peer problems, that is, peer victimization, friendship stress and loneliness. Because this study recruited two different cohorts (Grade 7 and 8 at baseline) and data were collected over time with an interval of one year between consecutive assessments, models were estimated using grade, rather than wave of data collection, as time metric. This allowed us to examine effects over a developmental period from grade 7 to 12, with data missing by design for some participants (Bollen & Curran, 2006). However, because loneliness and peer victimization were assessed only starting from Time 2, models including these variables were restricted to the developmental period from grade 8 to 12[8]. Due to the non-normal distribution of NSSI, resulting from most adolescents reporting no engagement in NSSI, RI-CLPMs were estimated using a censored-normal distribution to account for the preponderance of zeros in the data, using Weighted Least Square Mean and Variance adjusted (WLSMV) estimation in Mplus (Asparouhov & Muthén, 2010). This approach deviates from our pre-registered analyses, as we initially aimed and attempted to model NSSI using a (zero-inflated) negative binomial distribution; yet this option failed in combination with RI-CLPMs[9].

---

[8] Theoretically, also for loneliness and peer victimization analyses could have been carried out from grade 7 to 12 by handling missing data on loneliness and peer victimization at Time 1 as missing by design. However, this would have resulted in a substantially higher proportion of missing data; specifically, at grade 7 only participants from the grade 7 cohort would have had data on NSSI, with no participants having data on loneliness or peer victimization.

[9] In our preregistration, we reported that as an altenrative to the (zero-inflated) negative binomial distribution we would have log10 transformed the NSSI variables to correct for skewness. This approach however did not reduce skewness, due to the high proportion of participants reporting no NSSI engagement. Thus, based on Muthén's suggestion (Schultzberg et al., 2017), we opted for a censored approach with WLSMV estimation. Note that the use of WLSMV estimation – rather than maximum likelihood (ML) estimation – in Mplus also resulted in additional deviations from the preregistration (e.g., chi-square test for difference testing was used for comparing models rather than Satorra–Bentler-scaled chi-square difference tests, as the latter is not appropriate for WLSMV estimator).

To evaluate the model fit, traditional goodness-of-fit indices were used, including the chi-square (χ^2) statistic, the root-mean-squared error of approximation (RMSEA), the comparative fit index (CFI) and the weighted root mean square residual (WRMR). Models with RMSEA less than .08, WRMR higher than 1.0 and CFI higher than .90 are considered to have acceptable fit, while RMSEA less than .05, WRMR less than 1.0 and CFI higher than .95 are considered to have good fit (Bollen, 1989; Hu & Bentler, 1998; Yu, 2002).

All models were initially tested with all paths freely estimated over time, to allow for possible developmental differences in the examined effects. Subsequently, to examine whether effects were similar over time (i.e., time-invariance of effects), we compared a model with freely estimated paths to a model where paths were fixed to be equal over time. Time invariance of model estimates were examined by comparing groups of effects, starting with autoregressive effects - separately for peer problems and NSSI - followed by concurrent (i.e., within-time) effects (i.e., residual covariances) and residual variances[10] and finally with cross-lagged effects separately for the peer problems variables and for NSSI. Nested models were compared using Chi-Square test for difference testing (Asparouhov et al., 2006; Mulder & Hamaker, 2021). Whenever the constrained model did not result in a significantly worse fit than the unconstrained model (i.e., non-significant chi-square difference test), the constrained model was retained. Finally, we compared the strength of the cross-lagged effects from peer problems to NSSI with the cross-lagged effects from NSSI to peer problems, to examine whether significant differences emerged in the extent to which these constructs reciprocally influenced each other over time.

Finally, a series of supplementary analyses was also conducted. First, the main study associations were examined using traditional Cross-lagged Panel Models (CLPMs), to explore whether model fits improved using RI-CLPM. Second, gender differences were explored

---

[10] We fix the covariances between the residuals of the within-person centered variables (i.e., concurrent associations) and residual variances in the same step.

using a multi-group approach, in which models with all paths freely estimated across gender were compared to models in which the cross-lagged paths were fixed to be equal across gender. Finally, as sensitivity analyses (i.e., not pre-registered), we estimated RI-CLPMs including bi-directional associations between peer problems, NSSI as well as depression, to explore the robustness of the findings when controlling for within-person fluctuations in depression symptoms. All main analyses were conducted in Mplus version 7 (Muthen & Muthen, 2012).

2.4 Results

2.4.1 Descriptive analysis

Across the six assessments (see Figure 2.1), between 17.3% and 31.9% of adolescents reported that they had engaged in at least one NSSI episode during the previous year (i.e., T1=32.1%, T2=30.1%, T3=27.2%, T4=24.7%, T5=21.1%, T6=17.3%).

Figure 2.1

NSSI trend across waves
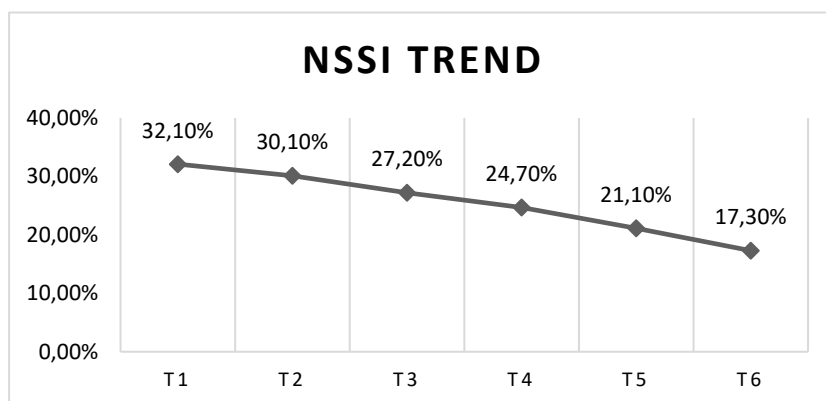
The bivariate correlations between peer problems (i.e., peer victimization, friendships stress, loneliness) and NSSI are reported in Table 2.1. Intra-class correlations (ICC) were respectively .41 for NSSI, .45 for victimization, .50 for friendships stress and .56 for loneliness. These results suggest that between 41% and 56% of the observed variance in the study variables was due to stable between-person differences while the remaining variance was attributable to within-person variations over time.

73

Table 2.1

Bivariate Correlations between Peer Problems and Non-Suicidal Self-Injury across all Time Points.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	16	19	20	21	22
1. Friend stress T1	1																					
2. Friend stress T2	.61***	1																				
3. Friend stress T3	.48***	.61***	1																			
4. Friend stress T4	.42***	.54***	.60***	1																		
5. Friend stress T5	.35***	.41***	.46***	.51***	1																	
6. Friend stress T6	.39***	.43***	.52***	.54***	.55***	1																
7. Loneliness T2	.43***	.55***	.43***	.38***	.28***	.29***	1															
8. Loneliness T3	.37***	.43***	.50***	.41***	.29***	.25***	.67***	1														
9. Loneliness T4	.30***	.34***	.40***	.56***	.35***	.43***	.56***	.67***	1													
10. Loneliness T5	.29***	.32***	.33***	.40***	.41***	.35***	.50***	.58***	.65***	1												
11. Loneliness T6	.24***	.33***	.41***	.39***	.36***	.45***	.41***	.50***	.57***	.68***	1											
12. Victimization T2	.02	.02	-.02	.04	.008	-.07	.14***	.10*	.10***	.13***	.02	1										
13. Victimization T3	.03	.04	.05	.05	.05	-.01	.14***	.15***	.12***	.18***	.11	.64***	1									
14. Victimization T4	.03	.04	.05	.08*	.08*	.03	.09*	.10**	.11***	.12**	.004	.56***	.63***	1								
15. Victimization T5	.06	.013	.007	.06	.03	-.02	.10*	.07	.11***	.11**	.11	.44***	.46***	.45***	1							
16. Victimization T6	-.04	-.06	-.03	.03	-.03	-.08	.07	-.01	.09	.10	.10	.48***	.42***	.45***	.46***	1						
17. NSSI T1	.30***	.26***	.20***	.18***	.18***	.17***	.30***	.29***	.30***	.26***	.21**	.13***	.17***	.13***	.10*	.06	1					
18. NSSI T2	.24***	.25***	.20***	.17***	.14***	.13*	.40***	.36***	.28***	.23***	.24***	.12***	.17***	.08*	.06	.02	.46***	1				
19. NSSI T3	.20***	.19***	.26***	.22***	.19***	.10	.36***	.44***	.37***	.29***	.20***	.11**	.14***	.07	.06	.01	.38***	.56***	1			
20. NSSI T4	.09*	.06	.17***	.22***	.19***	.21***	.27***	.31***	.41***	.36***	.30***	.14***	.15***	.11**	.14***	.04	.35***	.40***	.62***	1		
21. NSSI T5	.10*	.10***	.11***	.16***	.21***	.25***	.17***	.17***	.28***	.33***	.28***	.11***	.08*	.07	.10*	.04	.24***	.22***	.35***	.47***	1	
22. NSSI T6	.003	.06	.07	.09	.09	.13***	.05	.07	.11	.02	.26***	-.04	-.01	-.02	-.06	-.11	.18***	.24***	.17**	.28***	.39***	1
Mean	2.25	2.29	2.37	2.37	2.56	2.30	2.15	2.28	2.23	2.30	2.20	.23	.24	.28	.27	.21	7.13	7.09	7.06	6.90	6.86	6.72
SD	.93	.91	.85	.86	.87	.89	1.14	1.24	1.15	1.20	1.16	.16	.17	.15	.16	.18	2.78	2.65	2.67	2.44	2.75	2.22

Note. NSSI = non-suicidal self-injury. For peer victimization $\log_{10}$ values are reported. *$p <.05$; **$p <.01$; ***$p <.001$

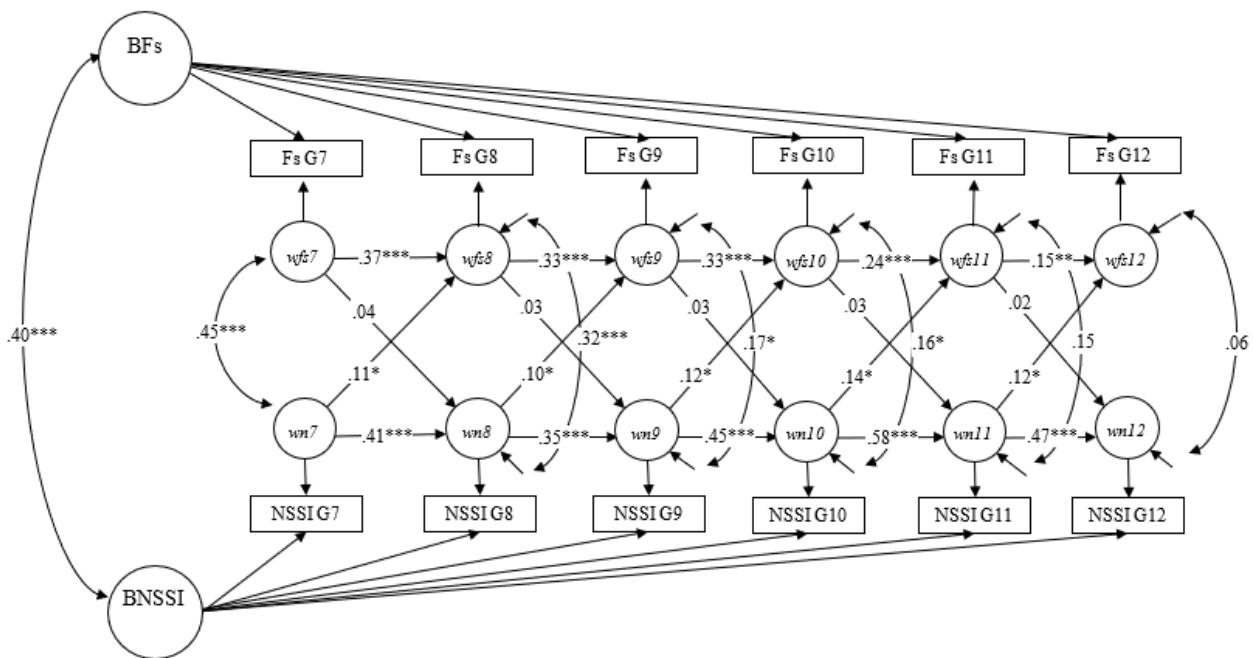### 2.4.2 Random Intercept Cross-Lagged Panel Model (RI-CLPM)

Reciprocal associations between Friendship Stress and NSSI

All model comparisons conducted to test time invariance of the estimates are reported in the Appendix 2 (Table 2.2). Figure 2.2 displays the final model (see also Table 2.3 for SEs and 95% CI), in which autoregressive paths, residual variances and covariances were all freely estimated over time; conversely cross-lagged effects emerged to be all time invariant and were therefore constrained to be equal over time. This model showed an excellent fit, χ^2 (45) = 47.187 (p = .383), RMSEA = .007 (90% CI = [.000, .024]), CFI = 0.999, TLI = 0.998, and WRMR= 0.525, and emerged to fit the data significantly better than a traditional CLPM, $\Delta\chi^2$ (3) = 122.011, p<.001, indicating the need to distinguish between and within-person effects and suggesting that the two models differ (see appendix 2; Table 2.9). At the within-person level, the cross-lagged paths from NSSI to friendship stress were positive and significant. This indicates that when adolescents reported higher levels of NSSI (as compared to their own mean) they also reported higher levels of friendship stress at the subsequent time point. However, no reverse effects from friendship stress to NSSI were found. Furthermore, the model with the cross-lagged effects fixed to be equal to the ones from friendship stress to NSSI and vice-versa (i.e., to test the strength of the cross-lagged effects) worsened the model fit, $\Delta\chi^2$ (1) = 4.859, p=.027, so Model 7 was retained as final model (Figure 2.2). This suggested that the effects from NSSI to friendship stress were stronger than the effects from friendship stress to NSSI. Moreover, significant concurrent correlations indicated that when adolescents reported higher level of friendships stress (as compared to their own mean level) at a specific time point, they also reported more NSSI at that time point (i.e., from Grade 7 to Grade 10, see Figure 2.2). Finally, the autoregressive paths of both friendships stress and NSSI were all positive and significant, indicating that adolescents tended to report higher levels of NSSI and friendship stress (as compared to their own mean levels) when they also reported

higher levels of NSSI and friendship stress respectively, at the previous assessment (i.e., carry-over effect). This suggested that within-person deviations from expected scores on friendships stress predict later deviations from expected scores on the same variable, and the same is for NSSI. Notably, more friendships stress at within persons level leads to more friendship stress at subsequent waves. At the between-person level, more friendships stress was positively associated with more NSSI, with a medium effect size ($\beta = .40$, SE=.07, p <.001). Thus, across waves, adolescents who reported higher level than average of friendship stress also reported to engage in NSSI more often.

Figure 2.2

Final Random-Intercept Cross-lagged Panel Model of Friendship stress and NSSI.

Note. BFs= Between friendship stress; BNSSI= Between non-suicidal self-injury; G=grade of school; wfs= within friendship stress; wn= within non-suicidal self-injury. Standardized estimates are reported. *p <.05; **p <.01; ***p <.001

Reciprocal associations between loneliness and NSSI

All model comparisons conducted to test time invariance of the estimates are reported in the Appendix 2 (Table 2.4). Figure 2.2 displays the final model (see also Table 2.5 for SEs and 95%CI), in which autoregressive paths on NSSI, residual variances and covariances were

all freely estimated over time; conversely autoregressive paths on loneliness and cross-lagged effects emerged to be all time invariant and were therefore constrained to be equal over time. This model showed an excellent fit, χ^2 (30) = 35.651 (p = .219), RMSEA = .015 (90% CI = [.000, .032]), CFI = 0.995, TLI = 0.993, and WRMR= 0.454, and emerged to fit the data significantly better than a traditional CLPM, $\Delta\chi^2$ (3) = 36.919, p<.001, indicating the need to distinguish between and within-person effects and suggesting that the two models differ (see appendix 2; Table 2.9).

At the within-person level, the cross-lagged paths from NSSI to loneliness were positive and significant, suggesting that when adolescents reported higher levels of NSSI (as compared to their own mean) they also reported higher levels of loneliness at the subsequent time point. However, no reverse effects from loneliness to NSSI were found. Furthermore, the model with the cross-lagged effects fixed to be equal to the ones from loneliness to NSSI and vice-versa worsened the model fit, $\Delta\chi^2$ (1) = 9.792, p=.002, so Model 7 was retained as final model (Figure 2.3). This suggested that the effects from NSSI to loneliness were stronger than the effects from loneliness to NSSI. Besides, significant concurrent correlations indicated that when adolescents reported higher level of loneliness (as compared to their own mean level) at a specific time point, they also reported more NSSI at that time point. This is true for all time points excepted for Grade 11. The autoregressive paths of both loneliness and NSSI were all positive and significant, indicating that adolescents tended to report higher levels of loneliness and NSSI (as compared to their own mean levels) when they also reported higher levels of loneliness and NSSI respectively, at the previous assessment. This suggested that within-person deviations from expected scores on loneliness predict later deviations from expected scores on the same variable, and the same is for NSSI. Notably, more loneliness at within persons level leads to more loneliness at subsequent waves. At the between-person level, more loneliness was positively associated with more NSSI, with a large effect size (β =

.68, SE=.08, p<.001). So, across waves, adolescents who reported higher level than average of loneliness also reported to engage in NSSI more often.

Figure 2.3

Final Random-Intercept Cross-lagged Panel Model of Loneliness and NSSI.
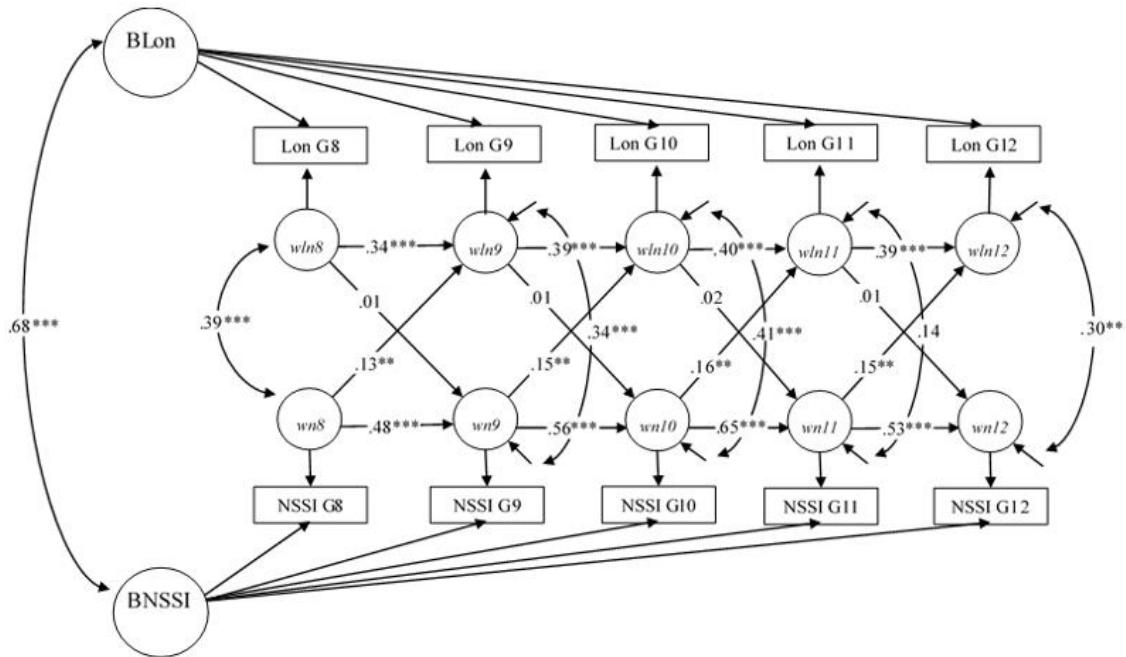
Note. BLon= Between loneliness; BNSSI= Between non-suicidal self-injury; G=grade of school; *wln*= within loneliness; *wn*= within non-suicidal self-injury. Standardized estimates are reported. *p <.05; **p <.01; ***p <.001

Reciprocal associations between peer victimization and NSSI

All model comparisons conducted to test time invariance of the estimates are reported in the Appendix 2 (Table 2.6). Figure 2.3 displays the final model (see also Table 2.7 for SEs and 95%CI), in which autoregressive paths on victimization, residual variances and covariances were all freely estimated over time; conversely autoregressive paths on NSSI and cross-lagged effects emerged to be all time invariant and were therefore constrained to be equal over time. This model showed good fit, χ^2 (30) = 45.209 (p = .037), RMSEA = .025 (90% CI = [.006, .039]), CFI = 0.988, TLI = 0.982, and WRMR= 0.672, and emerged to fit the data significantly better than a traditional CLPM, $\Delta\chi^2$ (3) = 79.450, p<.001, indicating the

need to distinguish between and within-person effects, suggesting that the two models differ (see Table 2.9). At the within-person level, the cross-lagged paths from NSSI to victimization were positive and significant. This suggests that when adolescents reported higher levels of NSSI (as compared to their own mean) they also reported higher levels of peer victimization at the subsequent time point. However, no reverse effects from peer victimization to NSSI were found. Although the model with the cross-lagged effects fixed to be equal to the ones from peer victimization to NSSI and vice-versa did not worse the model fit, $\Delta\chi^2$ (1) = 3.699, p=.054, we consider model 7 as the final model. This because the test of strength of the cross-lagged effects is an additional step to be able to draw conclusions on the difference in estimates between cross-lagged. Moreover, significant concurrent correlations were found only at Grade 8, suggesting that when adolescents reported higher level of peer victimization (as compared to their own mean level), they also reported more NSSI at the same time point. Besides, the autoregressive paths of peer victimization were significant from Grade 8 to Grade 11, while for NSSI were significant over time. This indicated that adolescents tended to report higher levels of peer victimization (excepted for Grade 12) and NSSI (as compared to their own mean levels) when they also reported higher levels of peer victimization and NSSI respectively, at the previous assessment. This suggested that within-person deviations from expected scores on peer victimization predict later deviations from expected scores on the same variable, and the same is for NSSI. At the between-person level, more peer victimization was not associated with more NSSI (β = -.22, SE=1.18, p =.850). Thus, across waves, adolescents who reported higher level than average of peer victimization did not reported to engage in NSSI more often.

Figure 2.4

Final Random-Intercept Cross-lagged Panel Model of Peer Victimization and NSSI.
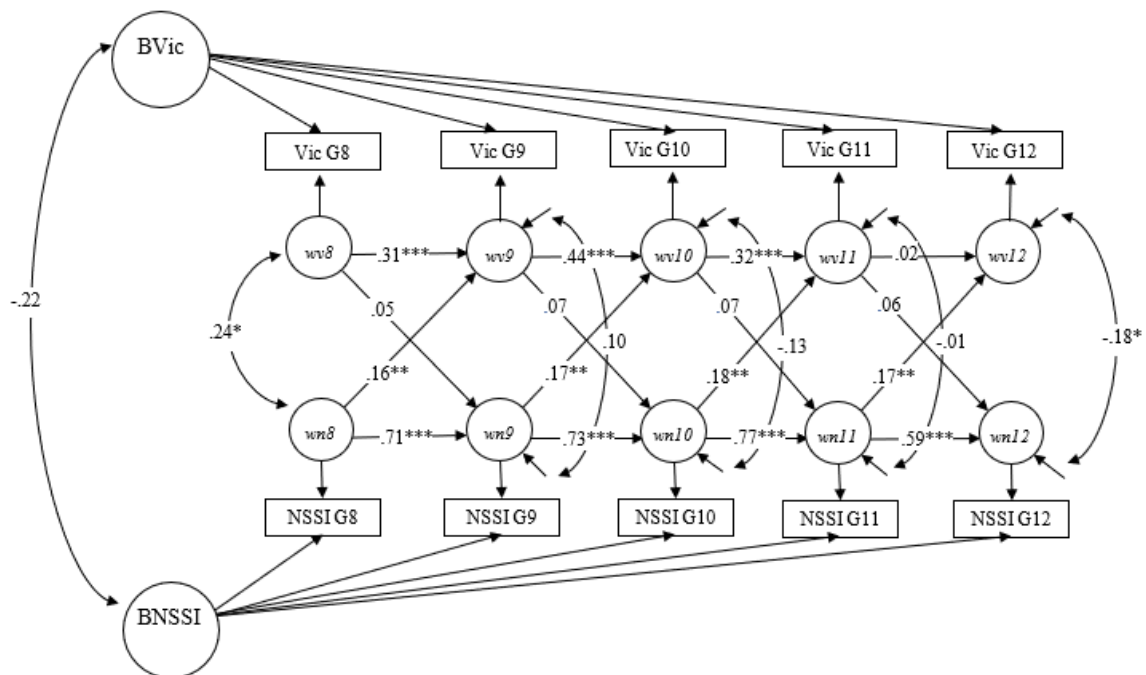
Note. BVic= Between peer victimization; BNSSI= Between non-suicidal self-injury; *wv*= within victimization; *wn*= within non-suicidal self-injury. Standardized estimates are reported. *p <.05; **p <.01; ***p <.001

2.4.3 Supplementary analyses

All RI-CLPMs estimated to explore gender differences (Table 2.8) and the confounding effects of depressive symptoms (Table 2.10-2.12; Figure 2.8-2.10) are reported in the Appendix 2. Constraining the cross-lagged effects to be equal across gender did not worsen the model fits (see Table 2.8), indicating that the within-person reciprocal effects between peer problems and NSSI were similar for boys and girls.

In the RI-CLPMs including depressive symptoms, the between-person associations between peer problems and NSSI remained unchanged. However, the within-person effects of NSSI on peer problems were strongly attenuated, so that they only reached significance for peer victimization (from Grade 8 to 9, and marginal significance from Grade 10 to 11), and approached significance for friendship stress (see Figures 2.8-2.10). Interestingly, NSSI

positively predicted within-person changes in depression, but not vice-versa; besides, positive reciprocal within-person cross-lagged effects were found between depressive symptoms and both friendship stress and loneliness.

2.5 Discussion

Despite evidence that adolescents who experience peer problems are at greater risk for engaging in NSSI, little is known about the possible consequences of NSSI for adolescents' relationships with their peers. This study contributed to this research by examining, for the first time, how peer problems (i.e., peer victimization, friendship stress and loneliness) and NSSI may reciprocally affect one another throughout adolescence, using a state-of-the-art analytic technique that allowed us to differentiate between-person from within-person effects. Findings revealed that loneliness and friendship stress, but not peer victimization, were associated with NSSI primarily at the between-person level, indicating that adolescents who reported more loneliness and friendship stress also reported more NSSI engagement. After controlling for these between-person associations, adolescents' higher-than-usual levels of NSSI were also found to predict subsequent higher-than-usual levels in their own peer problems, although sensitivity analyses revealed that these effects were mostly explained by within-person fluctuations in depressive symptoms. These findings advance our current understanding of adolescent NSSI and have several noteworthy theoretical and practical implications.

Consistent with our hypothesis, the between-person associations between NSSI and both loneliness and friendship stress supported the possibility that NSSI and difficulties with peers may in part be manifestations of stable, shared underlying vulnerabilities. For example, personality traits, such as neuroticism or genetic predispositions, may increase the risk for both engaging in NSSI and experiencing higher levels of loneliness and friendship stress (e.g., Kiekens et al., 2015). However, the lack of between-person association between NSSI and

peer victimization was unexpected. This finding may in part stem from the different assessment method used to measure NSSI (i.e., self-report) and peer victimization (i.e., peer nomination procedure), and it indicates that those adolescents who had a 'victim' reputation among their peers were not necessarily those who also engaged more often in NSSI. At the within-person level, although we hypothesized bi-directional effects over time, initial results indicated that NSSI consistently increased the risk for all type of peer problems, but not vice-versa, similarly among boys and girls. These findings extend prior work on NSSI as predictor of interpersonal stress over time (e.g., Burke et al., 2015; Ewing et al., 2019), and consistent with interpersonal theories of developmental psychopathology (Rudolph et al., 2016) suggest that adolescents who engage in NSSI may shape their social environment in a way that could potentially deprive them from a positive social context fundamental for their development.

Yet, these findings should be also interpreted considering the sensitivity analyses which included depressive symptoms. First, in these analyses NSSI no longer predicted loneliness over time, yet bi-directional relationships between depressive symptoms and loneliness emerged. While these results may indicate that the effects of NSSI on loneliness were spurious, it is also plausible that higher levels of depressive symptoms that predicted higher loneliness over time were in part explained by the frequent co-occurring of NSSI engagement (as evident in the concurrent within-person association between depression and NSSI). Second, after controlling for depression, NSSI only marginally predicted friendship stress over time, yet it was positively associated with subsequent depressive symptoms, which in turn were associated with higher-than-usual levels of friendship stress at the following time point. These findings are remarkable as they imply possible cascade effects from NSSI to stress exposure within friendships. Specifically, NSSI may lead to an escalation of negative emotions and depressive feelings that, as suggested by the stress generation hypothesis (Hammen, 1991), may in turn contribute actively to create a stressful environment. Thus,

depression may represent a mechanism through which NSSI poses risk for stressful experiences within friendship, similarly to emotion dysregulation as reported in prior work (e.g., Ewing et al., 2019), as well as externalizing problems. Indeed, research has shown that adolescents who report higher levels of externalizing problems (e.g., aggression, irritability), which often co-occur with NSSI engagement (e.g., Tang et al., 2013), are at increased risk for experiencing peer problems (e.g., peer rejection; see Prinstein & Giletta, 2016).

Finally, in the models with peer victimization, the effects of NSSI on depressive symptoms as well as peer victimization were replicated, although the latter not consistently over time. Because in these models, depression did not predict peer victimization, high levels of depressive symptoms are unlikely to underlie the link between NSSI and peer victimization. Instead, a possible explanation for these findings could be that adolescents who self-injure may be stigmatized and perceived as deviant, who could increase their risk for being rejected and victimized by their peers (e.g., Piccirillo et al., 2020). In sum, altogether these findings provide some preliminary support that NSSI may increase the risk for being victimized and, via elevations in depressive symptoms, for experiencing more stress within friendships. However, future research is needed to replicate the effects of depressive symptoms (which were not pre-registered) as well as to directly examine the role of externalizing symptoms as possible mechanisms linking NSSI to peer problems.

Differently from what we expected, no evidence of peer problems as predictors of subsequent engagement in NSSI emerged in any model. This finding is in contrast with prior work, according to which difficulties with peers can lead to higher levels of NSSI (e.g., Giletta et al., 2015; You et al., 2012). At least two main reasons could explain these discrepant results. First, prior studies investigated the effects of peer problems on NSSI using traditional analytic techniques that confound between- and within-person effects (e.g., cross-lagged panel models; You et al., 2012). Although in our study results from the RI-CLPMs and the CLPMs were

rather consistent, prior work indicated that not disentangling between-person from within-person effects may yield very different results (Nelemans et al., 2020). Second, the time span between consecutive assessments may have been too long to capture the possible effects of peer problems on NSSI. In fact, stressful peer relationships may be temporally delimited or perhaps may constitute a more proximal trigger for the engagement in NSSI (e.g., Liu et al., 2016). Specifically, NSSI may be a maladaptive way to regulate stressful situations in the short run, yet these effects are more likely observable sooner rather than one year later. Similarly, it is plausible that the effects of NSSI on peer problems could also be accentuated or change within shorter time periods. For example, consistent with theoretical works on the functions of NSSI, NSSI engagement may contribute to short-term social benefits (e.g., increased support), that however could be only observed when examining changes over days or perhaps even hours. Yet, in the longer-run – over the course of one year – NSSI may be more likely to undermine adolescents' social and mental health. These hypotheses require to be directly examined in future studies.

Concerning practical implications, findings suggested the importance of intervening both at the community level and individual level. First of all, in order to reduce NSSI stigma (e.g., Piccirillo et al., 2020) and to promote the disclosure to others (Simone & Hamza, 2020), it would be important to raise awareness of this behavior, its characteristics, motivations and functioning mechanisms (i.e., universal prevention). This could consequently help adolescents who self-injure to be more willing to disclosure to others with subsequent fewer negative consequences. Besides, our findings suggest that clinical intervention should also attend to support adolescents who engage in NSSI (i.e., individual prevention) in order to prevent the development and maintenance of internalizing symptoms (e.g., depression) and possible peer difficulties, for example by targeting emotion regulation skills.

2.5.1 Strengths and limitations

This study has several strengths, including the large sample, the multi-wave design and the analytic approach (i.e., RI-CLPM) that differentiates between-person and within-person associations. Notably, this approach allowed us to examine the extent to which peer problems and NSSI reciprocally influenced each other over time, while taking into account all stable factors that may have influence both peer problems and NSSI.

Despite these strengths, the current results should be considered in light of some limitations. First, limitations related to the study measures should be noted. The self-report assessment of NSSI may have been affected by social desirability, respondent, and recall biases, or may have been subjected to possible misinterpretation (e.g., in the definition of NSSI). Moreover, the measure used to assess loneliness was not validated and did not directly ask about peer-related loneliness. Thus, these findings should be replicated, for instance using clinical interviews or multi-method assessments of NSSI. Second, although RI-CLPMs to date offer one of the most suitable analytic approaches to strengthen causal inferences from observational data, the use of a non-experimental design still does not allow us to draw strong causal conclusions. Moreover, due to the complexity of these models and the large sample sizes required to identify small effects, we decided to examine associations between NSSI and each of the three peer problems in separate models. Thus, it remains unclear whether NSSI may simultaneously pose risk for different types of peer problems, or whether some of the observed associations are redundant. Third, additional contextual factors, such as school-level characteristics, were not considered. Previous work has shown that rates of self-injurious behaviors may be affected by school-level factors, such as peer network cohesion in school (Wyman, et al., 2019); therefore, future work is warranted to examine the extent to which these broader-level school factors may also influence the associations between peer problems and

NSSI. Finally, as discussed above, the time span between waves was 12 months, and it may have been too long to identify within-person effects (Dormann & Griffin, 2015).

In conclusion, the present study offers the first in-depth investigation on how NSSI and different types of peer problems may reciprocally influence each other over the course of adolescence. Findings highlight that the links between NSSI and both loneliness and friendship stress may be due to stable, common underlying factors. However, some evidence also indicates that NSSI engagement may increase adolescents' vulnerability to be exposed to peer victimization as well as stress within their friendships, likely because NSSI puts them at risk for experiencing higher levels of depressive symptoms. Altogether, these findings underscore the need to pay attention to the possible mental and social risks of NSSI engagement during adolescence.

For these reasons, given the important negative consequences of NSSI's behavior on the psychological well-being of young people, it is relevant to examine the impact of the Covid-19 pandemic on the implementation of risky behaviors in adolescence such as the NSSI. Specifically, Covid-19 pandemic represented a powerful stressful life event for many people, and in particular for adolescents, likely leading to negative consequences on social and individual well-being. Thus, it may be relevant to examine the extent to which Covid-19 related stress may influence NSSI, especially for adolescents that presented prior individual and psychological vulnerabilities. Besides, it may be also important to explore possible consequences that this period had on the level of social relations.

CHAPTER 3

Non-Suicidal Self-Injury in adolescence: the role of pre-existing vulnerabilities and Covid-19 related stress

3.1 Introduction

As previously reported Non-Suicidal Self-Injury (NSSI), defined as direct and deliberate destruction of one's body tissue without suicidal intent, is a risk behavior that can have deleterious health consequences, especially in adolescence (Kiekens et al., 2018). Prior work suggested that negative life events may serve as powerful precipitants for NSSI, especially when individuals perceive these events as particularly stressful (Liu & Miller, 2014; Madge et al., 2011). Over the past year, the Covid-19 pandemic undoubtedly represented a significantly stressful life event for many people, that not only had an impact on public health but likely also on individuals' psychological health (World Health Organization, 2020a). In fact, even among individuals who were not directly affected by the virus, the containment measures such as quarantine and self-isolation have limited the quantity and quality of social interactions, normal activities, and routines (e.g., school, extra-curricular activities), likely leading to negative consequences on social and individual well-being, especially for adolescents (e.g., Gruber et al., 2020). Accordingly, it has been suggested that mental problems, as well as self-injurious behavior, could have increased during the Covid-19 period (e.g., Gruber et al., 2020).

However, to date, little is known about changes in NSSI behaviors across the pandemic, and no study examined who (e.g., which youth) may be at higher risk for NSSI during this period and why. Indeed, although Covid-19 is a worldwide pandemic, the extent to which it affected youth and therefore, similarly, how it may influence NSSI may probably depend on prior individual vulnerabilities. Considering these premises, the main aim of the present study was to examine if adolescents with pre-existing vulnerabilities, including a prior history of NSSI, higher levels of internalizing symptoms, and poorer regulatory emotional

self-efficacy have a higher likelihood to be involved in NSSI and to increase their frequency across the pandemic period through higher levels of Covid-19 related stress. Moreover, we analyzed the extent to which the Covid-19 related stress predicts NSSI may be buffered for adolescents who perceive higher levels of social support during the pandemic (i.e., peer support and parental support).

3.1.1 Covid-19 related stress and NSSI

Stressful and negative life events were recognized as crucial predictor factors for the initiation and maintenance of NSSI (e.g., Liu et al., 2016; Madge et al., 2011). In fact, for individuals that experienced stressful life events and that had difficulties to manage negative emotions, NSSI may represent a maladaptive coping strategy that serves to regulate their emotions (Gratz & Roemer, 2008; Liu et al., 2016).

Among these, Covid-19 might be considered as a stressful life event, having a strong impact not only on public health but also on mental health of individuals, and especially on adolescents (Branje & Morris, 2021; Gruber et al., 2020; World Health Organization, 2020a). Covid-19 pandemic might have interfered with the developmental tasks of adolescence, might constitute the *"perfect storm"* for difficulties to emerge in some adolescents (Branje & Morris, 2021). The changes in the individual and social environment, together with a series of challenges and difficulties given by this emergency, could have affected the well-being of adolescents and their developmental tasks. Virus containment measures such as social distancing, quarantine, and self-isolation have drastically changed the normal activities and routines, likely leading to many interpersonal sources of adversity and consequently to several negative consequences on social and individual well-being (e.g., Rajkumar, 2020). In particular, adolescence represents a sensitive period of development, characterized by biological, but also social transitions. The increase of autonomy from the family and the expansion of a network of friendships represent important developmental tasks in the definition of one's identity (Alonso-Stuyck et al., 2018; Kroger & Marcia, 2011). Thus, during

Covid-19, strong changes in daily life and the loss of important developmental factors such as attending school and peer experiences could have led to psychological consequences as well as self-injury (e.g., Ellis et al., 2020; World Health Organization, 2020c). For instance, psychological stressors due to the Covid-19 pandemic may have increased maladaptive emotion regulation strategies, leading to internalizing symptoms such as self-injury (e.g., Nolen-Hoeksema & Aldao, 2011).

Despite the great importance of this risky behavior, little is known about the association between Covid-19 related stress and self-injurious behavior. Most existing publications raised concerns about the possibility of an increase in self-injury behavior (Eisner & Nivette, 2020; Plener, 2021), but no empirical longitudinal study has demonstrated it, yet.

3.1.2 Pre-existing vulnerabilities and NSSI

Especially during adolescence, Covid-19 changes could exacerbate pre-existing psychopathology and developmental vulnerabilities, probably leading to a higher level of internalizing symptoms and risk behavior (e.g., Gruber et al., 2020). For example, adolescents that had specific vulnerabilities such as higher stress, maladaptive coping, or internalizing problems before the pandemic, experienced more Covid-19 related concerns during the pandemic (van Loon et al., 2021). Thus, adolescents that are more vulnerable and that experiment maladaptive interpersonal events may be more exposed to stressful experience like Covid-19 and consequently could be more exposed to NSSI. Previous studies examined the role of possible risk factors in predicting engagement in NSSI (Fox et al., 2015). Among the intrapersonal factors, for example, a prior history of self-injurious behavior, internalizing symptoms (e.g., anxiety, depression) and emotion dysregulation were found strong predictors of future NSSI (Fox et al., 2015).

In this regard, prior work suggested that a prior history of NSSI increases the likelihood of future NSSI engagement (e.g., Fox et al., 2015). Thus, having a pre-existing history of NSSI could represent a major factor to engage in NSSI especially during the pandemic period.

Furthermore, also internalizing symptoms were found to be linked to a higher level of NSSI. Prior studies found that adolescents with emotional problems such as depressive symptoms (Prinstein et al., 2010; Muehlenkamp & Gutierrez, 2004) and anxious symptoms (Bentley et al., 2015; Robinson et al., 2017; Tatnell et al., 2017; Valencia-Agudo et al., 2018) were at increased risk for self-injury. According to the theoretical models, the engagement on NSSI becomes a strategy to cope with the internalizing symptoms (Nixon et al., 2002). Consequently, depressive, and anxious symptoms could be probably involved in translating Covid-19 related stress into an increased risk for NSSI.

Emotional experience and, in particular, emotion dysregulation represents a crucial factor in understanding why people engage in NSSI (e.g., Chapman et al., 2006a; Selby & Joiner, 2009). Emotion regulation processes are directly associated with individual's behavior and responses (Gross, 1998). In fact, adolescents who engage in NSSI experience a lot of negative emotions that they are unable to manage, leading them to an increased risk for NSSI. At this regard, it could be important to introduce another important component that is emotion regulation self-efficacy. In fact, self-efficacy is a cognitive mechanism through which individuals react to stressful events (Bandura, 1988) and is also defined as the belief in their own ability to successfully manage and regulate emotions (Bandura, 1997; Caprara et al., 2008). In fact, prior work found that higher levels of self-efficacy were associated with lower levels of stress (Hackett & Betz, 1995; Newby-Fraser & Schlebusch, 1997). Self-efficacy is linked to the perception of controllability of a stressful situation, which decreases when the perception of own ability to regulate emotion and the consequent management of the event are low (Suldo & Shaffer, 2007). Thus, the low confidence in the self-efficacy to cope with stressful events may lead to the engagement in NSSI, contributing to the maintenance of the behavior over time (Nock & Mendes, 2008; Tatnell et al., 2014). Therefore, this may suggest that adolescents with lower levels of self-efficacy in regulating negative emotions, may in turn

report a higher level of stress during the Covid-19 pandemic and consequently higher levels of NSSI.

Thus, in the light of these premises, we can suppose that adolescents that are more vulnerable may be more affected by stressful experience like Covid-19 pandemic, and consequently could be more at risk for NSSI occurrence.

3.1.3 Social support as a possible moderator

Interpersonal factors such as social support (e.g., perceived support from friends or parents) may represent a crucial protective factor for NSSI, able to buffer the impact of stressful events (Cohen & Wills, 1985). The literature on NSSI suggested that higher levels of perceived social support are correlated to lower levels of NSSI (e.g., Prinstein et al., 2010). Conversely, adolescents who perceive low levels of support from friends, family, or other significant relationships are at greater risk for NSSI (Hankin & Abela, 2011; Prinstein et al., 2008).

According to the stress buffering hypothesis, social support may have represented a protective factor during the Covid-19 pandemic. Specifically, we might assume that the perceived social support (e.g., peer and parental support) could have moderated the link between Covid-19 perceived stress and NSSI. The more constant presence of parents and the sharing of experience with peers, also thanks to the use of internet, could have somehow buffered the effect of stress due to the pandemic, thus reducing the probability of being involved in risky behaviors. Despite this, it is important to underline that the Covid-19 pandemic has led to a restriction of social interactions. Undoubtedly, the restrictions (e.g., prohibition of outdoor physical activity, the closure of schools) have changed the usual routines, interrupting face to face peer relationships and increasing family time. Despite the possibility of maintaining long-distance relationships thanks to the use of internet, the lack of opportunities for exchange and interactions, both at school and outside, could have led to a reduced perception of peer support. As concerns the family, the pandemic could have led to

contrasting situations. For example, the functioning of the family may not have been affected, or it could have been affected only partially by the stress due to Covid-19, returning soon to the normal functioning. Supportive parenting during the pandemic was associated with child functioning and well-being, that was consequently linked to longitudinal change in internalizing and prosocial behavior (Neubauer et al., 2021), protecting children from experiencing emotional distress (Masten & Motti-Stefanidi, 2020). Conversely, some families may have been severely affected by the stress of the pandemic, probably aggravating existing vulnerabilities and difficulties. In fact, a recent study showed that parents' high levels of stress and a poor relationship between parents and their children were associated with higher levels of children's internalizing and externalizing behaviors (Lionetti et al., in press). Given these contrasting aspects caused by the pandemic, it would be important to examine the role of social support during this period, understanding if it was a protective factor from perceived stress levels for adolescents who perceived higher levels of support.

3.2 The current study

The present study aimed to investigate the extent to which adolescents with pre-existing vulnerabilities, defined as a prior history of NSSI, higher levels of internalizing symptoms, and poorer regulatory emotional self-efficacy, have a higher likelihood to be involved in NSSI and to increase their frequency across the pandemic period through higher levels of Covid-19 related stress (see Figure 3.1). Moreover, we also examined how the impact of Covid-19 related stress on NSSI is buffered for adolescents who perceive higher levels of social support during the pandemic (i.e., peer support and parental support). All study hypotheses and the analytic approach were preregistered (https://osf.io/xa6vm/?viewonly_=58b_2eec0376b 483ba25abf22_39f2ec26). Specifically, we hypothesized that adolescents with pre-existing vulnerabilities, including a prior history of NSSI, higher levels of internalizing symptoms, and poorer regulatory emotional self-efficacy, were more likely to involve in NSSI across the pandemic period through higher levels of Covid-19 related stress. Moreover, we also

hypothesized that perceiving higher levels of social support during the pandemic (i.e., peer support and parent support) buffered the impact of Covid-19 related stress on NSSI.

Figure 3.1

The proposed moderated mediation model
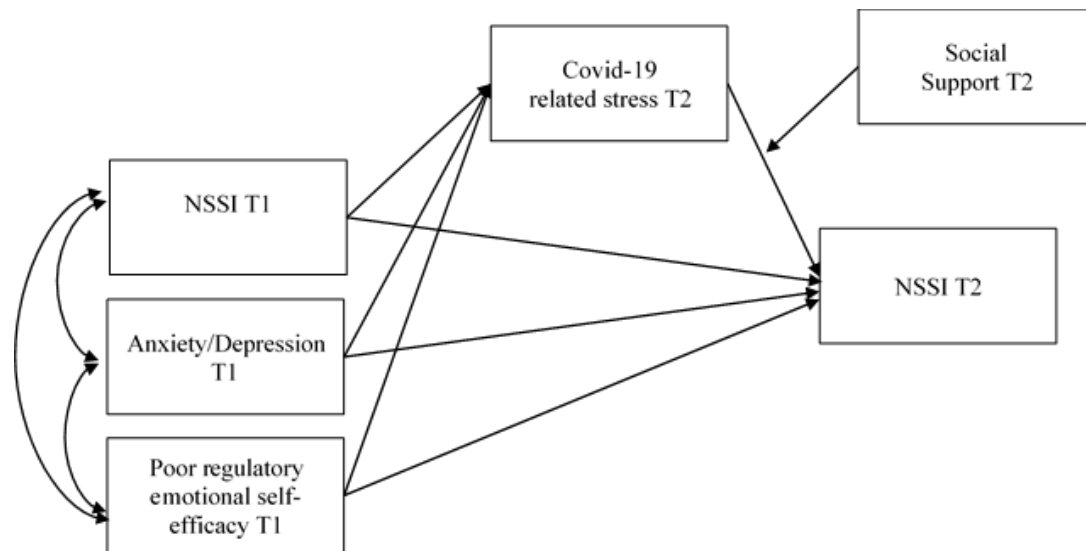
3.3 Methods

3.3.1 Participants and procedure

Participants included 1061 adolescents (52.4% females) that participated at least at one-time point, enrolled in 9th and 10th grade of high school in Tuscany, Italy. The mean age was 15.49 years (SD=.76) at the baseline, ranging from 14 to 21 years[11]. As regards nationality, the sample included 947 (89.3%) Italians and 113 (10.7%) foreigners. The participants were part of a longitudinal research project "Silent suffering in adolescence: personal and social factors" that started in the school year 2019-2020. This study was approved by the University of Florence Ethics Committees for Research (Prot. n. 0027539 of 9th August 2019). During January/February of 2020 (Wave 1, pre Covid-19 pandemic), all students in Grade 9 and Grade 10 were invited to participate (N =919). Subsequently, participants were monitored the

---

[11] The frequency of the age was as follow: 21 (2%) had 14 years old; 623 (58.8%) had 15 years old; 313 (29,6%) 16 years old; 86 (8.2%) 17 years old; 14 (1.3%) 18 years old; 2 (0.2%) 19 years old and 1(0.1%) 21 years old.

following year between December and January of 2020/2021 (Wave 2, during Covid-19 pandemic)[12], when students attended the Grade 10 and 11 (N = 579). Retention rate between the two assessments was 47%. Study attrition was mainly due to the decision of some schools to not participate for the difficulties and restrictions related to the Covid-19 situation, which strongly limited data collection conditions. Specifically, four schools and six classes decided not to continue the project for the current school year, for a total of 368 students. Besides, a total of 114 students were not present at T2 due to individual variables (e.g., absenteeism). To explore the nature of the drop out at T2, attrition analysis was conducted through a multinomial logistic regression model in which dropout at T2 (1=participants at both waves, 2=schools that not participated at T2 due to Covid-19 limitations, 3=dropout (e.g., absenteeism) was predicted separately by prior history of NSSI at T1, anxiety/depression at T1 and poor regulatory emotional self-efficacy at T1. Results showed that dropout at T2 was predicted by prior history of NSSI (OR=1.667, 95% CI= 1.251-2.223, p<.001), anxiety/depression (OR=2.017, 95% CI= .1.502-2.708, p<.001), and poor regulatory emotional self-efficacy (OR=1.487, 95% CI= 1.251-1.767, p<.001) only for schools and classes that did not participate at T2 because of the Covid-19 situation. This could be because these schools, probably, have been most affected (i.e., on the organizational level) by the situation due to Covid-19. Instead, for the participants that did not complete the questionnaire at T2 due to other reasons (i.e., absenteeism) the analyses showed that the dropout at T2 was not predicted by prior history of NSSI (OR=1.289, 95% CI= .840-1.977, p=.245),

---

[12] The first administration of the questionnaire was carried out before the outbreak of the pandemic due to Covid-19. In fact, on January 30, 2020, following the reporting by China (December 31, 2019) of a cluster of cases of pneumonia of unknown etiology (new coronavirus Sars-CoV-2), the World Health Organization declared a public health emergency of international interest. The Italian government has proclaimed a state of emergency and implemented the first containment measures on the national territory. The second survey took place almost a year after the first when new restrictive and containment measures were introduced. With the DPCM of November 3, 2020, in consideration of the particularly widespread nature of the pandemic and the increase on the national territory, new provisions limiting the teaching activities in presence were progressively introduced. Specifically, the use of distance learning for high schools was introduced. In fact, during the survey, most of the schools that participated in the project were in distance learning, while others were in mixed mode teaching. Between December and January, a series of containment and restriction measures were arranged for the development of the pandemic, with the extension of the state of emergency until April 30, 2021.

anxiety/depression (OR=1.332, 95% CI= .861-2.061, p=.199), and poor regulatory emotional self-efficacy (OR=.995, 95% CI= .775-1.278, p=.968), confirming that were missing at random. Considering all these information, we decided to include in the analyses all students who filled out the questionnaire (N = 1061).

The informed consent procedure consisted of preliminary approval by the school principal and the class council. To the school that gave the permission, consent forms were distributed to both students' families and students themselves to inform them about the project and to ask them the consent for their child to participate in the study. Only students that had parent's authorization participate in the questionnaire administration. The data at Time 1 were collected digitally (e.g., link) through a smartphone, tablet, or PC according to the arrangements of the school, with the presence of a doctoral student psychologist. At Time 2, the data collection was online (i.e., not in presence) due to the Covid-19 restrictions (e.g., most of the schools in Italy were still in distance learning). The administration took place, when possible, through an online platform to which the class was connected with a teacher and an operator of the project. In case this method was not possible, the link for accessing the questionnaire was sent to the referring teacher and he/she took the responsibility of carrying out and supervising the survey. All the studied variables were measured at both waves, except for Covid-19 measures that were assessed only at wave 2.

3.3.2 Measures

Anxious/Depressive symptoms were assessed, at T1, by nine items from the scale of the internalizing problem of the Youth Self-Report (YSR; Achenbach et al., 2001). Items were rated on a three-point Likert scale, from 0 ('*not true*') to 2 ('*somewhat or sometimes true*) in the past 6 months. Examples for the scale were like "I feel useless or inferior", "I am nervous or tense", "I am too fearful or anxious" and "I am unhappy, sad, or depressed". The average score was used, with higher scores indicating more levels of anxiety and depression. The scale showed good reliability (Cronbach's α=0.85).

Regulatory emotional self-efficacy was assessed, at T1, using four items rated on a five-point Likert scale ranging from 1 (*'not all capable'*) to 5 (*'entirely capable'*) of the Perceived Emotional Self-Efficacy Scale (Caprara & Gerbino, 2001). This scale was a self-report measure composed of 12 items that assessed three areas of the self-efficacy construct (i.e., self-efficacy in the expression of positive emotions, self-efficacy in the management of negative emotions, and empathetic self-efficacy). In this study, we will use only the negative emotions subscale (e.g., "overcome the frustration if others don't appreciate you as you would like"; "keep yourself calm in stressful situations"). The items were reversed in the negative meaning. The total score was computed with the mean score of the four items. Internal consistency (Cronbach's α) was 0.72.

Covid-19 related perceived stress was measured, at T2, using the Perceived Stress Scale (PSS-10; Cohen et al., 1983; Mondo et al., 2019). The scale was composed of ten items on a 5-point Likert scale from 1 ('*Never*') to 5 ('*Very often*') of which six negatively stated (e.g., "in the last month, how often have you felt upset because of something that happened unexpectedly"; "in the last month, how often have you felt angered because of things that were outside your control?") and four positively stated (e.g., "in the last month, how often have you felt confident about your ability to handle your personal problems"; "in the last month, how often have you felt dealt successfully with irritating life hassles?"). The scale was preceded by a brief explanation of what a stressful event means and that the health emergency due to COVID-19 can be defined as a stressful event. Thus, the students were asked to respond to subsequent items on how they felt in the last month, referring to Covid-19. The total PSS-10 score was computed, after reversing positive items' scores, by taking the mean over the ten items. In the present sample, CFAs showed good fit for the assessment of perceived stress scale ($\chi2(34) = 140.923$, p<.001 CFI = 0.953; TLI=.938, RMSEA = 0.074, 90% CI [0.061, 0.087]). Cronbach's alpha was used as index of internal consistency, demonstrating good reliability of the measure (α= .87).

Perceived social support was measured, at both waves (i.e., T1 and T2), using the Multidimensional Scale of Perceived Social Support (MSPSS; Zimet et al., 1988). The scale included overall twelve items with three specific dimensions that assessed the perceived social support by the family (e.g., "my family tries to help me; I can talk about my problems with my family"), by peers (e.g., "I can count on my friends when things go wrong"; "I have friends with whom I share joys and sorrows") and by a significant other (e.g., "There is a special person around when things go wrong"; "there is a special person who cares about feelings"). Each dimension was composed of four items rated on a seven-point Likert scale ranging from 1 (*'very strongly disagree'*) to 7 (*'very strongly agree'*). In this study, the "significant other" subscale was not included. A total score of family support and peer support was computed by taking the mean over the related items. A high observed total mean score means a high level of perceived social support for each dimension. The scale showed good reliability (Peer support α=0.92; Parental support α=0.91).

Non-suicidal self-injury (NSSI) was measured at both waves (i.e., T1 and T2), using six items, that assessed different types of NSSI behavior (e.g., cutting/carving, burning, hitting, scraping/picking skin to the point of bleeding, biting, inserting objects under the skin/nails) on a five-point Likert scale ranging from "never" to "10+times" (Prinstein, 2008). Participants were asked to indicate how many times in the previous year intentionally engaged in each of these behaviors, without suicidal intent. The mean over the six items was computed to have the total NSSI score. Internal consistency (Cronbach's α) ranged between 0.83 (at Time 1) and 0.85 (at Time 2) across time points.

3.3.3 Analysis plan

Analyses were carried out consistent with our preregistration (see https://osf.io/xa6vm/?viewonly =58b 2eec0376b 483ba25abf22 39f2ec26) unless differently indicated. First, we computed bivariate correlations to examine the relations between all variables considered in the study (i.e., negative emotion self-efficacy, anxiety/depression,

Covid-19 related stress, perceived social support, and NSSI). We also computed the percentages of subjects reporting NSSI at T1 and T2 to examine, among participants who completed both assessments, the prevalence of NSSI increases over time.

Second, path analyses were used to test the direct and indirect effects of individual vulnerabilities at T1 (e.g., prior history of NSSI, anxiety/depression symptoms, poor regulatory emotional self-efficacy) on level of NSSI at T2, throughout Covid-19 related perceived stress at T2. Specifically, at first, we tested a mediation model (see Figure 3.1), in which we examined the indirect effects of prior history of NSSI (modeled as a dichotomous variable), anxious/depressive symptoms, and poor regulatory emotional self-efficacy on NSSI at T2 through levels of Covid-19 related perceived stress. Then we tested the interaction between social support (i.e., peer support and parental support) and Covid-19 related stress on NSSI at T2. Notably, two separate models were estimated to examine the moderating effect of two different types of social support that were perceived peer support and perceived parental support. Assessment of significant direct and indirect effects was based on the associated 95% confidence intervals, from $k = 1,000$ bootstrap re-samples, not containing zero (Hayes & Scharkow, 2013).

To model the NSSI, we used a two-part model to deal with the non-normal distribution of NSSI. These models are often used to model variables with a large number of zero values and they allow the prediction of both the likelihood of a certain behavior to occur (e.g., NSSI) as well as the frequency of the behavior among those who report it. In two-part models, continuous data can be treated as a mixture of zero values (i.e., responses that assume a value of zero) and continuous values (i.e., other responses that have a continuous distribution) (Olsen & Schafer, 2001). Thus, given the use of two-part models, the mediation model included two different outcomes, that is, the frequency (i.e., continuous values) and the occurrence of NSSI (i.e., yes/no) at T2.

As secondary analyses, we examined the role of gender as a moderator of the relationship between a prior history of NSSI, anxious/depressive symptoms, and poor regulatory emotional self-efficacy, and NSSI at T2, through Covid-19 related stress. The gender moderation was tested with a multi-group approach, comparing the model-free estimated (e.g., without constraints across the two different groups) with a constrained model in which the different paths were equal across the groups.

3.4 Results

3.4.1 Descriptive analysis

Table 3.1 reported bivariate correlations, means, and standard deviations for all study variables. Then we computed the percentages of subjects reporting NSSI at T1 and T2 to examine, among participants who completed both assessments, if the prevalence of NSSI increases over time. From the analysis of students that participated at both time points (N=437), 143 (33.1%) reported NSSI at Time 1, while 150 (34.8%) reported NSSI at T2. We also computed the Paired Samples t-Test, comparing the means of NSSI at T1 and the NSSI at T2. The adolescents that participated at T1 and T2 (M=-.038, SD = .419) did not differ significantly on the level of NSSI, t (433) = -1.892, p = .059.

Table 3.1

Bivariate Correlations between the study variables.

	1	2	3	4	5	6	7
1.Anxiety/Depression T1	1						
2. Poor regulatory emotional self-efficacy	.52***	1					
3. Covid-19 related stress T2	.58***	.48***	1				
4. Peer support T2	-.29***	-.15***	-.31***	1			
5. Parental support T2	-.36***	-.22***	-.51***	.43***	1		
6. NSSI T1	.40***	.25***	.37***	-.24***	-.39***	1	
7. NSSI T2	.35***	.16***	.43***	-.40***	-.44***	.46***	1
Mean	.73	2.99	1.99	5.56	5.65	38.7	.08
Sd	.83	.48	.73	1.31	1.37	-	.14

Note. NSSI = non-suicidal self-injury. For NSSI T1 we reported the frequency. For NSSI T2 $\log_{10}$ values are reported. ***p <.001

3.4.2 Mediation model among pre-existing vulnerabilities and NSSI through Covid-19 related stress

Direct and indirect effects

As a first step, we tested the direct path from pre-existing vulnerabilities to NSSI without the mediation of Covid-19 related stress. As regards the occurrence of NSSI, the results showed a positive and significant effect from the prior history of NSSI (β=.446, SE=.050, p<.001) and anxious/depressive symptoms (β = .175, SE=.061, p=.004) on NSSI at T2. No significant effect was found between poor regulatory emotion self-efficacy and NSSI at T2. As regards the frequency of NSSI, the results showed a positive and significant effect of anxiety/depression on the level of NSSI at T2 (β = .318, SE=.101, p=.002). No significant effect was found between prior history of NSSI, regulatory emotion self-efficacy, and the frequency of NSSI at T2.

Then, the mediation model of the effects of pre-existing vulnerabilities on NSSI at T2 via Covid-19 related stress was tested. Figures 3.2 displays the final mediation model, and Table 3.2 displays the estimate for each path of the model. Findings showed a positive and significant effect of the previous history of NSSI (β= .158, SE=.041, p <.001), anxious/depressive symptoms (β= .395, SE=.040, p<.001), poor regulatory emotional self-efficacy (β=.243, SE=.052, p<.001) on Covid-19 related stress, which in turn was positively associated with NSSI at T2 (β=.418, SE=.063, p<.001).

As regards the indirect effects, the results showed that adolescents with pre-existing vulnerabilities were at increased risk to engage in NSSI through Covid-19 related stress (see Table 3.2). Specifically, the indirect effect of prior history of NSSI (β=.066, SE=.020, p=.001), anxious and depressive symptoms (β=.165, SE=.029, p<.001), and poor regulatory emotional self-efficacy (β=.101, SE=.029, p=.001) on the occurrence of NSSI at T2 through Covid-19 related stress resulted significant. Thus, adolescents with pre-existing vulnerabilities perceived the Covid-19 period as more stressful, and this increased the risk for NSSI. No significant indirect effects were found on the frequency of NSSI (i.e., continuous variable).

Concerning the direct effects of pre-existing vulnerabilities on the occurrence/frequency of NSSI, findings showed a positive and significant effect of a prior history of NSSI on the occurrence of NSSI at T2 ($\beta = .389$, SE = .047, p<.001) and a negative and significant effect of poor regulatory emotional self-efficacy on the occurrence of NSSI at T2 ($\beta = -.156$, SE = .065, p=.017). Besides, findings showed a positive and significant effect from anxious/depressive symptoms on the frequency of NSSI at T2 ($\beta = .238$, SE = .112, p=.034). As regards the regression coefficient of poor regulatory emotional self-efficacy, it was in the opposite direction and this could be attributed to a statistical artifice probably due to the presence of many variables in the model (e.g., suppression effect).

Perceived peer and parental support

As for the interaction effect between perceived peer support and Covid-19-related stress, we did not find a significant effect both on the presence of NSSI at T2 ($\beta = -.010$, SE = .059, p = .870) and on the frequency of NSSI at T2 ($\beta = -.054$, SE = .066, p = .416). Similar results were also found with respect to the interaction between perceived parental support and Covid-19-related stress on the presence of NSSI at T2 ($\beta = -.055$, SE = .065, p = .396) as well as on the frequency of NSSI at T2 ($\beta = .025$, SE = .080, p = .754). Therefore, given the absence of a significant interaction, we did not test the moderated mediation model.

Table 3.2

Estimate regression coefficient

Criterion	Predictors	β	SE	95% C.I.	P-Value	R²	OR	95% C.I.
NSSI T2 occurence	NSSI T1	.389***	.047	.1.399-2.288	<.001	.38	6.319**	4.051-9.856
	Anxiety/Depression	.007	.066	-.494-.556	.921		1.032	.610-1.744
	Poor regulatory emotional self-efficacy	-.156*	.065	-.742- -.125	.017		.648**	.476-.883
	Covid-19 stress T2	.418***	.063	.939-.1.704	<.001		3.750**	2.558-5.497
NSSI T2 continous	NSSI T1	.105	.101	-.111-.491	.300	.15	-	-
	Anxiety/Depression	.238*	.112	.100-.775	.034		-	-
	Poor regulatory emotional self-efficacy	-.103	.099	-.285-.065	.298		-	-
	Covid-19 stress	.185	.107	.008-.441	.083		-	-
Covid-19 stress T2	NSSI T1	.158***	.041	.135-.339	<.001	.41	-	-
	Anxiety/Depression	.395***	.040	.492-.704	<.001		-	-
	Poor regulatory emotional self-efficacy	.243***	.052	.138-.287	<.001		-	-

Figure 3.2

Mediation model among pre-existing vulnerabilities and NSSI at T2 via Covid-19 related stress
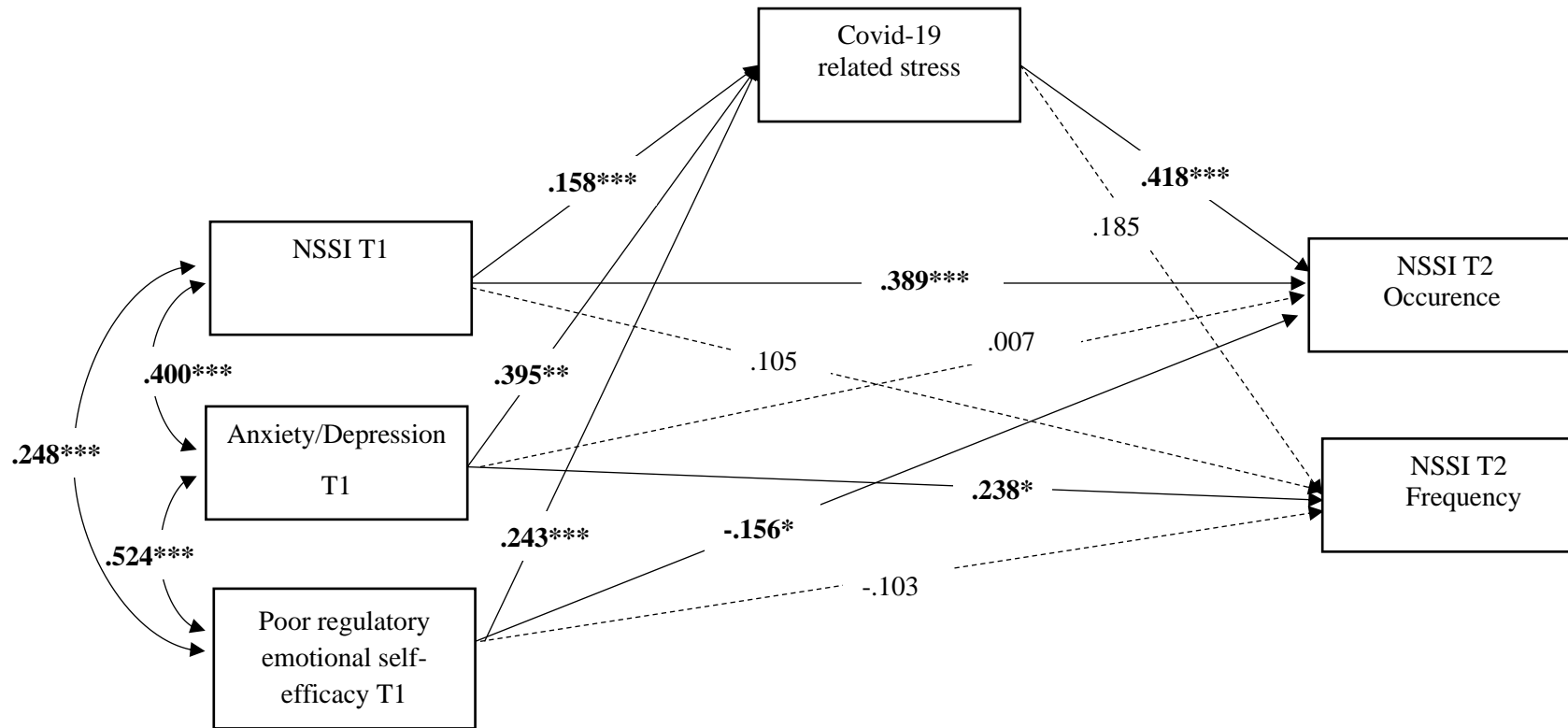
Indirect effects:

NSSI T1→ Covid-19 related stress → NSSI T2 occurrence: β=.066; p=.001; 95% CI [.035, .097]

Anxiety/Depression → Covid-19 related stress → NSSI T2 occurrence: β=.165; p<.001; 95% CI [.105, .215]

Poor regulatory emotional self-efficacy → Covid-19 related stress → NSSI T2 occurrence: β=.101; p=.001; 95% CI [.063, .140]

Gender differences

Finally, the multi-group analyses used to explore gender differences revealed that constraining the paths to be equal across gender did not worsen the model fit, indicating that the effect of pre-existing vulnerabilities on NSSI via Covid-19 related stress was similar for boys and girls, $\Delta\chi^2$ (14) = 7.430, *p*=.917.

Table 3.3

Gender moderation of the mediation model among pre-existing vulnerabilities and NSSI at T2 via Covid-19 related stress

	Model fit		Difference test		
Models	Loglikelihood	df	$\Delta\chi^2$	Δdf	p
Model 1	-3863.309	32	-	-	-
Model 2	-3855.879	46	7.43	2	.917

3.4.3 Supplementary analyses

Given the consistent number of schools that did not participate in the second survey due to the Covid-19, we decided to test the same model on the sample of schools that participated in both data collection (N=693) to examine the robustness of the analysis. The results are consistent with the previous model that included the whole sample, confirming that Covid-19 related stress mediated the association between pre-existing vulnerabilities and the occurrence of NSSI. Specifically, the indirect effects of pre-existing vulnerabilities on the occurrence of NSSI through Covid-19 related stress resulted significant (prior history of NSSI: β=.065, SE=.020, p=.001; anxious/depressive symptoms: β=.164, SE=.028, p<.001; poor regulatory negative emotional self-efficacy: β=.104, SE=.030, p<.001). For more details see sensitivity analysis in Appendix 3.

As an exploratory analysis, we conducted a three-way interaction between social support at both waves and Covid-19 related stress to explore the possible changes of social support over time (see Appendix 3). Findings did not show a significant effect both on the presence and frequency of NSSI at T2.

3.5 Discussion

Despite the large concerns about the possible influence of the Covid-19 pandemic on the increased level of engagement in NSSI, little is known about the possible changes in NSSI behaviors across the pandemic and no study examined *who* (e.g., which youth) may be at higher risk for NSSI during this period and *why*. This study contributes to the research on this topic by examining if adolescents with pre-existing vulnerabilities, including a prior history of NSSI, higher levels of internalizing symptoms, and poorer regulatory emotional self-efficacy, were more likely to show increases in NSSI across the pandemic period through higher levels of Covid-19 related stress. Moreover, we analyzed the role of social support as a buffering element for the impact of Covid-19 related stress on NSSI.

The findings suggested that the relationship between pre-existing vulnerabilities and NSSI was mediated by Covid-19 related stress. Specifically, adolescents with a prior history of NSSI, higher levels of anxiety and depressive symptoms, and poorer regulatory emotional self-efficacy showed a higher level of Covid-19 related stress, which in turn was associated with an increased risk for the occurrence of NSSI. In particular, the results showed a larger effect size of the indirect effect between anxious/depressive symptoms and NSSI through Covid-19 related stress. This could suggest that adolescents who had anxious and depressive symptoms were more prone to perceive the Covid-19 pandemic as more stressful, leading to a higher risk for NSSI. Therefore, the higher risk of being involved in NSSI after the pandemic can be identified for those adolescents high on anxious/depressive symptoms. Instead, the small effect size of the indirect effect related to the previous history of NSSI may suggest how having a previous

history of NSSI is only marginally linked to an increased risk for NSSI via Covid-19 stress. Furthermore, our results underline the important role of self-efficacy in the management of negative emotions, suggesting that adolescents who are not able to regulate and control their negative emotions are more exposed to perceive higher levels of stress during the pandemic, thus being at greater risk for NSSI. Self-efficacy is considered as a cognitive mechanism through which individuals react to stress with the perception of controllability of the event (Bandura, 1988). Thus, regulatory emotional self-efficacy represents an important component of behavior since the controllability of a stressful situation decreases when the perception of one's own ability to regulate emotion and the consequent management of the event are low (Suldo & Shaffer, 2007). Consequently, the lack of perception of one's effectiveness does not allow the use of subsequent coping behavior (Bandura, 1997), and hind the management of stressful events that in turn increase the risk of engaging in NSSI.

Overall, this study underlined the mediating role of Covid-19 related stress on the link between pre-existing vulnerabilities and NSSI one year later. Pre-existing difficulties explained who (e.g., which adolescents) were at higher risk for NSSI during the pandemic. A strong experience of stress, such as Covid-19 related stress, could exacerbate prior vulnerabilities, likely leading to difficulties to deal with intense and uncontrollable emotions, including anger, frustration, sadness (Stänicke et al., 2019). Consequently, consistent with the theoretical and empirical literature on the function of NSSI (Chapman et al., 2006a), the avoidance of negative emotion due, for example, to stressful events may have a central role in explaining the engagement in NSSI. In fact, NSSI may provide immediate relief from emotional distress in a specific moment (Armey et al., 2011), representing a maladaptive coping strategy, for example to down-regulate arising negative feelings (e.g., Liu et al., 2016).

As for the direct effect, our results showed how a prior history of NSSI was associated with the occurrence of NSSI one year later. According to the literature, this result suggests a

considerable continuity of the presence of NSSI between pre Covid-19 and during the pandemic (Steinhoff et al., 2021), highlighting that NSSI can be maintained over time (Nock, 2009). This result suggested that, despite the containments measures of Covid-19, adolescents continued to engage in NSSI since the engagement typically occurred in private situations (e.g., at home) (Steinhoff et al., 2021). Instead, as regards the direct effect between poor regulatory negative emotional self-efficacy and NSSI at T2 we found a controversial result. The significant and negative association could be explained by a suppression effect, due to the adding effect of the variables in the model. Despite this, the bivariate correlation analysis showed a positive association between poor regulatory emotional self-efficacy and NSSI. Regarding the direct effect on the frequency of NSSI, we can only find a direct association between anxiety/depression and NSSI at T2. Consistent with prior work, adolescents with more depressive symptoms tend to engage in more levels of NSSI behaviors (Marshall et al., 2013; Valencia-Agudo et al., 2018). Regarding this latter point, the use of the two-part model also gives information on the occurrence and frequency of the behavior. The findings seem to suggest that adolescents with pre-existing vulnerabilities perceive higher levels of Covid-19-related stress which in turn increases the risk of occurrence of the behavior, but not the frequency. This probably happens because the implementation of NSSI becomes a temporary strategy for managing a highly stressful situation. Besides, the results showed that only anxious and depressive symptoms are associated with higher levels of NSSI (e.g., frequency), suggesting how the presence of these symptoms leads directly to a higher frequency of NSSI behavior regardless of the perception of stress-related to Covid-19. Therefore, it is important to underline the result related to anxious and depressive symptoms, which shows that adolescents with previous anxiety/depression are more prone to engage on NSSI (i.e., occurrence) through stress due to Covid-19, while showing higher levels of NSSI (i.e., frequency) regardless of stress caused by Covid-19.

Finally, in contrast with the reference literature (Cohen & Wills, 1985; Xin et al., 2020), our findings did not support the role of social support as a stress-buffering. Both peer and parental support did not have a moderation effect on the relation between Covid-19 related stress and NSSI, suggesting that social support did not modify the effect of Covid-19 perceived stress. Yet, these findings should also be interpreted considering the exploratory analysis which explored the possible changes of social support over time. Results revealed that there is no change over time in the levels of perceived social support, highlighting how this does not buffer the effects of Covid-19 related stress at both times for the engagement on NSSI. These findings are in contrast with our hypothesis, but they could be explained in the light of the pandemic. In fact, Covid-19 has led to a restriction of social interactions, probably limiting the possibility of perceived social support. The quarantine and the social isolation have limited the social interaction, the normal activities (e.g., school, physical activities), and routines. These reasons could explain why peer social support did not represent a buffer of the stress before and during the pandemic, leading to a lower level of NSSI. At the same time also family support seems not to represent a protective factor against the development of internalizing behavior, probably for the poor or negative quality of parental support during the confinement. In fact, even if in some cases the functioning of the family may not have been affected by the pandemic, on the other hand some families may have been severely affected by the stress of the pandemic (Fontanesi et al., 2020; Griffith et al., 2020; Spinelli & Pellino, 2020), probably aggravating existing vulnerabilities. For these reasons, largely due to the situation and consequences created by Covid-19, social support probably did not represent a protective factor capable of moderating the effects of stress on the possible implementation of NSSI.

3.5.1 Strengths and limitations

The strengths of this study consisted in the use of a large sample and a multi-wave design that covered the period pre Covid-19 pandemic and a year later during the Covid-19 period

taking into consideration a specific measure of stress related to Covid-19. This allows us to examine possible changes in the level of NSSI due to the Covid-19 pandemic. Moreover, the use of the two-part model allowed us to examine the effects of pre-existing vulnerabilities and the Covid-19 related stress both on the occurrence and frequency of NSSI. Despite these strengths, the current study presents some limitations. First, the use of self-report measures for NSSI, rather than a clinical interview, did not allow us to better understand the assessed constructs, because social desirability, respondent bias, and recall bias might influence the results, leading to possible misinterpretation. Second, the study includes only two time-point when at least three-time points would be recommended. Third, there was a loss of participants across the two waves due to covid-19 situation. Finally, the study is culture-specific, and the findings cannot be generalized to other cultures.

In conclusion, the present study provides strong evidence about the role of Covid-19 in mediating the association between pre-existing difficulties and NSSI at T2, underling how more vulnerable adolescents perceive a higher level of stress in the Covid-19 period that in turn lead to a higher risk for NSSI.

3.5.2 Clinical implications

Concerning practical implications, findings suggested the importance of providing psychological and clinical support to youth who have experienced a stressful situation such as the pandemic due to Covid-19, especially in a vulnerable period as adolescence. In particular, the results of the two-part model allow us to reflect in terms of implications related to the occurrence and frequency of NSSI behavior. In this regard, the results reveal that, adolescents with pre-existing vulnerabilities, during a highly stressful period such as Covid-19, were more likely to engage in NSSI, probably as a coping strategy to deal with a stressful situation. Therefore, our findings suggested the importance of intervening, at the individual level, with those adolescents with pre-existing vulnerabilities (e.g., anxiety/depression) who have suffered

the most. Clinical intervention should attend to develop and improve coping strategy to deal with stressful experiences in a more adaptive way. Moreover, it would be important to increase the emotional regulatory self-efficacy, that plays a crucial role in the management of stressful events (Chapman et al., 2006a; Gratz & Roemer, 2008). Therefore, promoting interpersonal skills as well as coping strategies and emotional regulatory self-efficacy may be helpful to improve adaptive ways to manage stressful experiences, decreasing the likelihood to engage in maladaptive behavior as NSSI. On the other hand, the results on the frequency of NSSI revealed that adolescents with anxious and depressive symptoms showed higher levels of NSSI one year later, regardless of the perceived stress due to the Covid-19. These findings suggest the importance of providing psychological support to adolescents with anxiety and depression. For example, programs designed to increase cognitive reappraisal could be indicated to help adolescents to manage anxious and depressive symptoms to reduce the likelihood of engaging in NSSI to cope with their internalizing problems. Specifically, for example, a cognitive or dialectical behavioral therapy (DBT) may allow to focus on improving overall self-concept, and affect regulation, improving adaptive coping skills. In addition, with a view to reviving the school system and routine, it might be important to provide school support to the students, promoting the disclosure and encouraging them to seek help and support (Muehlenkamp et al., 2010).

CHAPTER 4

General discussion and conclusions

The general aim of the dissertation was to contribute to the scientific literature on Non-Suicidal Self-Injury (NSSI). Specifically, we aimed to improve knowledge about the longitudinal development of NSSI and its association with interpersonal and intrapersonal risk factors. Three studies were conducted: 1) The longitudinal development of Non-Suicidal Self-Injury, from childhood to young adulthood; 2) Reciprocal associations between peer problems and non-suicidal self-injury throughout adolescence; 3) The role of pre-existing vulnerabilities and Covid-19-related stress, in the occurrence and frequency of Non-Suicidal Self-Injury.

To date, there are no studies that have summarized quantitatively what we know about the development of NSSI (i.e., meta-analysis). The majority of studies addressed self-injury behavior at a cross-sectional level, and thus little is known about the longitudinal growth of this behavior (Glenn & Klonsky, 2011; Guerry & Prinstein, 2010; Plener et al., 2015). Thus, given the importance of increasing the longitudinal literature on NSSI, we conducted, as first study, a meta-analysis of published longitudinal studies to understand the development of NSSI from childhood to young adulthood. The aim was to examine the occurrence and frequency of NSSI over time and the role of possible factors that can moderate the development of the behavior. Results showed the role of gender and age in explaining the occurrence and the frequency/severity of NSSI over time. Besides, several methodological issues emerged from the results, providing important suggestions that lead the design of the following two studies (e.g., importance of using a longitudinal design that focus on a specific and homogeneous cohort; a robust and well-defined scale to assess NSSI; the importance of intrapersonal and interpersonal factors in explaining this behavior). So, the following two studies have been developed considering both the methodological suggestions resulting from the meta-analysis

and the theoretical models taken as a reference for this thesis such as the interpersonal models of developmental psychopathology (Rudolph et al., 2016), and the four-factor model (Nock & Prinstein, 2004). According to the developmental perspective of "individual by context" (Cicchetti, 1993; Rutter, 2014; Sameroff, 2014), we have tried to examine the role of both interpersonal and intrapersonal factors in explaining the development of the behavior over time in adolescence.

Therefore, study 2 presents a longitudinal study carried out on North American sample that covers a total of six years with six waves of data collection (i.e., about the whole adolescence), using defined scale that assesses how frequently adolescents have engaged in six different types of NSSI (e.g., cutting/carving). Specifically, this study deepens the role of interpersonal factors, examining the reciprocal associations between peer problems (i.e., peer victimization, friendship stress, and loneliness) and NSSI throughout adolescence, by distinguishing between- and within-person effects.

The third study is a new longitudinal study carried out with an Italian sample recruited few months before the Covid-19 pandemic outburst (i.e., data collection pre and post pandemic). It involves a large sample of adolescents enrolled in the 9th and 10th grade who took part in two waves of data collection. In line with the Study 2, we used the same scale that assesses how frequently adolescents engaged in six types of non-suicidal self-injurious behavior. This study investigates the role of intrapersonal and contextual factors. Specifically, it examined the role of Covid-19 related stress in the association between pre-existing vulnerabilities (i.e., a prior history of NSSI, higher levels of internalizing symptoms, and poorer regulatory emotional self-efficacy) and the engagement in NSSI (e.g., both presence and frequency) during the pandemic.

4.1 Dissertation's contribution to the literature

The present dissertation contributes in many ways to the research literature about the longitudinal development of Non-Suicidal Self-Injury.

The longitudinal development of Non-Suicidal Self-Injury

The first contribution wants to synthesize, with a meta- analytic approach, the state of art in the area (i.e., what we know in the scientific literature about the longitudinal development of NSSI behavior). Despite the fact that research on the longitudinal development of self-injury started about 10 years ago (Glenn & Klonsky, 2011; Guerry & Prinstein, 2010), to date, there are no studies that have synthetized quantitatively (i.e., meta-analysis) what we know about the development of the behavior at the longitudinal level from adolescence to young adulthood, in a community samples. For these reasons, given the strong impact and the negative consequences of this behavior on adolescents' mental health, the first contribution aimed to examine the occurrence (i.e., presence) and frequency (i.e., severity) of NSSI over time and the role of possible factors that can moderate the development of this behavior. The distinction between occurrence and frequency highlights how occurrence is reported by a large part of adolescents as a widespread phenomenon, whereas the frequency of the behavior reflects its severity and a pattern linked to a condition of greater suffering. Findings showed that mid-adolescence represents the highest risk period for occurrence (i.e., 14/15 years) and frequency (i.e., 15/16 years) of the behavior over time. Besides, study 1 underlined the importance of expanding the research on NSSI, using a longitudinal design (i.e., multiple time points) that allow to capture the development of this behavior. Additionally, the importance of focusing on a specific and homogeneous cohort that reduces the time span of participants' age is also underscored in the meta-analysis. These results guided us in the structuring of subsequent two studies. Particularly, the second study is a longitudinal study (i.e., multi-wave design) that cover a total of six years in a large sample of US students. It used a six-wave prospective design in

which a large community sample of adolescents were followed throughout adolescence from Grade 7 to 12 during the whole high school period (i.e., from 12-13 years to 17-18 years). Regarding the prevalence of this behavior over time, we can see how it is higher at the first two/third time points (i.e., 13-15 years), tending to decrease progressively during the assessments. Also, study 3 contributes on this issue with a longitudinal study (i.e., pre and post pandemic) that involve adolescents enrolled in the 9th and 10th grade in Tuscany, Italy (i.e., about 15 years-old at the baseline). Although the meta-analysis shows that the period of mid-adolescence is salient for the increase in this behavior, during the period of the pandemic, the NSSI did not increase but remained stable. This underlines how contextual factors can intervene in influencing development trajectories.

The measurement of Non-Suicidal Self-Injury

The meta-analysis contributed to the literature with some suggestions related to methodological issues such as the importance of using a well-defined measure of the construct that allows to assess the phenomenon accurately and in a reliable way (i.e., scale). We can notice how some studies included single items on the presence or absence of self-injury (i.e., binary questions; yes, vs no), while others included the assessment of frequency, types of behavior, body parts injured, along with reporting the likelihood of maintaining these behaviors (i.e., scales; Gillies et al., 2018; Swannell et al., 2014). These different types of measures could interfere with the prevalence rates across studies (Brown & Plener, 2017). As compared to a binary question, a scale may yield more accurate results because the list of items require participants to take more time to process each item (Schaeffer & Presser, 2003) and being more precise in the answers. Furthermore, the different typologies targeted in the literature do not allow comparable measurements, and in turn have implications in detecting the phenomenon accurately. Thus, study 2 and 3 aim to overcome to this issue, using a defined scale (Prinstein, 2008) that assessed how frequently, over the past year, adolescents had engaged in six different

types of non-suicidal self-injurious behavior (e.g., cutting/carving), without suicidal intent. Thanks to that, we can detect the prevalence and frequency of the phenomenon, and examine possible changes and the development over time, within a clear definition of the construct and a reference time span (i.e., the past year).

Moreover, study 1 and 3 contribute to the literature with findings related to the occurrence and frequency/severity of the behavior. Study 1 allows to examine the occurrence and the frequency of the development of NSSI and how these are moderated by age and gender. Whereas Study 3 tries to examine which types of intrapersonal mechanisms are associated to the presence or to the severity of the behavior.

The association between interpersonal factors and non-suicidal self-injury throughout adolescence

An important contribution of the present dissertation has been to deepen the role of interpersonal factors in the longitudinal development of NSSI (i.e., Study 2 and 3). Specifically, the contribution of Study 2 has been to fill the gap in the scientific literature about the reciprocal association between interpersonal problems (i.e., peer problems; peer victimization, friendship stress, and loneliness) and NSSI in adolescence. Previous work emphasized the crucial role of interpersonal risk factors (e.g., stressful life events) for the occurrence of NSSI (e.g., Baetens et al., 2011; Nock, 2010). Notably, adolescents who have experienced troubles with their peers (e.g., victimized adolescents), showed to be at greater risk of engaging in NSSI (e.g., Jutengren et al., 2011). However, while peer relationship difficulties have been identified as important predictors of NSSI development, the possibility that NSSI engagement may in turn increase adolescents' difficulties with peers has rarely been examined (You et al., 2012). Understanding whether peer problems and NSSI mutually reinforce one another over time has significant practical relevance, for example, preventing these effects from intensifying and leading to a negative vicious cycle that is difficult to break. Findings showed how at the between person

level there was an association between peer problems (i.e., friendship stress, loneliness) and NSSI, whereas at within person-level results indicated that higher-than-usual levels of NSSI predicted higher-than-usual levels of adolescents' own friendship stress, loneliness, and peer victimization at the subsequent time point.

While the second study aimed at examining the role of peer problems as a possible risk factor of NSSI, study 3 deepen the role of social support (i.e., peer and parental) as stress-buffering of the association between Covid-19 related stress and NSSI. Both peer and parental support showed a non-significant effect in moderating the impact of a stressful event such as Covid-19 pandemic on the engagement in NSSI.

The role of intrapersonal factors and negative life events in the occurrence and frequency of Non-Suicidal Self-Injury

Following the theoretical frame that guided us in structuring this dissertation, the last contribution seeks to analyze the relationship between intrapersonal factors and the presence/frequency of NSSI at a longitudinal level (Chapter 3). Prior work has highlighted the important role not only of interpersonal factors, but also of intrapersonal factors in predicting youths' engagement in NSSI (Fox et al., 2015). More in general, negative life events revealed themselves to be powerful precipitants for NSSI, especially when individuals perceive these events as particularly stressful (Liu & Miller, 2014; Madge et al., 2011). Over the past year, the Covid-19 pandemic undoubtedly represented a powerful stressful life event that affected not only public health, but also individuals' psychological health (World Health Organization, 2020a). Thus, especially during adolescence, Covid-19 could have exacerbated pre-existing psychopathology and developmental vulnerabilities, leading to higher levels of internalizing symptoms and risk behaviors (e.g., Gruber et al., 2020). This study contributes to the research on this topic by showing how adolescents with pre-existing vulnerabilities, (i.e., including a prior history of NSSI, higher levels of internalizing symptoms, and poorer regulatory emotional

self-efficacy) were more likely to show increases in the occurrence of NSSI across the pandemic period through higher levels of Covid-19 related stress. Moreover, this study has the strength to clarify this relation both on the occurrence and the frequency of NSSI thanks to the use of the two-part model.

4.2 Strengths and Limitations

The strengths and limitations of the present dissertation need to be acknowledged. As a general conclusion, the studies have the main strength of examining the longitudinal development of NSSI, by considering a series of individual (i.e., intrapersonal factors) and contextual factors (i.e., interpersonal factors). Most of the previous studies examined this behavior mainly at the cross-sectional level and little is known about the development of NSSI at the longitudinal level (e.g., Gillies et al., 2018). Nevertheless, most of the longitudinal studies showed several limitations (e.g., at methodological level) that do not allow to capture the different changes of NSSI over time. For these reasons, this dissertation contributes to the longitudinal studies on NSSI, with a meta-analytic synthesis of the literature and two longitudinal empirical studies.

Another important strength is the use of a defined and consistent scale across the studies that assessed how frequently adolescents engaged in different types of NSSI. In fact, previous studies have highlighted the importance of using well-defined measurement scales (e.g., checklist instead of binary question) both at the construct level and concerning the reference period to which it refers, in order to give an estimate of a precise phenomenon and to have comparable data (e.g., Swannell et al., 2014).

Additionally, literature have highlighted that having a sample of participants with an age range either too wide or too narrow and following it for a limited period does not allow the understanding of the development of NSSI over time (e.g., Plener et al., 2015). For this reasons, study 2 and 3 address to this limit by using a large and homogeneous sample at the age range

level, followed over time with multiple time points at regular and defined intervals. Besides in the dissertation we had the opportunity to use data from a North American longitudinal sample and data from an Italian sample.

Regarding the methodological approach, this study has the important strength of having used sophisticated, advanced, and new analysis techniques in the field of NSSI. Specifically, the use of a Bayesian approach that is widely used in health care meta-analyses (Egger et al., 2008), and is having an increasingly frequent use in recent years in the developmental psychology field (van de Schoot et al., 2013). This approach allows us to use information from previous studies (i.e., prior distribution) and to do a comparison between the models to identify the best one (i.e., prior distribution, posterior distribution). In addition to having the advantage of being the first meta-analysis investigating longitudinal development of NSSI, it is also the first one to use a Bayesian framework. In the second study, we used a type of analysis that is recent in the field of NSSI. The Random Intercept-Cross Lagged Panel Model (RI-CLPM) allowed us to differentiate between between-person and within-person associations, and to date, it offers the closest possible approximation to identify "causal effects" using observational data (Lervåg, 2020). In fact, RI-CLPMs allowed us to control for every unmeasured stable confounder that may explain the associations between peer problems and NSSI (e.g., genetic vulnerabilities), by removing the variance that is due to time-invariant between-person differences. Finally, in the third study, we used a model (i.e., two-part model) that allowed to examine both the occurrence and frequency of the behavior and could represent an important strength that may better explain the process and the dynamic of youths' engagement in NSSI.

The last important strength concerns having taken into consideration the interaction between the individual and the contextual characteristics. Following the "individual by context"

perspective (Cicchetti, 1993; Rutter, 2014; Sameroff, 2014), the dissertation focused also on the role of both individual and contextual mechanisms in the development of NSSI over time. In fact, both individual (i.e., intrapersonal) and contextual (i.e., interpersonal) factors are crucial in explaining the development of NSSI behavior over time. While the second study has a specific focus on interpersonal factors such as peer problems (i.e., peer victimization, friendship stress, and loneliness), the third study focuses more on the role of pre-existing individual vulnerabilities (e.g., internalizing symptoms). Furthermore, given the importance of the interaction between individual factors and the surrounding environment, in both studies we have tried to take this aspect into account. In fact, the second study analyzed the role of internalizing factors, such as depression, in the mutual association between peer problems and NSSI. In the third study, we considered not only the role of social support provided by parents and friends, but, above all, the reference context that characterized 2020 (i.e., Covid-19 pandemic). Moreover, this study has the important strength of having analyzed the association between pre-existing vulnerabilities, Covid-19 related stress and both the occurrence and the frequency of NSSI.

Despite these important strengths, some limitations must be acknowledged. First, the self-report assessment of NSSI may have been affected by social desirability, respondent bias, and recall bias, which may have had an influence on our results, or led to possible misinterpretation. Moreover, more in general, the studies of this dissertation have the limit of making use mainly of self-report questionnaires, instead of using multiple detection methods that can examine NSSI in a more comprehensive and exhaustive way. Thus, future works would benefit of using clinical interviews or multi-method assessments that can integrate self-report measure with methods that assess adolescents' emotional, cognitive, and physiological functioning in the short run and in the real-time.

Second, our studies (i.e., Study 2 and 3) are culture specific, and therefore do not

consider differences across countries. In fact, the cultural context, as well as participants 'cultural origins, may be important factors to be taken into consideration to understand whether they have an influence in affecting the development of the behavior over time.

Another limitation is the lack of consideration of other specific personological and contextual factors that could influence the development of NSSI over time. For example, family background factors for study 2 and pandemic contextual factors for study 3 (e.g., severity of the impact, knowledge of people who have contracted the virus). Other more specific limits are discussed directly in each chapter.

4.3 Further research directions

The present dissertation opens new directions of research investigation. A first reflection which arose from the second study, but which can also be extended to the third study, regards the time span between the first wave of assessment and the following ones. It may be useful, in future studies, to use a shorter time span between waves, instead of 12 months, which may be too long to identify within-person effects (Dormann & Griffin, 2015). In fact, some factors (e.g., interpersonal factors such as stressful peer relationships) may be temporally delimited or perhaps may constitute a more proximal trigger for the engagement in NSSI (e.g., Liu et al., 2016). Thus, NSSI may be a maladaptive way to regulate stressful situations in the short run, yet these effects are more likely observable sooner rather than one year later. We would suggest, for example, a time span of six months, to more precisely capture a snapshot of the development of NSSI over time, and to better understand the mechanisms involved.

Following the interpersonal models of developmental psychopathology (Rudolph et al., 2016), it would be important, in future studies, to further investigate into the contextual factors that are important to take into account for the development of the behavior over time. Specifically, it could be interesting to check for factors related to the different contexts in which

the individuals live, such as school, peers, family, as well as specific events that may have a crucial role in influencing the behavior. In fact, these factors, at certain moments of development, could influence a series of key mechanisms and processes for the engagement of NSSI. Specifically, regarding the school context, it would be interesting to examine the role of academic stress as a potential risk factor for engagement in NSSI. For example, vulnerabilities related to the transition from middle to high school and/or possible academic and learning difficulties could lead to frustration and consequently to difficulties in dealing with certain negative emotional states. This could therefore constitute a predisposing factor for engagement in NSSI as a coping strategy to manage the frustration and difficulties one has experienced.

Future studies are encouraged to integrate the usual questionnaire administration with other types of procedure that can assess emotional, cognitive, and physiological functioning in a very short run (i.e., hours, days). For example, the Experience Sampling Method (ESM) is one of the most reliable procedures for studying daily lives and people's experiences, activities, and feelings throughout the day (Hektner et al., 2007). ESM allows to study what people do, feel, and think during daily lives, with an "ecological" way, in "real-time" and "real-life" situations (Schiffman et al., 2008). Therefore, this type of procedure would be important to assess a series of emotional and physiological factors that are crucial for the engagement in NSSI.

Another important point that should be considered for further study is related to culture and ethnic belonging. In fact, one's origins, together with a series of other cultural factors, could influence the occurrence and the development of NSSI behavior (e.g., difference between Eastern and Western countries; collectivist vs individualist cultures).

As concerns gender differences, given the contrasting results in literature, it would be important to continue to examine the role of gender, and of being female, as risk factor for the development of NSSI over time. In fact, from the results of the meta-analysis, it is clear how

being female represent a risk factor for the engagement in NSSI (i.e., main effect), but the role of gender in the development of the behavior over time, it is already unclear. Thus, for these reasons, it would be important continue to explore the role of gender as a risk factor for the development of NSSI from early adolescence to young adulthood.

Moreover, future studies could examine the role played by the development of technologies. Adolescent's use of social media, web sites, blogs, social networks, and TV series, may influence NSSI behavior over time. In fact, a series of information and materials easily available online could lead to risky behaviors such as NSSI. In fact, if the online content is not contextualized and carefully processed with the right level of awareness, cognitive distortions may occur as a consequence. This might be exacerbated when adolescents have already experienced interpersonal or intrapersonal struggles. Besides, according to the *"dual systems model"* (Somerville et al., 2010; Steinberg, 2010), increased risk-taking during mid-adolescence may be due to a combination of heightened reactivity of the socioemotional system (i.e., reward sensitivity and immature impulse control), against a backdrop of still maturing cognitive control. With further maturation, the socioemotional system becomes less reactive, and the cognitive control system becomes more efficient. Together, these changes lead to an increase in risky behaviors, such as the engagement in NSSI during adolescence followed by a decrease in young adulthood (Strang et al., 2013).

Finally, we believe that it is important to continue investigating the development of NSSI behavior considering the consequences of the Covid-19 pandemic. In fact, it would be interesting to explore how having experienced negative stressful events (i.e., Covid-19), together with other contextual influences, could interfere with several developmental mechanisms and tasks, causing maladaptive behaviors both in the short and long run.

Finally, the results of this dissertation give important suggestions for future implications with respect to possible prevention programs. Concerning practical implications, findings

suggested the importance of intervening both at the community level and individual level. Firstly, it would be extremely important to intervene at the level of universal prevention in adolescence, given this period of vulnerability and transition. Specifically, preventive interventions should begin in early adolescence, which is the period in which individuals are most at risk of taking up this behavior. Interventions should promote interpersonal skills as well as coping strategies, emotional regulatory self-efficacy, promotion of self-esteem, all which may be helpful to improve adaptive ways to manage and to deal with stressful experiences, decreasing the likelihood of engaging in maladaptive behavior such as NSSI. As regards the specific mechanism of NSSI, in order to reduce the NSSI stigma (e.g., Piccirillo et al., 2020) and to promote opening up others (Simone & Hamza, 2020), it would be important to raise awareness of this behavior, its characteristics, motivations and functioning mechanisms (i.e., universal prevention). This could consequently help adolescents who self-injure to be more willing to disclose to others, thus limiting subsequent negative consequences. At the same time, it could also be important for uninvolved peers, in order to offer help and support to friends that engage in NSSI. Working at a universal prevention level could make it possible to reduce the possibility of engagement in risky behavior during adolescence. Besides, our findings also suggest that clinical intervention should also support adolescents who engage in NSSI (i.e., individual prevention) to prevent the development and maintenance of internalizing symptoms (e.g., depression), for example by targeting emotion regulation skills. Moreover, in general, it is important to provide specific and clinical support to adolescents with vulnerabilities (e.g., anxiety and depression symptoms), to improve their ability to deal with stressful and difficult situations, thus reducing the possibility of engaging in maladaptive behavior.

REFERENCES

Abdelraheem, M., McAloon, J., & Shand, F. (2019). Mediating and moderating variables in the prediction of self-harm in young people: A systematic review of prospective longitudinal studies. *Journal of Affective Disorders*, *246*, 14–28. https://doi.org/10.1016/j.jad.2018.12.004

Achenbach, T. M., Dumenci, L., & Rescorla, L. A. (2001). Ratings of relations between DSM-IV diagnostic categories and items of the CBCL/6-18, TRF, and YSR. *Burlington, VT: University of Vermont*, 1–9.

Alonso-Stuyck, P., Zacarés, J. J., & Ferreres, A. (2018). Emotional separation, autonomy in decision-making, and psychosocial adjustment in adolescence: A proposed typology. *Journal of Child and Family Studies*, *27*(5), 1373–1383. https://doi.org/10.1007/s10826-017-0980-5

Ammerman, B. A., Jacobucci, R., Kleiman, E. M., Uyeji, L. L., & McCloskey, M. S. (2018). The relationship between nonsuicidal self-injury age of onset and severity of self-harm. *Suicide and Life-Threatening Behavior*, *48*(1), 31-37. https://doi.org/10.1111/sltb.12330

Andover, M. S. (2014). Non-suicidal self-injury disorder in a community sample of adults. *Psychiatry research*, *219*(2), 305–310. https://doi.org/10.1016/j.psychres.2014.06.001

Andrews, T., Martin, G., Hasking, P., & Page, A. (2013). Predictors of continuation and cessation of nonsuicidal self-injury. *Journal of Adolescent Health*, *53*(1), 40-46. https://doi.org/10.1016/j.jadohealth.2013.01.009

Angold, A., Costello, E. J., Pickles, A., Winder, F., & Silver, D. (1987). The development of a questionnaire for use in epidemiological studies of depression in children and adolescents. *Unpublished manuscript, London University*.

Armey, M. F., Crowther, J. H., & Miller, I. W. (2011). Changes in ecological momentary assessment reported affect associated with episodes of nonsuicidal self-injury. *Behavior therapy*, *42*(4), 579–588. https://doi.org/10.1016/j.beth.2011.01.002

Asparouhov, T., & Muthén, B. (2010). Weighted least squares estimation with missing data. *Mplus Technical Appendix*, *2010*, 1–10.

Asparouhov, T., Muthén, B., & Muthén, B. O. (2006). Robust chi square difference testing with mean and variance adjusted test statistics. *matrix*, *1*(5), 1–6.

Baetens, I., Claes, L., Muehlenkamp, J., Grietens, H., & Onghena, P. (2011). Non-suicidal and suicidal self-injurious behavior among Flemish adolescents: A web-survey. *Archives of Suicide Research*, *15*(1), 56–67. https://doi.org/10.1080/13811118.2011.540467

Baetens, I., Claes, L., Onghena, P., Grietens, H., Van Leeuwen, K., Pieters, C., Wiersema, J. R., & Griffith, J. W. (2014). Non-suicidal self-injury in adolescence: A longitudinal study of the relationship between NSSI, psychological distress and perceived parenting. *Journal of Adolescence*, *37*(6), 817–826. https://doi.org/10.1016/j.adolescence.2014.05.010

Baetens, I., Claes, L., Onghena, P., Grietens, H., Van Leeuwen, K., Pieters, C., Wiersema, J. R., & Griffith, J. W. (2015). The effects of nonsuicidal self-injury on parenting behaviors: A longitudinal analyses of the perspective of the parent. *Child and Adolescent Psychiatry and Mental Health*, *9*(1). https://doi.org/10.1186/s13034-015-0059-2

Bjärehed, J., Wångby-Lundh, M., & Lundh, L. G. (2012). Nonsuicidal self-injury in a community sample of adolescents: Subgroups, stability, and associations with psychological difficulties. *Journal of Research on Adolescence*, *22*(4), 678-693. https://doi.org/10.1111/j.1532-7795.2012.00817.x

Bandura, A. (1988). Self-efficacy conception of anxiety. *Anxiety research*, *1*(2), 77–98. https://doi.org/10.1080/10615808808248222

Bandura, A. (1997). The anatomy of stages of change. *American journal of health promotion: AJHP*, *12*(1), 8–10. https://doi.org/10.4278/0890-1171-12.1.8

Barrocas, A. L., Giletta, M., Hankin, B. L., Prinstein, M. J., & Abela, J. R. (2015). Nonsuicidal self-injury in adolescence: Longitudinal course, trajectories, and intrapersonal predictors. *Journal of Abnormal Child Psychology*, *43*(2), 369-380. https://doi.org/10.1007/s10802-014-9895-4

Bentley, K. H., Cassiello-Robbins, C. F., Vittorio, L., Sauer-Zavala, S., & Barlow, D. H. (2015). The association between nonsuicidal self-injury and the emotional disorders: A meta-analytic review. *Clinical psychology review*, *37*, 72–88. https://doi.org/10.1016/j.cpr.2015.02.006

Bentley, K. H., Nock, M. K., & Barlow, D. H. (2014). The four-function model of nonsuicidal self-injury: Key directions for future research. *Clinical Psychological Science*, *2*(5), 638–656. https://doi.org/10.1177/2167702613514563

Blakemore, S.-J., & Mills, K. L. (2014). Is adolescence a sensitive period for sociocultural processing? *Annual review of psychology*, *65*, 187–207. https://doi.org/10.1146/annurev-psych-010213-115202

Bollen, K. A. (1989). A new incremental fit index for general structural equation models. *Sociological methods & research*, *17*(3), 303–316. https://doi.org/10.1177/0049124189017003004

Bollen, K. A., & Curran, P. J. (2006). *Latent curve models: A structural equation perspective* (Vol. 467). John Wiley & Sons.

Branje, S., & Morris, A. S. (2021). The Impact of the COVID-19 Pandemic on Adolescent Emotional, Social, and Academic Adjustment. *Journal of Research on Adolescence*, *31*(3), 486–499. https://doi.org/ 10.1111/jora.12668.

Brausch, A. M., & Gutierrez, P. M. (2010). Differences in non-suicidal self-injury and suicide attempts in adolescents. *Journal of youth and adolescence*, *39*(3), 233–242. https://doi.org/10.1007/s10964-009-9482-0.

Bresin, K., & Schoenleber, M. (2015). Gender differences in the prevalence of nonsuicidal self-injury: A meta-analysis. *Clinical psychology review*, *38*, 55–64. https://doi.org/ 10.1016/j.cpr.2015.02.009

Brown, R. C., & Plener, P. L. (2017). Non-suicidal Self-Injury in Adolescence. *Current Psychiatry Reports*, *19*(3), Article 3. https://doi.org/10.1007/s11920-017-0767-9

Buelens, T., Luyckx, K., Gandhi, A., Kiekens, G., & Claes, L. (2019). Non-Suicidal Self-Injury in Adolescence: Longitudinal Associations with Psychological Distress and Rumination. *Journal of Abnormal Child Psychology*, *47*(9), 1569–1581. https://doi.org/10.1007/s10802-019-00531-8

Burke, T. A., Piccirillo, M. L., Moore-Berg, S. L., Alloy, L. B., & Heimberg, R. G. (2019). The stigmatization of nonsuicidal self-injury. *Journal of clinical psychology*, *75*(3), 481–498. https://doi.org/10.1002/jclp.22713

Burke, T. A., Stange, J. P., Hamilton, J. L., Cohen, J. N., O'Garro-Moore, J., Daryanani, I., Abramson, L. Y., & Alloy, L. B. (2015). Cognitive and Emotion-Regulatory Mediators of the Relationship between Behavioral Approach System Sensitivity and Nonsuicidal Self-Injury Frequency. *Suicide and Life-Threatening Behavior*, *45*(4), 495–504. https://doi.org/10.1111/sltb.12145

Bürkner, P. C. (2017). brms: An R package for Bayesian multilevel models using Stan. *Journal of statistical software*, *80*(1), 1-28. https://doi.org/10.18637/jss.v080.i01

Butler, A. M., & Malone, K. (2013). Attempted suicide v. non-suicidal self-injury: behaviour, syndrome or diagnosis?. *The British Journal of Psychiatry*, *202*(5), 324-325. https://doi.org/10.1192/bjp.bp.112.113506

Calvete, E., Orue, I., & Sampedro, A. (2017). Does the acting with awareness trait of mindfulness buffer the predictive association between stressors and psychological symptoms in adolescents?. *Personality and individual differences*, *105*, 158-163. https://doi.org/10.1016/j.paid.2016.09.055

Caprara, G. V., Di Giunta, L., Eisenberg, N., Gerbino, M., Pastorelli, C., & Tramontano, C. (2008). Assessing regulatory emotional self-efficacy in three countries. *Psychological Assessment*, *20*(3), 227–237. https://doi.org/10.1037/1040-3590.20.3.227

Caprara, G. V., & Gerbino, M. (2001). Autoefficacia emotiva: La capacità di regolare l'affettività negativa e di esprimere quella positiva [Emotional self-efficacy: The ability to regulate negative affect and to express the positive one]. *GV Caprara (a cura di), La valutazione dell'autoefficacia [The evaluation of self-efficacy], Trento, Erickson*. https://doi.org/ 10.1449/81775

Cassels, M., Baetens, I., Wilkinson, P., Hoppenbrouwers, K., Wiersema, J. R., Van Leeuwen, K., & Kiekens, G. (2019). Attachment and non-suicidal self-injury among young adolescents: The indirect role of behavioral problems. *Archives of suicide research*, *23*(4), 688-696. https://doi.org/10.1080/13811118.2018.1494651

Cassidy, J., & Asher, S. R. (1992). Loneliness and peer relations in young children. *Child development*, *63*(2), 350–365. https://doi.org/10.1111/j.1467-8624.1992.tb01632.x

Castellvi, P., Miranda-Mendizabal, A., Pares-Badell, O., Almenara, J., Alonso, I, Blasco, M. J., Cebria, A., Gabilondo, A., Gili, M., Lagares, C., Piqueras, J. A., Roca, M., Rodriguez-Marin, J., Rodriguez-Jimenez, T., Soto-Sanz, V., & Alonso, J. (2017). Exposure to violence, a risk for suicide in youths and young adults. A meta-analysis of

longitudinal studies. *Acta Psychiatrica Scandinavica*, *135*(3), 195–211. https://doi.org/10.1111/acps.12679

Chapman, A. L., Gratz, K. L., & Brown, M. Z. (2006a). Solving the puzzle of deliberate self-harm: The experiential avoidance model. *Behaviour research and therapy*, *44*(3), 371–394. https://doi.org/10.1016/j.brat.2005.03.005

Chapman, A. L., Gratz, K. L., & Brown, M. Z. (2006b). Solving the puzzle of deliberate self-harm: The experiential avoidance model. *Behaviour Research and Therapy*, *44*(3), 371–394. https://org.doi/10.1016/j.brat.2005.03.005

Cheek, S. M., Reiter-Lavery, T., & Goldston, D. B. (2020). Social rejection, popularity, peer victimization, and self-injurious thoughts and behaviors among adolescents: A systematic review and meta-analysis. *Clinical Psychology Review*, 101936. https://doi.org/10.1016/j.cpr.2020.101936

Chiodo, D., Wolfe, D. A., Crooks, C., Hughes, R., & Jaffe, P. (2009). Impact of sexual harassment victimization by peers on subsequent adolescent victimization and adjustment: A longitudinal study. *Journal of Adolescent Health*, *45*(3), 246-252. https://doi.org/10.1016/j.jadohealth.2009.01.006

Cicchetti, D. (1993). Developmental psychopathology: Reactions, reflections, projections. *Developmental review*, *13*(4), 471–502. https://doi.org/10.1006/drev.1993.1021

Cohen, S., Kamarck, T., & Mermelstein, R. (1983). A global measure of perceived stress. *Journal of health and social behavior*, 385–396.

Cohen, S., & Wills, T. A. (1985). Stress, social support, and the buffering hypothesis. *Psychological bulletin*, *98*(2), 310. https://doi.org/10.1037/0033-2909.98.2.310

Daly, O., & Willoughby, T. (2019). A longitudinal study investigating bidirectionality among nonsuicidal self-injury, self-criticism, and parental criticism. *Psychiatry research*, *271*, 678-683. https://doi.org/10.1016/j.psychres.2018.12.056

Daukantaitė, D., Lundh, L. G., & Wångby-Lundh, M. (2019). Association of direct and indirect aggression and victimization with self-harm in young adolescents: A person-oriented approach. *Development and psychopathology*, *31*(2), 727-739. https://doi.org/10.1017/S0954579418000433

Daukantaitė, D., Lundh, L.-G., Wångby-Lundh, M., Claréus, B., Bjärehed, J., Zhou, Y., & Liljedahl, S. I. (2020). What happens to young adults who have engaged in self-injurious behavior as adolescents? A 10-year follow-up. *European Child and Adolescent Psychiatry,* 30, 475–492. https://doi.org/10.1007/s00787-020-01533-4

de Oliveira Costa, R. P., Peixoto, A. L. R. P., Lucas, C. C. A., Falcão, D. N., da Silva Farias, J. T., Viana, L. F. P., de Alencar Pereira, M. A., Sandes, M. L. B., Lopes, T. B., & Mousinho, K. C. (2020). Profile of non-suicidal self-injury in adolescents: Interface with impulsiveness and loneliness. *Jornal de pediatria,* 97(2), 184-190. https://doi.org/10.1016/j.jped.2020.01.006

Dormann, C., & Griffin, M. A. (2015). Optimal time lags in panel studies. *Psychological methods*, *20*(4), 489. https://doi.org/10.1037/met0000041

Duggan, J., Heath, N. & Hu, T. (2015). Non-suicidal self-injury maintenance and cessation among adolescents: a one-year longitudinal investigation of the role of objectified body consciousness, depression and emotion dysregulation. *Child Adolesc Psychiatry Ment Health* 9, 21. https://doi.org/10.1186/s13034-015-0052-9

Egger, M., Davey-Smith, G., & Altman, D. (2008). *Systematic reviews in health care: Meta-analysis in context*. John Wiley & Sons.

Eisner, M., & Nivette, A. (2020). Violence and the pandemic: Urgent questions for research. *New York: Harry Frank Guggenheim Foundation*.

Ellis, W. E., Dumas, T. M., & Forbes, L. M. (2020). Physically isolated but socially connected: Psychological adjustment and stress among adolescents during the initial COVID-19

crisis. *Canadian Journal of Behavioural Science/Revue canadienne des sciences du comportement*, *52*(3), 177. https://doi.org/10.1037/cbs0000215

Emery, A. A., Heath, N. L., & Mills, D. J. (2017). The role of basic need satisfaction in the onset, maintenance, and cessation of non-suicidal self-injury: an application of self-determination theory. *Archives of Suicide Research*, *21*(3), 413-424. https://doi.org/10.1080/13811118.2016.1211043

Esposito, C., Bacchini, D., & Affuso, G. (2019). Adolescent non-suicidal self-injury and its relationships with school bullying and peer rejection. *Psychiatry research*, *274*, 1-6. https://doi.org/10.1016/j.psychres.2019.02.018

Ewing, L., Hamza, C. A., & Willoughby, T. (2019). Stressful Experiences, Emotion Dysregulation, and Nonsuicidal Self-Injury among University Students. *Journal of Youth and Adolescence*, *48*(7), 1379–1389. https://doi.org/10.1007/s10964-019-01025-y

Favazza, A. R., & Conterio, K. (1988). The plight of chronic self-mutilators. *Community Mental Health Journal*, *24*(1), 22–30. https://doi.org/ 10.1007/BF00755050

Fisher, H. L., Moffitt, T. E., Houts, R. M., Belsky, D. W., Arseneault, L., & Caspi, A. (2012). Bullying victimisation and risk of self harm in early adolescence: Longitudinal cohort study. *BMJ (Online)*, *344*(7855). https://doi.org/10.1136/bmj.e2683

Fontanesi, L., Marchetti, D., Mazza, C., Di Giandomenico, S., Roma, P., & Verrocchio, M. C. (2020). The effect of the COVID-19 lockdown on parents: A call to adopt urgent measures. *Psychological Trauma: Theory, Research, Practice, and Policy*, *12*(S1), S79. https://doi.org/ 10.1037/tra0000672

Fox, K. R., Franklin, J. C., Ribeiro, J. D., Kleiman, E. M., Bentley, K. H., & Nock, M. K. (2015). Meta-analysis of risk factors for nonsuicidal self-injury. *Clinical Psychology Review*, *42*, 156–167. https://doi.org/10.1016/j.cpr.2015.09.002

Fuhrmann, D., Knoll, L. J., & Blakemore, S.-J. (2015). Adolescence as a sensitive period of brain development. *Trends in cognitive sciences*, *19*(10), 558–566. https://doi.org/10.1016/j.tics.2015.07.008

Furman, W., & Rose, A. J. (2015). Friendships, romantic relationships, and peer relationships. *Handbook of child psychology and developmental science*, 1–43. https://doi.org/10.1002/9781118963418.childpsy322

Gandhi, A., Luyckx, K., Goossens, L., Maitra, S., & Claes, L. (2018). Association between Non-Suicidal Self-Injury, Parents and Peers Related Loneliness, and Attitude Towards Aloneness in Flemish Adolescents: An Empirical Note. *Psychologica Belgica*, *58*(1), 3–12. https://doi.org/10.5334/pb.385

Gandhi, A., Luyckx, K., Maitra, S., Kiekens, G., Verschueren, M., & Claes, L. (2017). Directionality of effects between non-suicidal self-injury and identity formation: A prospective study in adolescents. *Personality and Individual Differences*, *109*, 124-129. https://doi.org/10.1016/j.paid.2017.01.003

Gandhi, A., Luyckx, K., Molenberghs, G., Baetens, I., Goossens, L., Maitra, S., & Claes, L. (2019). Maternal and peer attachment, identity formation, and non-suicidal self-injury: a longitudinal mediation study. *Child and adolescent psychiatry and mental health*, *13*(1), 1-11. https://doi.org/10.1186/s13034-019-0267-2

Garisch, J. A., & Wilson, M. S. (2015). Prevalence, correlates, and prospective predictors of non-suicidal self-injury among New Zealand adolescents: Cross-sectional and longitudinal survey data. *Child and Adolescent Psychiatry and Mental Health*, *9*(1). https://doi.org/10.1186/s13034-015-0055-6

Gelman, A., Goodrich, B., Gabry, J., & Vehtari, A. (2019). R-squared for Bayesian regression models. *The American Statistician*. https://doi.org/10.1080/00031305.2018.1549100

Giletta, M., Burk, W. J., Scholte, R. H. J., Engels, R. C. M. E., & Prinstein, M. J. (2013). Direct and Indirect Peer Socialization of Adolescent Nonsuicidal Self-Injury. *Journal of Research on Adolescence*, *23*(3), 450–463. https://doi.org/10.1111/jora.12036

Giletta, M., Prinstein, M. J., Abela, J. R. Z., Gibb, B. E., Barrocas, A. L., & Hankin, B. L. (2015). Trajectories of suicide ideation and nonsuicidal self-injury among adolescents in Mainland China: Peer predictors, joint development, and risk for suicide attempts. *Journal of Consulting and Clinical Psychology*, *83*(2), 265–279. https://doi.org/10.1037/a0038652

Giletta, M., Scholte, R. H. J., Engels, R. C. M. E., Ciairano, S., & Prinstein, M. J. (2012). Adolescent non-suicidal self-injury: A cross-national study of community samples from Italy, the Netherlands and the United States. *Psychiatry Research*, *197*(1–2), 66–72. https://doi.org/10.1016/j.psychres.2012.02.009

Gillies, D., Christou, M. A., Dixon, A. C., Featherston, O. J., Rapti, I., Garcia-Anguita, A., Villasis-Keever, M., Reebye, P., Christou, E., & Al Kabir, N. (2018). Prevalence and characteristics of self-harm in adolescents: Meta-analyses of community-based studies 1990–2015. *Journal of the American Academy of Child & Adolescent Psychiatry*, *57*(10), 733–741. https://doi.org/10.1016/j.jaac.2018.06.018

Glenn, C. R., & Klonsky, E. D. (2011). One-year test-retest reliability of the inventory of statements about self-injury (ISAS). *Assessment*, *18*(3), 375–378. https://doi.org/10.1177/1073191111411669

Glenn, C. R., Kleiman, E. M., Cha, C. B., Nock, M. K., & Prinstein, M. J. (2016). Implicit cognition about self-injury predicts actual self-injurious behavior: Results from a longitudinal study of adolescents. *Journal of Child Psychology and Psychiatry*, *57*(7), 805-813. https://doi.org/10.1111/jcpp.12500

Good, M., Hamza, C., & Willoughby, T. (2017). A longitudinal investigation of the relation between nonsuicidal self-injury and spirituality/religiosity. *Psychiatry research*, *250*, 106-112. https://doi.org/10.1016/j.psychres.2017.01.062

Goossens, L., Lasgaard, M., Luyckx, K., Vanhalst, J., Mathias, S., & Masy, E. (2009). Loneliness and solitude in adolescence: A confirmatory factor analysis of alternative models. *Personality and Individual Differences*, *47*(8), 890–894. https://doi.org/10.1016/j.paid.2009.07.011

Gratz, K., Conrad, S. D., & Roemer, L. (2002). Risk factors for deliberate selfharm among college students. *American Journal of Orthopsychiatry, 72,* 128–140. https://doi.org/10.1037/0002-9432.72.1.128

Gratz, K. L., & Roemer, L. (2008). The relationship between emotion dysregulation and deliberate self-harm among female undergraduate students at an urban commuter university. *Cognitive behaviour therapy*, *37*(1), 14–25. https://doi.org/10.1080/16506070701819524

Griffith, G. J., Morris, T. T., Tudball, M. J., Herbert, A., Mancano, G., Pike, L., Sharp, G. C., Sterne, J., Palmer, T. M., & Smith, G. D. (2020). Collider bias undermines our understanding of COVID-19 disease risk and severity. *Nature communications*, *11*(1), 1–12. https://doi.org/10.1038/s41467-020-19478-2

Gross, J. J. (1998). The emerging field of emotion regulation: An integrative review. *Review of general psychology*, *2*(3), 271–299. https://doi.org/10.1037/1089-2680.2.3.271

Grotpeter, J. K., & Crick, N. R. (1996). Relational aggression, overt aggression, and friendship. *Child development*, *67*(5), 2328–2338. https://doi.org/10.1111/j.1467-8624.1996.tb01860.x

Gruber, J., Prinstein, M. J., Clark, L. A., Rottenberg, J., Abramowitz, J. S., Albano, A. M., Aldao, A., Borelli, J. L., Chung, T., Davila, J., Forbes, E. E., Gee, D. G., Hall, G. C. N.,

Hallion, L. S., Hinshaw, S. P., Hofmann, S. G., Hollon, S. D., Joormann, J., Kazdin, A. E., … Weinstock, L. M. (2020). Mental health and clinical psychological science in the time of COVID-19: Challenges, opportunities, and a call to action. *American Psychologist,* 76(3), 409-426. https://doi.org/10.1037/amp0000707

Guerry, J. D., & Prinstein, M. J. (2010). Longitudinal prediction of adolescent nonsuicidal self-injury: Examination of a cognitive vulnerability-stress model. *Journal of Clinical Child and Adolescent Psychology*, *39*(1), 77–89. https://doi.org/10.1080/15374410903401195

Hackett, G., & Betz, N. E. (1995). Self-efficacy and career choice and development. In *Self-efficacy, adaptation, and adjustment* (pagg. 249–280). https://doi.org/10.1017/CBO9780511527692.010

Hamaker, E. L., Kuiper, R. M., & Grasman, R. P. (2015). A critique of the cross-lagged panel model. *Psychological methods*, *20*(1), 102. https://doi.org/10.1186/s13034-015-0055-6

Hammen, C. (1991). Generation of stress in the course of unipolar depression. *Journal of abnormal psychology*, *100*(4), 555. https://doi.org/10.1037/0021-843X.100.4.555

Hamza, C. A., & Willoughby, T. (2014). A longitudinal person-centered examination of nonsuicidal self-injury among university students. *Journal of Youth and Adolescence*, *43*(4), 671-685. https://doi.org/10.1007/s10964-013-9991-8

Hanania, J. W., Heath, N. L., Emery, A. A., Toste, J. R., & Daoud, F. A. (2015). Non-suicidal self-injury among adolescents in Amman, Jordan. *Archives of suicide research*, *19*(2), 260–274. https://doi.org/ 10.1080/13811118.2014.915778

Hankin, B. L., & Abela, J. R. Z. (2011). Nonsuicidal self-injury in adolescence: Prospective rates and risk factors in a 2 1/2 year longitudinal study. *Psychiatry Research*, *186*(1), 65–70. https://org.doi/10.1016/j.psychres.2010.07.056

Hasking, P., Momeni, R., Swannell, S., & Chia, S. (2008). The nature and extent of non-suicidal self-injury in a non-clinical sample of young adults. *Archives of suicide research*, *12*(3), 208–218. https://doi.org/ 10.1080/13811110802100957

Hasking, P., Andrews, T., & Martin, G. (2013). The role of exposure to self-injury among peers in predicting later self-injury. *Journal of youth and adolescence*, *42*(10), 1543-1556. https://doi.org/ 10.1007/s10964-013-9931-7

Hasking, P., Rees, C. S., Martin, G., & Quigley, J. (2015). What happens when you tell someone you self-injure? The effects of disclosing NSSI to adults and peers. *BMC Public Health*, *15*(1). https://doi.org/10.1186/s12889-015-2383-0

Havighurst, R. J. (1948). *Developmental tasks and education.* University of Chicago Press.

Hayes, A. F., & Scharkow, M. (2013). The relative trustworthiness of inferential tests of the indirect effect in statistical mediation analysis: Does method really matter? *Psychological science*, *24*(10), 1918–1927.https://doi.org/ 10.1177/0956797613480187

Heath, N. L., Schaub, K., Holly, S., & Nixon, M. K. (2008). Self-injury today: Review of population and clinical studies in adolescents. *Self-injury in youth*, 28–46. https://doi.org/ 10.4324/9780203892671

Heath, N., Toste, J., Nedecheva, T., & Charlebois, A. (2008). An examination of nonsuicidal self-injury among college students. *Journal of mental health counseling*, *30*(2), 137-156. https://doi.org/10.17744/mehc.30.2.8p879p3443514678

Heffer, T., & Willoughby, T. (2018). The role of emotion dysregulation: A longitudinal investigation of the interpersonal theory of suicide. *Psychiatry Research*, *260*, 379-383. https://doi.org/10.1016/j.psychres.2017.11.075

Heilbron, N., & Prinstein, M. J. (2010). Adolescent peer victimization, peer status, suicidal ideation, and nonsuicidal self-injury examining concurrent and longitudinal

associations. *Merrill-Palmer Quarterly*, *56*(3), 388–419. https://doi.org/10.1353/mpq.0.0049

Helms, S. W., Gallagher, M., Calhoun, C. D., Choukas-Bradley, S., Dawson, G. C., & Prinstein, M. J. (2015). Intrinsic religiosity buffers the longitudinal effects of peer victimization on adolescent depressive symptoms. *Journal of Clinical Child & Adolescent Psychology*, *44*(3), 471–479. https://doi.org/ 10.1080/15374416.2013.865195

Hektner, J.M., Schmidt, J.A., Csikszentmihalyi, M. (2007). Experience sampling method: measuring the quality of everyday life. Thousand Oaks, CA: Sage Publications.

Hielscher, E., DeVylder, J., Hasking, P., Connell, M., Martin, G., & Scott, J. G. (2021). Mediators of the association between psychotic experiences and future non-suicidal self-injury and suicide attempts: results from a three-wave, prospective adolescent cohort study. *European Child & Adolescent Psychiatry*, *30*(9), 1351-1365. https://doi.org/10.1007/s00787-020-01593-6

Hilt, L. M., Nock, M. K., Lloyd-Richardson, E. E., & Prinstein, M. J. (2008). Longitudinal study of nonsuicidal self-injury among young adolescents: Rates, correlates, and preliminary test of an interpersonal model. *Journal of Early Adolescence*, *28*(3), 455–469. https://doi.org/10.1177/0272431608316604

Hu, L., & Bentler, P. M. (1998). Fit indices in covariance structure modeling: Sensitivity to underparameterized model misspecification. *Psychological methods*, *3*(4), 424. https://doi.org/10.1037/1082-989X.3.4.424

Jacobson, C. M., & Gould, M. (2007). The epidemiology and phenomenology of non-suicidal self-injurious behavior among adolescents: A critical review of the literature. *Archives of Suicide Research*, *11*(2), 129–147. https://doi.org/ 10.1080/13811110701247602

Jarvi, S., Jackson, B., Swenson, L., & Crawford, H. (2013). The impact of social contagion on non-suicidal self-injury: A review of the literature. *Archives of Suicide Research*, *17*(1), 1–19. https://doi.org/ 10.1080/13811118.2013.748404

Jiang, Y., You, J., Hou, Y., Du, C., Lin, M.-P., Zheng, X., & Ma, C. (2016). Buffering the effects of peer victimization on adolescent non-suicidal self-injury: The role of self-compassion and family cohesion. *Journal of Adolescence*, *53*, 107–115. https://doi.org/10.1016/j.adolescence.2016.09.005

Jutengren, G., Kerr, M., & Stattin, H. (2011). Adolescents' deliberate self-harm, interpersonal stress, and the moderating effects of self-regulation: A two-wave longitudinal analysis. *Journal of School Psychology*, *49*(2), 249–264. https://doi.org/10.1016/j.jsp.2010.11.001

Kang, N., Jiang, Y., Ren, Y., Gong, T., Liu, X., Leung, F., & You, J. (2018). Distress intolerance mediates the relationship between child maltreatment and nonsuicidal self-injury among Chinese adolescents: A three-wave longitudinal study. *Journal of youth and adolescence*, *47*(10), 2220-2230. https://doi.org/10.1007/s10964-018-0877-7

Kessler, R. C., Berglund, P., Borges, G., Nock, M., & Wang, P. S. (2005). Trends in suicide ideation, plans, gestures, and attempts in the United States, 1990-1992 to 2001-2003. *Jama*, *293*(20), 2487–2495. https://doi.org/ 10.1001/jama.293.20.2487

Kessler, R. C., Borges, G., & Walters, E. E. (1999). Prevalence of and risk factors for lifetime suicide attempts in the National Comorbidity Survey. *Archives of general psychiatry*, *56*(7), 617–626. https://doi.org/ 10.1001/archpsyc.56.7.617

Kiekens, G., Hasking, P., Boyes, M., Claes, L., Mortier, P., Auerbach, R. P., Cuijpers, P., Demyttenaere, K., Green, J. G., & Kessler, R. C. (2018). The associations between non-suicidal self-injury and first onset suicidal thoughts and behaviors. *Journal of affective disorders*, *239*, 171–179. https://doi.org/10.1016/j.jad.2018.06.033

Klonsky, E. D. (2011). Non-suicidal self-injury in United States adults: Prevalence, sociodemographics, topography and functions. *Psychological medicine*, *41*(9), 1981. https://doi.org/10.1017/S0033291710002497

Klonsky, E. D., & Muehlenkamp, J. J. (2007). Self-injury: A research review for the practitioner. *Journal of clinical psychology*, *63*(11), 1045–1056. https://doi.org/10.1002/jclp.20412

Kmet, L. M., Cook, L. S., & Lee, R. C. (2004). *Standard quality assessment criteria for evaluating primary research papers from a variety of fields*. Edmonton: Alberta Heritage Foundation for Medical Research (AHFMR).

Kochel, K. P., Ladd, G. W., & Rudolph, K. D. (2012). Longitudinal associations among youth depressive symptoms, peer victimization, and low peer acceptance: An interpersonal process perspective. *Child development*, *83*(2), 637–650. https://doi.org/10.1111/j.1467-8624.2011.01722.x

Kroger, J., & Marcia, J. E. (2011). The identity statuses: Origins, meanings, and interpretations. In *Handbook of identity theory and research* (pagg. 31–53).

Ladd, G. W., & Burgess, K. B. (1999). Charting the relationship trajectories of aggressive, withdrawn, and aggressive/withdrawn children during early grade school. *Child Development*, *70*(4), 910-929. https://doi.org/10.1111/1467-8624.00066

Lasgaard, M., Goossens, L., Bramsen, R. H., Trillingsgaard, T., & Elklit, A. (2011). Different sources of loneliness are associated with different forms of psychopathology in adolescence. *Journal of Research in Personality*, *45*(2), 233–237. https://doi.org/10.1016/j.jrp.2010.12.005

Latina, D., Bauducco, S., & Tilton-Weaver, L. (2021). Insomnia symptoms and non-suicidal self-injury in adolescence: understanding temporal relations and mechanisms. *Journal of sleep research*, *30*(1), e13190. https://doi.org/10.1111/jsr.13190

Laye-Gindhu, A., & Schonert-Reichl, K. A. (2005). Nonsuicidal self-harm among community adolescents: Understanding the «whats» and «whys» of self-harm. *Journal of Youth and Adolescence*, *34*(5), 447–457. https://doi.org/10.1007/s10964-005-7262-z

Lervåg, A. (2020). *Some roads less travelled—Different routes to understanding the causes of child psychopathology*. Wiley Online Library.

Lionetti, F., Spinelli, M., Moscardino, U., Ponzetti, S., Garito, M., C., Dellagiulia, A., Aureli, T., Fasolo, M., & Pluess, M., (under review). The Interplay Between Parenting and Environmental Sensitivity in the Prediction of Children's Externalizing and Internalizing Behaviors During COVID-19, *Developmental Psychology*.

Liu, R. T., Cheek, S. M., & Nestor, B. A. (2016). Non-suicidal self-injury and life stress: A systematic meta-analysis and theoretical elaboration. *Clinical Psychology Review*, *47*, 1–14. https://doi.org/10.1016/j.cpr.2016.05.005

Liu, X., Liu, Z. Z., Chen, R. H., Cheng, X. Z., Bo, Q. G., Wang, Z. Y., ... & Jia, C. X. (2019). Nightmares are associated with future suicide attempt and non-suicidal self-injury in adolescents. *The Journal of clinical psychiatry*, *80*(4), 0-0. https://doi.org/:10.4088/JCP.18m12181

Liu, R. T., & Miller, I. (2014). Life events and suicidal ideation and behavior: A systematic review. *Clinical psychology review*, *34*(3), 181–192. https://doi.org/10.1016/j.cpr.2014.01.006

Lloyd-Richardson, E. E. (2008). Adolescent nonsuicidal self-injury: Who is doing it and why? *Journal of Developmental & Behavioral Pediatrics*, *29*(3), 216–218. https://doi.org/10.1097/DBP.0b013e318173a5c1

Lodder, G. M., Scholte, R. H., Goossens, L., & Verhagen, M. (2017). Loneliness in early adolescence: Friendship quantity, friendship quality, and dyadic processes. *Journal of*

Clinical Child & Adolescent Psychology, *46*(5), 709–720. https://doi.org/10.1080/15374416.2015.1070352

Lofthouse, N., & Yager-Schweller, J. (2009). Nonsuicidal self-injury and suicide risk among adolescents. *Current opinion in pediatrics*, *21*(5), 641-645. https://doi.org/10.1097/MOP.0b013e3283306825

Lundh, L. G., WÅngby-Lundh, M., & Bjärehed, J. (2011). Deliberate self-harm and psychological problems in young adolescents: Evidence of a bidirectional relationship in girls. *Scandinavian journal of psychology*, *52*(5), 476-483. https://doi.org/10.1111/j.1467-9450.2011.00894.x

Lundh, L.-G., Wångby-Lundh, M., Paaske, M., Ingesson, S., & Bjärehed, J. (2011). Depressive symptoms and deliberate self-harm in a community sample of adolescents: A prospective study. *Depression Research and Treatment*, *2011*. https://doi.org/10.1155/2011/935871

Lundh, L. G., Bjärehed, J., & Wångby-Lundh, M. (2013). Poor sleep as a risk factor for nonsuicidal self-injury in adolescent girls. *Journal of Psychopathology and Behavioral Assessment*, *35*(1), 85-92. https://doi.org/10.1007/s10862-012-9307-4

Madge, N., Hawton, K., McMahon, E. M., Corcoran, P., De Leo, D., De Wilde, E. J., Fekete, S., van Heeringen, K., Ystgaard, M., & Arensman, E. (2011). Psychological characteristics, stressful life events and deliberate self-harm: Findings from the Child & Adolescent Self-harm in Europe (CASE) Study. *European child & adolescent psychiatry*, *20*(10), 499–508. https://doi.org/10.1007/s00787-011-0210-4

Manca, M. (2017). *L'autolesionismo nell'era digitale [Self-harm in the digital age]*. Alpes Italia. https://books.google.it/books?id=ieyuAQAACAAJ

Marin, S., Hajizadeh, M., Sahebihagh, M. H., Nemati, H., Ataeiasl, M., Anbarlouei, M., ... & Mohammadpoorasl, A. (2020). Epidemiology and determinants of self-injury among

high school students in Iran: a longitudinal study. *Psychiatric quarterly*, *91*, 1407-1413. https://doi.org/10.1007/s11126-020-09764-z

Marshall, S. K., Faaborg-Andersen, P., Tilton-Weaver, L. C., & Stattin, H. (2013). Peer sexual harassment and deliberate self-injury: Longitudinal cross-lag investigations in Canada and Sweden. *Journal of Adolescent Health*, *53*(6), 717–722. https://doi.org/10.1016/j.jadohealth.2013.06.009

Marshall, S. K., Tilton-Weaver, L. C., & Stattin, H. (2013). Non-suicidal self-injury and depressive symptoms during middle adolescence: A longitudinal analysis. *Journal of youth and adolescence*, *42*(8), 1234-1242. https://doi.org/ 10.1007/s10964-013-9919-3

Martin, G., Thomas, H., Andrews, T., Hasking, P., & Scott, J. G. (2015). Psychotic experiences and psychological distress predict contemporaneous and future non-suicidal self-injury and suicide attempts in a sample of Australian school-based adolescents. *Psychological Medicine*, *45*(2), 429-437. https://doi.org/ 10.1017/S0033291714001615

Martínez-Ferrer, B., & Stattin, H. (2019). Self-harm, depressive mood, and belonging to a subculture in adolescence. *Journal of adolescence*, *76*, 12-19. https://doi.org/ 10.1016/j.adolescence.2019.08.003

Massing-Schaffer, M., Nesi, J., Telzer, E. H., Lindquist, K. A., & Prinstein, M. J. (2020). Adolescent peer experiences and prospective suicidal ideation: The protective role of online-only friendships. *Journal of Clinical Child & Adolescent Psychology*, 1–12. https://doi.org/ 10.1080/15374416.2020.1750019

Masten, A. S., & Motti-Stefanidi, F. (2020). Multisystem resilience for children and youth in disaster: Reflections in the context of COVID-19. *Adversity and resilience science*, *1*(2), 95–106. https://doi.org/10.1007/s42844-020-00010-w

McElreath, R. (2018). *Statistical rethinking: A Bayesian course with examples in R and Stan*. Chapman and Hall/CRC. https://doi.org/10.1201/9781315372495

Moher, D., Liberati, A., Tetzlaff, J., Altman, D. G., & PRISMA, G. (2014). Ítems de referencia para publicar revisiones sistemáticas y metaanálisis: La Declaración PRISMA. *Revista Española de Nutrición Humana y Dietética*, *18*(3), 172–181. https://doi.org/10.14306/renhyd.18.3.114

Mondo, M., Sechi, C., & Cabras, C. (2019). Psychometric evaluation of three versions of the Italian Perceived Stress Scale. *Current Psychology*, 1–9. https://doi.org/10.1007/s12144-019-0132-8

Moran, P., Coffey, C., Romaniuk, H., Olsson, C., Borschmann, R., Carlin, J. B., & Patton, G. C. (2012). The natural history of self-harm from adolescence to young adulthood: A population-based cohort study. *The Lancet*, *379*(9812), 236–243. https://doi.org/10.1016/S0140-6736(11)61141-0

Muehlenkamp, J., Brausch, A., Quigley, K., & Whitlock, J. (2013). Interpersonal Features and Functions of Nonsuicidal Self-injury. *Suicide and Life-Threatening Behavior*, *43*(1), 67–80. https://doi.org/10.1111/j.1943-278X.2012.00128.x

Muehlenkamp, J. J., Claes, L., Havertape, L., & Plener, P. L. (2012). International prevalence of adolescent non-suicidal self-injury and deliberate self-harm. *Child and adolescent psychiatry and mental health*, *6*(1), 1–9. https://doi.org/10.1186/1753-2000-6-10

Muehlenkamp, J. J., & Gutierrez, P. M. (2004). An investigation of differences between self-injurious behavior and suicide attempts in a sample of adolescents. *Suicide and Life-Threatening Behavior*, *34*(1), 12–23. https://doi.org/ 10.1521/suli.34.1.12.27769

Muehlenkamp, J. J., & Gutierrez, P. M. (2007). Risk for suicide attempts among adolescents who engage in non-suicidal self-injury. *Archives of suicide research*, *11*(1), 69–82. https://doi.org/ 10.1080/13811110600992902

Muehlenkamp, J. J., Walsh, B. W., & McDade, M. (2010). Preventing non-suicidal self-injury in adolescents: The signs of self-injury program. *Journal of youth and adolescence*, *39*(3), 306–314. https://doi.org/10.1007/s10964-009-9450-8

Mulder, J. D., & Hamaker, E. L. (2021). Three extensions of the random intercept cross-lagged panel model. *Structural Equation Modeling: A Multidisciplinary Journal*, 1–11.

Muthen, L. K., & Muthen, B. O. (2012). Mplus user's guide. 7th. *Los Angeles, CA: Muthén & Muthén*, *19982006*.

Nelemans, S. A., Keijsers, L., Colpin, H., van Leeuwen, K., Bijttebier, P., Verschueren, K., & Goossens, L. (2020). Transactional links between social anxiety symptoms and parenting across adolescence: Between-and within-person associations. *Child development*, *91*(3), 814–828. https://doi.org/10.1111/cdev.13236

Nelson, B. D., Perlman, G., Klein, D. N., Kotov, R., & Hajcak, G. (2016). Blunted neural response to rewards as a prospective predictor of the development of depression in adolescent girls. *American Journal of Psychiatry*, *173*(12), 1223–1230. https://doi.org/10.1176/appi.ajp.2016.15121524

Neubauer, A. B., Schmidt, A., Kramer, A. C., & Schmiedek, F. (2021). A Little Autonomy Support Goes a Long Way: Daily Autonomy-Supportive Parenting, Child Well-Being, Parental Need Fulfillment, and Change in Child, Family, and Parent Adjustment Across the Adaptation to the COVID-19 Pandemic. *Child development,* 92, 1679-1697. https://doi.org/10.1111/cdev.13515

Newby-Fraser, E., & Schlebusch, L. (1997). Social support, self-efficacy and assertiveness as mediators of student stress. *Psychology: A Journal of Human Behavior*, *34*(3-4), 61–69. https://doi.org/ 10.1097/00004583-200211000-00015

Nixon, M. K., Cloutier, P. F., & Aggarwal, S. (2002). Affect regulation and addictive aspects of repetitive self-injury in hospitalized adolescents. *Journal of the American Academy*

of Child & Adolescent Psychiatry, *41*(11), 1333–1341. https://doi.org/ 10.1097/00004583-200211000-00015

Nock, M. K. (2009). Why Do People Hurt Themselves?: New Insights Into the Nature and Functions of Self-Injury. *Current Directions in Psychological Science*, *18*(2), 78–83. https://doi.org/10.1111/j.1467-8721.2009.01613.x

Nock, M. K. (2010). Self-injury. *Annual review of clinical psychology*, *6*, 339–363. https://doi.org/10.1146/annurev.clinpsy.121208.131258

Nock, M. K., Borges, G., Bromet, E. J., Cha, C. B., Kessler, R. C., & Lee, S. (2008). Suicide and Suicidal Behavior. *Epidemiologic Reviews*, *30*(1), 133–154. https://doi.org/10.1093/epirev/mxn002

Nock, M. K., & Favazza, A. R. (2009). Nonsuicidal self-injury: Definition and classification. In M. K. Nock (Ed.), *Understanding nonsuicidal self-injury: Origins, assessment, and treatment* (pp. 9–18). American Psychological Association. https://doi.org/10.1037/11875-001

Nock, M. K., & Mendes, W. B. (2008). Physiological arousal, distress tolerance, and social problem-solving deficits among adolescent self-injurers. *Journal of consulting and clinical psychology*, *76*(1), 28. https://doi.org/ 10.1037/0022-006X.76.1.28

Nock, M. K., & Prinstein, M. J. (2004). A functional approach to the assessment of self-mutilative behavior. *Journal of consulting and clinical psychology*, *72*(5), 885. https://doi.org/10.1037/0022-006X.72.5.885

Nock, M. K., Prinstein, M. J., & Sterba, S. K. (2009). Revealing the form and function of self-injurious thoughts and behaviors: A real-time ecological assessment study among adolescents and young adults. *Journal of abnormal psychology*, *118*(4), 816. https://doi.org/ 10.1037/a0016948

Nolen-Hoeksema, S. (1990). *Sex differences in depression*. Stanford University Press.

Nolen-Hoeksema, S., & Aldao, A. (2011). Gender and age differences in emotion regulation strategies and their relationship to depressive symptoms. *Personality and individual differences*, *51*(6), 704–708. https://doi.org/10.1016/j.paid.2011.06.012

Olsen, M. K., & Schafer, J. L. (2001). A two-part random-effects model for semicontinuous longitudinal data. *Journal of the American Statistical Association*, *96*(454), 730–745. https://doi.org/ 10.1198/016214501753168389

Perez, J., Venta, A., Garnaat, S., & Sharp, C. (2012). The Difficulties in Emotion Regulation Scale: Factor structure and association with nonsuicidal self-injury in adolescent inpatients. *Journal of Psychopathology and Behavioral Assessment*, *34*(3), 393–404. https://doi.org/ 10.1007/s10862-012-9292-7

Piccirillo, M., Burke, T., Moore-Berg, S., Alloy, L. B., & Heimberg, R. (2020). *Self-stigma toward nonsuicidal self-injury (NSSI): An examination of implicit and explicit attitudes towards self-injury* [Preprint]. https://doi.org/10.31234/osf.io/qcs84

Plener, P. L. (2021). COVID-19 and Nonsuicidal Self-Injury: The Pandemic's Influence on an Adolescent Epidemic. *American Journal of Public Health*, *111*(2), 195–196. https://doi.org/10.2105/AJPH.2020.306037

Plener, P. L., Libal, G., Keller, F., Fegert, J. M., & Muehlenkamp, J. J. (2009). An international comparison of adolescent non-suicidal self-injury (NSSI) and suicide attempts: Germany and the USA. *Psychological medicine*, *39*(9), 1549–1558. https://doi.org/ 10.1017/S0033291708005114.

Plener, P. L., Schumacher, T. S., Munz, L. M., & Groschwitz, R. C. (2015). The longitudinal course of non-suicidal self-injury and deliberate self-harm: A systematic review of the literature. *Borderline Personality Disorder and Emotion Dysregulation*, *2*, 2–2. https://doi.org/10.1186/s40479-014-0024-3

Plummer, M. (2014). Bayesian graphical models using MCMC. R package version 3-10. *Statistical software*.

Polek, E., Neufeld, S. A., Wilkinson, P., Goodyer, I., St Clair, M., Prabhu, G., ... & Jones, P. B. (2020). How do the prevalence and relative risk of non-suicidal self-injury and suicidal thoughts vary across the population distribution of common mental distress (the p factor)? Observational analyses replicated in two independent UK cohorts of young people. *BMJ open*, *10*(5), e032494. https://doi.org/ 10.1136/bmjopen-2019-03249

Prinstein, M. J. (2008). Introduction to the special section on suicide and nonsuicidal self-injury: A review of unique challenges and important directions for self-injury science. *Journal of Consulting and Clinical Psychology*, *76*(1), 1–8. https://doi.org/10.1037/0022-006X.76.1.1

Prinstein, M. J., Guerry, J. D., Browne, C. B., & Rancourt, D. (2009). Interpersonal models of nonsuicidal self-injury. In M. K. Nock (Ed.), *Understanding nonsuicidal self-injury: Origins, assessment, and treatment* (pp. 79–98). *American Psychological Association*. https://doi.org/10.1037/11875-005

Prinstein, M. J., Nock, M. K., Simon, V., Aikins, J. W., Cheah, C. S. L., & Spirito, A. (2008). Longitudinal Trajectories and Predictors of Adolescent Suicidal Ideation and Attempts Following Inpatient Hospitalization. *Journal of Consulting and Clinical Psychology*, *76*(1), 92–103. https://doi.org/10.1037/0022-006X.76.1.92

Prinstein, M. J., Heilbron, N., Guerry, J. D., Franklin, J. C., Rancourt, D., Simon, V., & Spirito, A. (2010). Peer influence and nonsuicidal self injury: Longitudinal results in community and clinically-referred adolescent samples. *Journal of abnormal child psychology*, *38*(5), 669-682. https://doi.org/10.1007/s10802-010-9423-0

Prinstein, M. J., & Giletta, M. (2016). Peer relations and developmental psychopathology. In D. E. Cicchetti (Ed.), *Developmental psychopathology* (Vol. 1, 3rd ed., pp. 527–579). Wiley.

Rajkumar, R. P. (2020). COVID-19 and mental health: A review of the existing literature. *Asian Journal of Psychiatry*, *52*, 102066. https://doi.org/10.1016/j.ajp.2020.102066

Riley, E. N., Davis, H. A., Combs, J. L., Jordan, C. E., & Smith, G. T. (2016). Nonsuicidal self-injury as a risk factor for purging onset: Negatively reinforced behaviours that reduce emotional distress. *European Eating Disorders Review*, *24*(1), 78-82. https://doi.org/10.1002/erv.2407

Riley, E. N., Combs, J. L., Jordan, C. E., & Smith, G. T. (2015). Negative urgency and lack of perseverance: Identification of differential pathways of onset and maintenance risk in the longitudinal prediction of nonsuicidal self-injury. *Behavior therapy*, *46*(4), 439-448. https://doi.org/10.1016/j.beth.2015.03.002

Roberts, B. W., Walton, K. E., & Viechtbauer, W. (2006). Patterns of mean-level change in personality traits across the life course: A meta-analysis of longitudinal studies. *Psychological bulletin*, *132*(1), 1. https://doi.org/10.1037/0033-2909.132.1.1

Roberts, E., Fraser, A., Gunnell, D., Joinson, C., & Mars, B. (2020). Timing of menarche and self-harm in adolescence and adulthood: a population-based cohort study. *Psychological medicine*, *50*(12), 2010-2018. https://doi.org/ 10.1017/S0033291719002095

Robinson, K., Garisch, J. A., Kingi, T., Brocklesby, M., O'Connell, A., Langlands, R. L., ... & Wilson, M. S. (2019). Reciprocal risk: The longitudinal relationship between emotion regulation and non-suicidal self-injury in adolescents. *Journal of abnormal child psychology*, *47*(2), 325-332. https://doi.org/10.1007/s10802-018-0450-6

Robinson, K., Brocklesby, M., Garisch, J. A., O'Connell, A., Langlands, R., Russell, L., Kingi, T., Brown, E.-J., & Wilson, M. S. (2017). Socioeconomic deprivation and non-suicidal

selfinjury in New Zealand adolescents: The mediating role of depression and anxiety. *New Zealand Journal of Psychology (Online)*, *46*(3), 126–136.

Rodav, O., Levy, S., & Hamdan, S. (2014). Clinical characteristics and functions of non-suicide self-injury in youth. *European psychiatry*, *29*(8), 503–508. https://doi.org/10.1016/j.eurpsy.2014.02.008

Rodham, K., & Hawton, K. (2009). Epidemiology and Phenomenology of Nonsuicidal Self-Injury. In M. K. Nock (Ed.), *Understanding Nonsuicidal Self-Injury: Origins, Assessment, and Treatment.* APA Books.

Rodham, K., Hawton, K., & Evans, E. (2004). Reasons for deliberate self-harm: Comparison of self-poisoners and self-cutters in a community sample of adolescents. *Journal of the American Academy of Child & Adolescent Psychiatry*, *43*(1), 80–87. https://doi.org/10.1097/00004583-200401000-00017

Rose, A. J., & Rudolph, K. D. (2006). A review of sex differences in peer relationship processes: Potential trade-offs for the emotional and behavioral development of girls and boys. *Psychological bulletin*, *132*(1), 98. https://doi.org/10.1037/0033-2909.132.1.98

Rudolph, K. D. (2017). Advances in conceptual and empirical approaches to understanding the interpersonal context of youth depression: Commentary. *Journal of Applied Developmental Psychology*, *51*, 65–69. https://dx.doi.org/10.1016/j.appdev.2017.05.006

Rudolph, K. D., & Flynn, M. (2007). Childhood adversity and youth depression: Influence of gender and pubertal status. *Development and psychopathology*, *19*(2), 497. https://doi.org/10.1017/S0954579407070241

Rudolph, K. D., Lansford, J. E., & Rodkin, P. C. (2016). Interpersonal theories of developmental psychopathology. *Developmental psychopathology*, 1–69. https://doi.org/10.1002/9781119125556.devpsy307

Rutter, M. (2014). Nature–nurture integration. In *Handbook of developmental psychopathology* (pagg. 45–65).

Sameroff, A. J. (2014). A dialectic integration of development for the study of psychopathology. In *Handbook of developmental psychopathology* (pagg. 25–43).

Schaeffer, N. C., & Presser, S. (2003). The science of asking questions. *Annual review of sociology*, *29*(1), 65–88. https://doi.org/10.1146/annurev.soc.29.110702.110112

Schultzberg, M., Muthén, B., Asparouhov, T., & Hamaker, E. (2017). Dynamic structural equation modeling of intensive longitudinal data using multilevel time series analysis in Mplus version 8 part 7. *Workshop at Johns Hopkins University*.

Selby, E. A., & Joiner J., T. E. (2009). Cascades of emotion: The emergence of borderline personality disorder from emotional and behavioral dysregulation. *Review of General Psychology*, *13*(3), 219–229. https://doi.org/ 10.1037/a0015687.

Shiffman, S., Stone, A. A., & Hufford, M. R. (2008). Ecological momentary assessment. *Annual Review of Clinical Psychology*, *4*, 1-32. https://doi.org/10.1146/annurev.clinpsy.3.022806.091415

Simone, A. C., & Hamza, C. A. (2020). Examining the disclosure of nonsuicidal self-injury to informal and formal sources: A review of the literature. *Clinical psychology review*, 101907. https://doi.org/10.1016/j.cpr.2020.101907

Somerville, L. H., Jones, R. M., & Casey, B. J. (2010). A time of change: behavioral and neural correlates of adolescent sensitivity to appetitive and aversive environmental cues. *Brain and cognition*, *72*(1), 124-133. https://doi.org/10.1016/j.bandc.2009.07.003

Somerville, L. H. (2013). The teenage brain: Sensitivity to social evaluation. *Current directions in psychological science*, *22*(2), 121–127. https://doi.org/10.1177/0963721413476512

Sornberger, M. J., Heath, N. L., Toste, J. R., & McLouth, R. (2012). Nonsuicidal self-injury and gender: Patterns of prevalence, methods, and locations among adolescents. *Suicide and Life-Threatening Behavior*, *42*(3), 266–278. https://doi.org/10.1111/j.1943-278X.2012.0088.x

Spinelli, A., & Pellino, G. (2020). COVID-19 pandemic: Perspectives on an unfolding crisis. *Journal of British Surgery*, *107*(7), 785–787. https://doi.org/10.1002/bjs.11627

Spirito, A., Overholser, J., & Stark, L. J. (1989). Common problems and coping strategies II: Findings with adolescent suicide attempters. *Journal of abnormal child psychology*, *17*(2), 213–221. https://doi.org/10.1007/BF00913795

Stänicke, L. I., Haavind, H., Rø, F. G., & Gullestad, S. E. (2019). Discovering One's Own Way: Adolescent Girls' Different Pathways Into and Out of Self-Harm. *Journal of Adolescent Research, 5,* 605-634. https://doi.org/10.1177/0743558419883360

Steinberg, L. (2010). A dual systems model of adolescent risk-taking. *Developmental Psychobiology: The Journal of the International Society for Developmental Psychobiology*, *52*(3), 216-224. https://doi.org/10.1002/dev.20445

Steinhoff, A., Bechtiger, L., Ribeaud, D., Murray, A. L., Hepp, U., Eisner, M., & Shanahan, L. (2021). Self-injury and domestic violence in young adults during the COVID-19 pandemic: Trajectories, precursors, and correlates. *Journal of research on adolescence*, *31*(3), 560–575. https://doi.org/10.1111/jora.12659

Strang, N. M., Chein, J. M., & Steinberg, L. (2013). The value of the dual systems model of adolescent risk-taking. *Frontiers in human neuroscience*, *7*, 223. https://doi.org/10.3389/fnhum.2013.00223

Suldo, S. M., & Shaffer, E. J. (2007). Evaluation of the self-efficacy questionnaire for children in two samples of American adolescents. *Journal of Psychoeducational Assessment*, *25*(4), 341–355. https://doi.org/ 10.1177/0734282907300636

Swannell, S. V., Martin, G. E., Page, A., Hasking, P., & St John, N. J. (2014). Prevalence of nonsuicidal self-injury in nonclinical samples: Systematic review, meta-analysis and meta-regression. *Suicide and Life-Threatening Behavior*, *44*(3), 273–303. https://doi.org/ 10.1111/sltb.12070

Tang, J., Ma, Y., Guo, Y., Ahmed, N. I., Yu, Y., & Wang, J. (2013). Association of aggression and non-suicidal self injury: a school-based sample of adolescents. *PLoS One, 8*(10). https://doi.org/10.1371/journal.pone.0078149

Tatnell, R., Hasking, P., Newman, L., Taffe, J., & Martin, G. (2017). Attachment, emotion regulation, childhood abuse and assault: Examining predictors of NSSI among adolescents. *Archives of suicide research*, *21*(4), 610–620. https://doi.org/ 10.1080/13811118.2016.1246267

Tatnell, R., Kelada, L., Hasking, P., & Martin, G. (2014). Longitudinal analysis of adolescent NSSI: The role of intrapersonal and interpersonal factors. *Journal of Abnormal Child Psychology*, *42*(6), 885–896. https://doi.org/10.1007/s10802-013-9837-6

Team, R. C. (2013). *R: A language and environment for statistical computing*.

Tilton-Weaver, L., Marshall, S. K., & Svensson, Y. (2019). Depressive symptoms and non-suicidal self-injury during adolescence: Latent patterns of short-term stability and change. *Journal of adolescence*, *75*, 163-174. https://doi.org/10.1016/j.adolescence.2019.07.013

Turner, B. J., Chapman, A. L., & Gratz, K. L. (2014). Why stop self-injuring? Development of the reasons to stop self-injury questionnaire. *Behavior modification*, *38*(1), 69–106. https://doi.org/10.1177/0145445513508977

Valencia-Agudo, F., Burcher, G. C., Ezpeleta, L., & Kramer, T. (2018). Nonsuicidal self-injury in community adolescents: A systematic review of prospective predictors, mediators and moderators. *Journal of Adolescence*, *65*, 25–38. https://doi.org/10.1016/j.adolescence.2018.02.012

van de Schoot, R., & Depaoli, S. (2014). Bayesian analyses: Where to start and what to report. *The European Health Psychologist*, *16*(2), 75–84.

van Geel, M., Goemans, A., & Vedder, P. (2015). A meta-analysis on the relation between peer victimization and adolescent non-suicidal self-injury. *Psychiatry research*, *230*(2), 364–368. https://doi.org/10.1016/j.psychres.2015.09.017

vanLoon, A., Creemers, H., Vogelaar, S., Miers, A., Saab, N., Westenberg, P. M., & Asscher, J. (2021). Prepandemic risk factors of COVID-19-related concerns in adolescents during the COVID-19 pandemic. Journal of Research on Adolescence, 31(3), 531–545. https://doi.org/10.1111/jora.12651

Vehtari, A., Gelman, A., & Gabry, J. (2017). Practical Bayesian model evaluation using leave-one-out cross-validation and WAIC. *Statistics and computing*, *27*(5), 1413-1432. https://doi.org/10.1007/s11222-016-9696-4

Viborg, N., Wångby-Lundh, M., Lundh, L. G., Wallin, U., & Johnsson, P. (2018). Disordered eating in a Swedish community sample of adolescent girls: subgroups, stability, and associations with body esteem, deliberate self-harm and other difficulties. *Journal of eating disorders*, *6*(1), 1-11. https://doi.org/10.1186/s40337-018-0189-z

Viechtbauer, W. (2010). Conducting meta-analyses in R with the metafor package. *Journal of statistical software*, *36*(3), 1–48. https://doi.org/ 10.18637/jss.v036.i03

Voon, D., Hasking, P., & Martin, G. (2014). Change in emotion regulation strategy use and its impact on adolescent nonsuicidal self-injury: A three-year longitudinal analysis using

latent growth modeling. *Journal of abnormal psychology*, *123*(3), 487. https://doi.org/10.1037/a0037024

Voon, D., Hasking, P., & Martin, G. (2014). Emotion regulation in first episode adolescent non-suicidal self-injury: What difference does a year make?. *Journal of adolescence*, *37*(7), 1077-1087. https://doi.org/10.1016/j.adolescence.2014.07.020

Wan, Y. H., Xu, S. J., Chen, J., Hu, C. L., & Tao, F. B. (2015). Longitudinal effects of psychological symptoms on non-suicidal self-injury: a difference between adolescents and young adults in China. *Social psychiatry and psychiatric epidemiology*, *50*(2), 237-247. https://doi.org 10.1007/s00127-014-0917-x

Wang, Q., & Liu, X. (2019). Peer victimization, depressive symptoms and non-suicidal self-injury behavior in Chinese migrant children: The roles of gender and stressful life events. *Psychology Research and Behavior Management*, *Volume 12*, 661–673. https://doi.org/10.2147/PRBM.S215246

Wang, L., Liu, X., Liu, Z. Z., & Jia, C. X. (2020). Digital media use and subsequent self-harm during a 1-year follow-up of Chinese adolescents. *Journal of affective disorders*, *277*, 279-286. https://doi.org/10.1016/j.jad.2020.05.066

Wang, B., You, J., Lin, M. P., Xu, S., & Leung, F. (2017). Developmental trajectories of nonsuicidal self-injury in adolescence and intrapersonal/interpersonal risk factors. *Journal of research on adolescence*, *27*(2), 392-406. https://doi.org/10.1111/jora.12273

Weeks, M. S., & Asher, S. R. (2012). Loneliness in childhood: Toward the next generation of assessment and research. *Advances in child development and behavior*, *42*, 1–39. https://doi.org/10.1016/B978-0-12-394388-0.00001-0

Weissman, M. M., Leaf, P. J., Holzer III, C. E., Myers, J. K., & Tischler, G. L. (1984). The epidemiology of depression: An update on sex differences in rates. *Journal of affective disorders*, *7*(3–4), 179–188. https://doi.org/10.1016/0165-0327(84)90039-9

Whitlock, J., Eckenrode, J., & Silverman, D. (2006). Self-injurious behaviors in a college population. *Pediatrics*, *117*(6), 1939–1948. https://doi.org/ 10.1542/peds.2005-2543

Whitlock, J., Muehlenkamp, J., Eckenrode, J., Purington, A., Baral Abrams, G., Barreira, P., & Kress, V. (2013). Nonsuicidal self-injury as a gateway to suicide in young adults. *Journal of Adolescent Health*, *52*(4), 486–492. https://doi.org/10.1016/j.jadohealth.2012.09.010

Willoughby, T., Heffer, T., & Hamza, C. A. (2015). The link between nonsuicidal self-injury and acquired capability for suicide: A longitudinal study. *Journal of Abnormal Psychology*, *124*(4), 1110. https://doi.org/10.1037/abn0000104

World Health Organization. (2020a). COVID-19 and violence against women: What the health sector/system can do. WHO, 26 March 2020. https://www.who.int /reproductivehealth /publications /emergencies/COVID-19-VAW-full-text.pdf.

World Health Organization. (2020c). Mental health and COVID-19. http://www.euro.who.int/en/health-topics/health-emergencies/coronavirus-covid-19/novel-coronavirus-2019-ncov-technical-guidance /coronavirus-disease-covid-19-outbreak-technical-guidance-europe/mental-health-and-covid-19

Wyman, P. A., Pickering, T. A., Pisani, A. R., Rulison, K., Schmeelk-Cone, K., Hartley, C., ... & Valente, T. W. (2019). Peer-adult network structure and suicide attempts in 38 high schools: implications for network-informed suicide prevention. J*ournal of Child Psychology and Psychiatry, 60*(10), 1065-1075. https://doi.org/ 10.1111/jcpp.13102.

Wu, N., Hou, Y., Chen, P., & You, J. (2019). Peer Acceptance and Nonsuicidal Self-injury among Chinese Adolescents: A Longitudinal Moderated Mediation Model. *Journal of Youth and Adolescence*, *48*(9), 1806–1817. https://doi.org/10.1007/s10964-019-01093-0

Xavier, A., Pinto-Gouveia, J., Cunha, M., & Dinis, A. (2017). Longitudinal pathways for the maintenance of non-suicidal self-injury in adolescence: The pernicious blend of depressive symptoms and self-criticism. In *Child & Youth Care Forum* (Vol. 46, No. 6, pp. 841-856). https://doi.org/10.1007/s10566-017-9406-1

Xin, M., Luo, S., She, R., Yu, Y., Wang, S., Tao, F., Zhao, J., Hu, D., Gu, J., Wang, H., Wang, Z., Hu, G., Li, L., Ma, L., Zhang, J., Li, L., Zhang, G., Lin, D., Cai, Y., … Lau, J. T.-F. (2020). Negative cognitive and psychological correlates of mandatory quarantine during the initial COVID-19 outbreak in China. *American Psychologist*, *75*(5), 607–617. https://doi.org/10.1037/amp0000692

Yao, Y., Vehtari, A., Simpson, D., & Gelman, A. (2018). Using stacking to average Bayesian predictive distributions (with discussion). *Bayesian Analysis*, *13*(3), 917-1007. https://doi.org/ 10.1214/17-BA1091

You, J., Leung, F., Lai, C. M., & Fu, K. (2012). The associations between non-suicidal self-injury and borderline personality disorder features among Chinese adolescents. *Journal of Personality Disorders*, *26*(2), 226–237. https://doi.org/10.1521/pedi.2012.26.2.226

You, J., & Lin, M. P. (2015). Predicting suicide attempts by time-varying frequency of nonsuicidal self-injury among Chinese community adolescents. *Journal of consulting and clinical psychology*, *83*(3), 524. https://doi.org/10.1037/a0039055

You, J., Deng, B., Lin, M. P., & Leung, F. (2016). The interactive effects of impulsivity and negative emotions on adolescent nonsuicidal self-injury: A latent growth curve analysis. *Suicide and Life-Threatening Behavior*, *46*(3), 266-283. https://doi.org/10.1111/sltb.12192

You, J., Lin, M. P., & Leung, F. (2015). A longitudinal moderated mediation model of nonsuicidal self-injury among adolescents. *Journal of abnormal child psychology*, *43*(2), 381-390. https://doi.org/10.1007/s10802-014-9901-x

You, J., Leung, F., & Fu, K. (2012). Exploring the reciprocal relations between nonsuicidal self-injury, negative emotions and relationship problems in Chinese adolescents: A longitudinal cross-lag study. *Journal of abnormal child psychology*, *40*(5), 829-836. https://doi.org/10.1007/s10802-011-9597-0

Yu, C. Y. (2002). *Evaluation of model fit indices for latent variable models with categorical and continuous outcomes. MPlus software Web site*.

Zelkowitz, R. L., & Cole, D. A. (2020). Longitudinal relations of self-criticism with disordered eating behaviors and nonsuicidal self-injury. *International journal of eating disorders*, *53*(7), 1097-1107. https://doi.org/10.1002/eat.23284

Zetterqvist, M., Lundh, L.-G., & Svedin, C. G. (2013). A Comparison of Adolescents Engaging in Self-Injurious Behaviors With and Without Suicidal Intent: Self-Reported Experiences of Adverse Life Events and Trauma Symptoms. *Journal of Youth and Adolescence*, *42*(8), 1257–1272. https://doi.org/10.1007/s10964-012-9872-6

Zhang, X., Ren, Y., You, J., Huang, C., Jiang, Y., Lin, M. P., & Leung, F. (2017). Distinguishing pathways from negative emotions to suicide ideation and to suicide attempt: The differential mediating effects of nonsuicidal self-injury. *Journal of abnormal child psychology*, *45*(8), 1609-1619. https://doi.org/10.1007/s10802-017-0266-9

Zhou, Y., Daukantaitė, D., Lundh, L. G., Wångby-Lundh, M., & Ryde, A. (2020). Adolescents' emotion regulation strategies questionnaire: initial validation and prospective associations with nonsuicidal self-injury and other mental health problems in adolescence and young adulthood in a Swedish youth cohort. *Frontiers in psychiatry*, *11*, 462. https://doi.org/10.3389/fpsyt.2020.00462

Zhu, J., Chen, Y., & Su, B. (2020). Non-suicidal self-injury in adolescence: Longitudinal evidence of recursive associations with adolescent depression and parental rejection. *Journal of Adolescence*, *84*, 36-44. https://doi.org/10.1016/j.adolescence.2020.08.002

Zimet, G. D., Dahlem, N. W., Zimet, S. G., & Farley, G. K. (1988). The multidimensional scale of perceived social support. *Journal of personality assessment*, *52*(1), 30–41. https://doi.org/10.1207/s15327752jpa5201_2

APPENDIX 1

CHAPTER 1 - THE DEVELOPMENT OF SELF-INJURY FROM CHILDHOOD TO YOUNG ADULTHOOD: A BAYESIAN META-ANALYSIS

Appendix of all models tested for the meta-regression

The numbers in brackets indicate the number of observations. If a variable does not have all the data, the removal of all the associated row is applied missing data (listwise deletion).

- M000: months
- M001: months
- M002: months
- M003: months + pc female (21, 18)
- M004: months x pc female (21, 18)
- M005: months + 1st mean age (21, 23)
- M006: months x 1st mean age (21, 23)
- M007: months + pc female + 1st mean age (21, 18)
- M008: months x pc female + 1st mean age (21, 18)
- M009: months x 1st mean age + pc female (21, 18)
- M010: pc female x 1st mean age + months (21, 18)
- M011: pc female x 1st mean age x months (21, 18)

APPENDIX 2

CHAPTER 2 - RECIPROCAL ASSOCIATIONS BETWEEN PEER PROBLEMS AND NON-SUICIDAL SELF-INJURY THROUGHOUT ADOLESCENCE

Additional Information on Random Intercept Cross-Lagged Panel Model (RI-CLPM) between Friendship Stress and Non-Suicidal Self-Injury

We examined time-invariance of the main parameters by comparing a model with all parameters freely estimated across time (Model 1) to a model in which, each time, groups of parameters were constrained to be similar (i.e., invariant) over time. Models were compared using chi-square difference tests ($\Delta\chi 2$). First, we examined whether the autoregressive paths of friendship stress (Model 2) and NSSI (Model 3) could be constrained to be equal over time. These equalities constraints worsened the mode fit (see Table S2). Second, we examined whether concurrent associations could be constrained to be equal over time (Model 4); also, these constraints worsened the model fit. Finally, we examined whether cross-lagged effects could be constrained to be equal over time, separately from friendship stress to NSSI (Model 5) and from NSSI to friendship stress (Model 6). Adding equality constrained over time to the cross-lagged effects did not worsened the model fit in both cases. Therefore, in the final model (Model 7) the autoregressive paths and the concurrent associations (i.e., within-time residual covariances and variances) were freely estimated over time, whereas all cross-lagged effects were fixed to be equal over time. This model had a good fit to the data (Table S2) and fitted the data equally well as the model with all freely estimated parameters (Model 1). Therefore, this model (Model 7) was retained as final model.

Table 2.2

Model Fit Indices and Model Fit Comparisons of Random-Intercept Cross-Lagged Panel Models between Friendships Stress and Non-Suicidal Self-Injury

Models	Model fit indices						Difference test		
	χ^2	*df*	*p*	CFI	TLI	RMSEA	$\Delta\chi^2$	Δdf	*p*
Model 1	41.735	37	0.273	0.997	0.995	0.012			
Model 2	49.826	41	0.162	0.995	0.992	0.016	10.410	4	0.034
Model 3	53.196	41	0.096	0.993	0.989	0.019	12.108	4	0.016
Model 4	64.048	49	0.073	0.992	0.989	0.019	25.035	12	0.015
Model 5	44.173	41	0.339	0.998	0.997	0.009	2.765	4	0.598
Model 6	45.344	41	0.296	0.998	0.996	0.011	4.265	4	0.371
Model 7	**47.187**	**45**	**0.383**	**0.999**	**0.998**	**0.007**	**5.805**	**8**	**0.669**

Note. Weighted Least Square Mean and Variance adjusted estimator (WLSMV) was used; therefore, the chi-square for difference testing ($\Delta\chi^2$) was used for comparing nested models. Model 7 (i.e., in bold) is the final model.

Table 2.3

Within-Person Effects on the Final Model (Model 7) between Friendship Stress and Non-Suicidal Self-Injury

Parameters	Grade 7		Grade 8		Grade 9		Grade 10		Grade 11		Grade 12	
	β (SE)	95% C.I.	β (SE)	95% C.I.	β (SE)	95% C.I.	β (SE)	95% C.I.	β (SE)	95% C.I.	β (SE)	95% C.I.
Within-person correlations	.45 (.10)***	.20-.70	.32 (.08)***	.10-.53	.17 (.07)*	-.01-.34	.16 (.08)*	-.04-.35	.15 (.08)	-.07-.36	.06 (.07)	-.13-.25
Friendship stress → NSSI			.04(.06)	-.12-.19	.03 (.05)	-.10-.16	.03 (.04)	-.09-.14	.03 (.05)	-.09-.15	.02(.03)	-.06-.10
NSSI → Friendship stress			.11 (.05)*	-.01-.23	.10 (.04)*	-.01-.22	.12 (.05)*	-.01-.25	.14 (.06)*	-.01-.28	.12 (.05)*	-.01-.25
Autoregressive paths friendship stress			.37 (.05)***	.23-.50	.33 (.05)***	.20-.47	.33 (.06)***	.18-.47	.24 (.06)***	.08-.40	.15 (.06)**	.01-.30
Autoregressive paths NSSI			.41 (.10)***	.15-.67	.35 (.10)***	.10-.61	.45 (.06)***	.28-.61	.58 (.06)***	.43-.72	.47 (.08)***	.27-.67

Note. The between-person effect is not reported in the table; this was β (SE)= .40 (.07), 95% C.I.= .22-.58, $p < .001$. Estimates for the cross-lagged and autoregressive effects reported in columns "Grade 8" to "Grade 12" refer to the grade in which the outcomes were measured; for example, longitudinal effects from grade 7 to grade 8 are reported in column "Grade 8".

*p <.05; **p <.01; ***p <.001

Additional Information on the Associations between Friendship Stress and NSSI at the Within-Person Level

Results from the final RI-CLPM indicated that, in addition to the significant cross-lagged effects from NSSI to friendship stress, the concurrent correlations emerged to be significant. This suggests that when adolescents reported higher level of friendships stress (as compared to their own mean level) at a specific time point, they also reported more NSSI at that time point (i.e., from Grade 7 to Grade 10, see Table S3). Moreover, the autoregressive paths of both friendships stress and NSSI were all positive and significant, indicating that adolescents tended to report higher levels of NSSI and friendship stress (as compared to their own mean levels) when they also reported higher levels of NSSI and friendship stress respectively, at the previous assessment (i.e., carry-over effect).

Additional Information on Random Intercept Cross-Lagged Panel Model (RI-CLPM) between Loneliness and Non-Suicidal Self-Injury

The same procedure used for the models including friendship stress was followed. First, fixing the autoregressive paths of loneliness to be equal over time (Model 2) did not worsen the model fit (see Table S3). However, a model with constrains on the autoregressive paths of NSSI (Model 3) yielded a poorer model fit (see Table S3). In Model 4, fixing the concurrent associations (i.e., within-time residual covariances and variances) to be equal over time also worsened the model fit. Finally, the cross-lagged effects emerged to be equal over time, both from loneliness to NSSI (Model 5) as well as from NSSI to loneliness (Model 6). Therefore, in the final model (Model 7) the autoregressive paths for NSSI and the concurrent associations were freely estimated over time; however, the autoregressive paths for loneliness and all cross-lagged effects were fixed to be equal over time. This model had a good fit to the data (Table S3) and fitted the data equally well as the model with all freely estimated parameters (Model 1). Therefore, this model (Model 7) was retained as final model.

Table 2.4

Model Fit Indices and Model Fit Comparisons of Random-Intercept Cross-Lagged Panel Models between Loneliness e Non-Suicidal Self-Injury

Models	Model fit indices						Difference test		
	χ^2	df	p	CFI	TLI	RMSEA	$\Delta\chi^2$	Δdf	p
Model 1	31.730	21	0.062	.991	.982	.025			
Model 2	33.861	24	0.087	.992	.985	.022	1.441	3	0.696
Model 3	42.704	24	0.011	.985	.972	.031	10.630	3	0.014
Model 4	49.688	30	0.013	.984	.976	.028	19.552	9	0.021
Model 5	37.418	24	0.039	.989	.980	.026	6.812	3	0.079
Model 6	31.920	24	0.129	.994	.988	.020	1.177	3	0.759
Model 7	**35.651**	**30**	**0.219**	**.995**	**.993**	**.015**	**7.735**	**9**	**0.561**

Note. Weighted Least Square Mean and Variance adjusted estimator (WLSMV) was used; therefore, the chi-square for difference testing ($\Delta\chi^2$) was used for comparing nested models. Model 7 (i.e. in bold) is the final model.

Table 2.5

Within-Person Effects on the Final Model (Model 7) between Loneliness and Non-Suicidal Self-Injury

Parameters	Grade 8		Grade 9		Grade 10		Grade 11		Grade 12	
	β (SE)	95% C.I.	β (SE)	95% C.I.	β (SE)	95% C.I.	β (SE)	95% C.I.	β (SE)	95% C.I.
Within-person correlations	.39 (.10)***	.13-.66	.34 (.07) ***	.17-.51	.41 (06) ***	.26-.55	.14 (.08)	-.06-.35	.30 (.08)***	.11-.50
Loneliness → NSSI			.01 (.05)	-.11-.14	.01 (.05)	-.12-.15	.02 (.06)	-.13-.16	.01 (.04)	-.09-.11
NSSI → Loneliness			.13 (.05)**	.01-.25	.15 (.05)**	.01-.28	.16 (.06)**	.01-31	.15 (.05)**	.01-.29
Autoregressive paths Loneliness			.34 (.04)***	.23-.46	.39 (.06)***	.23-.54	.40 (.07)***	.24-.57	.39 (.07)***	.22-57
Autoregressive paths NSSI			.48 (.09)***	.24-.72	.56 (.07)***	.38-.75	.65 (.06)***	.49-.81	.53 (.07)***	.34-.71

Note. The between-person effect is not report in the table; this was β (SE)=.68 (.08); 95% C.I.= .48-.88. Estimates for the cross-lagged and autoregressive effects reported in columns "Grade 9" to "Grade 12" refer to the grade in which the outcomes were measured; for example, longitudinal effects from grade 8 to grade 9 are reported in column "Grade 9".
*p <.05; **p <.01; ***p <.001

Additional Information on the Reciprocal Associations between Loneliness and NSSI at the Within-Person Level

Results from the final RI-CLPM indicated that, in addition to the significant cross-lagged effects from NSSI to loneliness, the concurrent correlations were also significant, indicating that when adolescents reported higher level of loneliness (as compared to their own mean level) at a specific time point, they also reported more NSSI at that same time point. This was the case for all time points, with the exception of Grade 11. The autoregressive paths of both loneliness and NSSI were all positive and significant, indicating that adolescents tended to report higher levels of loneliness and NSSI (as compared to their own mean levels) when they also reported higher levels of loneliness and NSSI respectively, at the previous assessment.

Additional Information on Random Intercept Cross-Lagged Panel Model (RI-CLPM) between Peer Victimization and NSSI

The same procedure of friendship stress and loneliness was used. Model 2 examined whether the autoregressive paths of peer victimization could be constrained to be equal over time; this worsened the model fit, so these paths were freely estimated over time. Subsequently a model with constrains on the autoregressive paths of NSSI (Model 3) was examined. This model did not worsen the model fit, so these constraints were retained (see Table S4). In Model 4, it was examined whether concurrent associations (i.e., within-time residual covariances and variances) could be constrained to be equal over time; these constraints worsened the model fit, so these paths were freely estimated over time. Subsequently, it was examined whether cross-lagged effects could be fixed to be equal over time separately from peer victimization to NSSI (Model 5) and from NSSI to peer victimization (Model 6). Adding equality constrained over time to the cross-lagged effects did not worsened the model fit in both cases. Therefore, in the final model (Model 7) the autoregressive paths for peer victimization and the concurrent associations were freely estimated over time, whereas the autoregressive paths for NSSI and all cross-lagged effects were fixed to be equal over time. This model had a good fit to the data (Table S4) and fitted the data equally well as the model with all freely estimated parameters (Model 1). Therefore, this model (Model 7) was retained as final model.

Table 2.6

Model Fit Indices and Model Fit Comparisons of Random-Intercept Cross-Lagged Panel Models between Peer Victimization and Non-Suicidal Self-Injury

Models	Model fit indices						Difference test		
	χ^2	*df*	*p*	CFI	TLI	RMSEA	$\Delta\chi^2$	Δdf	*p*
Model 1	32.141	21	0.057	0.991	0.982	0.025			
Model 2	66.099	24	<.001	0.968	0.939	0.046	37.208	3	<.001
Model 3	37.137	24	0.042	0.990	0.981	0.026	5.832	3	0.120
Model 4	58.653	30	0.001	0.978	0.967	0.034	29.831	9	<.001
Model 5	36.547	24	0.048	0.990	0.982	0.025	5.774	3	0.123
Model 6	37.051	26	0.074	0.991	0.985	0.023	4.091	3	0.252
Model 7	**45.209**	**30**	**0.037**	**0.988**	**0.982**	**0.025**	**14.555**	**9**	**0.104**

Note. Weighted Least Square Mean and Variance adjusted estimator (WLSMV) was used; therefore, the chi-square for difference testing ($\Delta\chi^2$) was used for comparing nested models. Model 7 (i.e. in bold) is the final model.

Table 2.7

Within-Person Effects on the Final Model (Model 7) between Peer Victimization and NSSI

Parameters	Grade 8		Grade 9		Grade 10		Grade 11		Grade 12	
	β (SE)	95% C.I.	β (SE)	95% C.I.	β (SE)	95% C.I.	β (SE)	95% C.I.	β (SE)	95% C.I.
Within-person correlations	.24 (.12)*	-.08 -.56	.10 (.07)	-.09-.29	.-.13 (.08)	-.34-.08	-.01 (.08)	-.22-.20	-.18 (.04)*	-.39-.04
Peer victimization → NSSI			.05 (.03)	-.03-.14	.07 (.04)	-.04-.19	.07 (.04)	-.04-.19	.06 (.03)	-.03-.14
NSSI → Peer victimization			.16 (.05)**	.02-29	.17 (.06)**	.03-31	.18 (.06)**	.03-.33	.17 (.06)**	.03-.31
Autoregressive paths Peer victimization			.31 (.06)***	.16-.46	.44 (.04)***	.33-.56	.32 (.05)***	.18-.46	.02 (.06)	-.12-.17
Autoregressive paths NSSI			.71 (.09)***	.48-.94	.73 (.08)***	.52-.93	.77 (.06)***	.60-.93	.59 (.08)***	.39-.79

Note. The between-person effect is not report in the table; this was β (SE)= -.22 (1.18); 95% C.I.=-3.27-2.82. Estimates for the cross-lagged and autoregressive effects reported in columns "Grade 9" to "Grade 12" refer to the grade in which the outcomes were measured; for example, longitudinal effects from grade 8 to grade 9 are reported in column "Grade 9".
*p <.05; **p <.01; ***p <.001

Additional Information on the Reciprocal Associations between Peer Victimization and NSSI at the Within-Person Level

Results from the final RI-CLPM indicated that, in addition to the significant cross-lagged effects from NSSI to peer victimization, significant concurrent correlations were found at Grade 8 and 12. At Grade 8, this association was positive, indicating that higher than usual peer victimization levels were associated with higher than usual NSSI levels; yet, the association was negative at Grade 12, suggesting an opposite effect. Besides, the autoregressive paths of peer victimization were also positive and significant, except from Grade 11 to Grade 12, while for NSSI they were significant across all time points.

Additional Information about Gender Moderation Analysis

Gender differences were examined using a multi-group approach. Specifically, a model with all parameters freely estimated across gender (Model 1) was compared to a constrained model in which cross-lagged effects were fixed to be equal for boys and girls (Model 2), using the chi-square difference test ($\Delta\chi2$). Results from model comparisons are reported in Table S8.

Table 2.8

Model Fit Indices and Model Fit Comparisons for Gender Multi-Group Random-Intercept Cross-lagged Panel Models.

Models	Model fit indices						Difference test		
	χ^2	df	p	CFI	TLI	RMSEA	$\Delta\chi^2$	Δd	p
Friendship stress									
Model 1	95.648	78	0.085	0.989	.0982	0.023			
Model 2	95.274	88	0.278	0.996	0.993	0.014	3.827	10	0 .955
Loneliness									
Model 1	48.353	42	0.232	0.995	0.989	0.019			
Model 2	53.386	50	0.346	0.997	0.995	0.013	5.75	8	0.675
Peer victimization									
Model 1	50.458	46	0.302	0.996	0.993	0.015			
Model 2	54.531	54	0.454	1.000	0.999	0.005	6.41	8	0.602

Note. Weighted Least Square Mean and Variance adjusted estimator (WLSMV) was used; therefore, the chi-square for difference testing ($\Delta\chi^2$) was used for comparing nested models.

Additional Information on Cross-lagged Panel Models (CLPM) between Peer Problems and Non-Suicidal Self-Injury

We compared time-variant CLPMs, with all parameters freely estimated over time (CLPM, Model 1), to the RI-CLPMs with all parameters freely estimated over time (RI-CLPM, Model 1). Moreover, we compared the final, retained RI-CLPMs (Models 7), with CLPMs in which the same parameters were constrained to be equal over time (CLPM, Models 7). As shown in Table S9, all RI-CLPMs fitted the data better than CLPMs. All models reported in Figures S1-S3 are CLPMs with estimates fixed to be equal over time (Models 7).

Table 2.9

Model Fit Indices and Model Fit Comparisons of Cross-lagged Panel Models between Peer Problems and Non-Suicidal Self-Injury

Models	Model fit indices						Difference test		
	χ^2	df	p	CFI	TLI	RMSEA	$\Delta\chi^2$	Δdf	p
Friendship stress									
RI-CLPM, Model 1	41.735	37	0.273	0.997	0.995	0.012			
CLPM, Model 1	209.519	40	<.001	0.906	0.845	0.070	147.156	3	<.001
RI-CLPM, Model 7	47.187	45	0.383	0.999	0.998	0.007			
CLPM, Model 7	169.262	48	<.001	0.933	0.908	0.054	122.011	3	<.001
Loneliness									
RI-CLPM, Model 1	31.730	21	0.062	0.991	0.982	0.025			
CLPM, Model 1	84.187	24	<.001	0.952	0.910	0.055	38.359	3	<.001
RI-CLPM, Model 7	35.651	30	0.219	0.992	0.986	0.022			
CLPM, Model 7	67.598	33	<.001	0.972	0.962	0.036	36.919	3	<.001
Peer Victimization									
RI-CLPM, Model 1	32.141	21	0.057	0.991	0.982	0.025			
CLPM, Model 1	157.112	24	<.001	0.897	0.808	0.082	74.439	3	<.001
RI-CLPM, Model 7	45.209	30	0.037	0.988	0.982	0.025			
CLPM, Model 7	119.594	33	<.001	0.933	0.909	0.056	79.450	3	<.001

Note. Weighted Least Square Mean and Variance adjusted estimator (WLSMV) was used; therefore, the chi-square for difference testing ($\Delta\chi^2$) was used.

Figure 2.5

Diagram of Final Cross-Lagged Panel Models between Friendship Stress and Non-Suicidal Self-Injury.
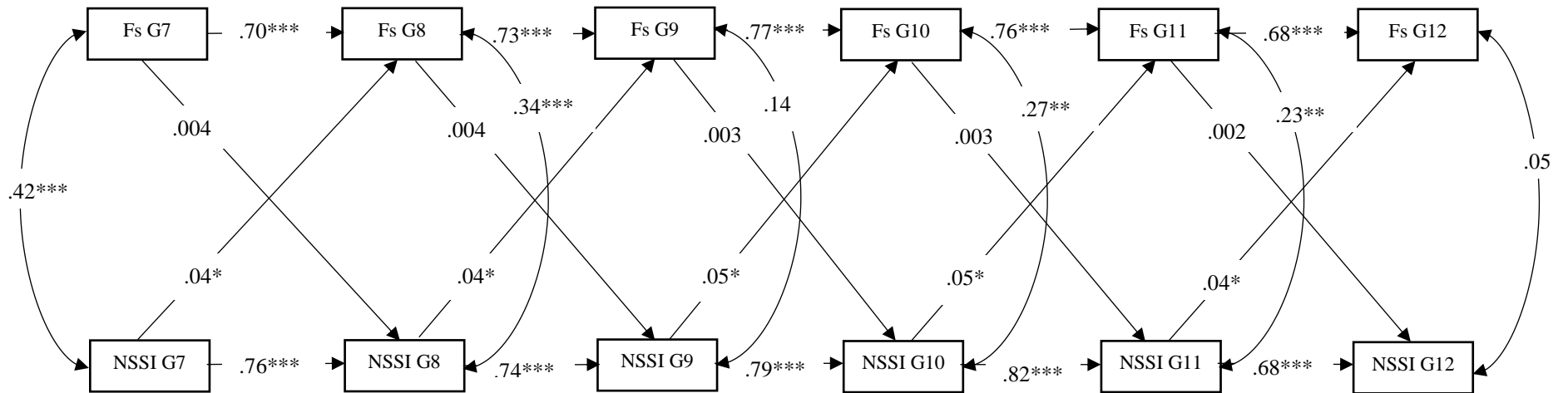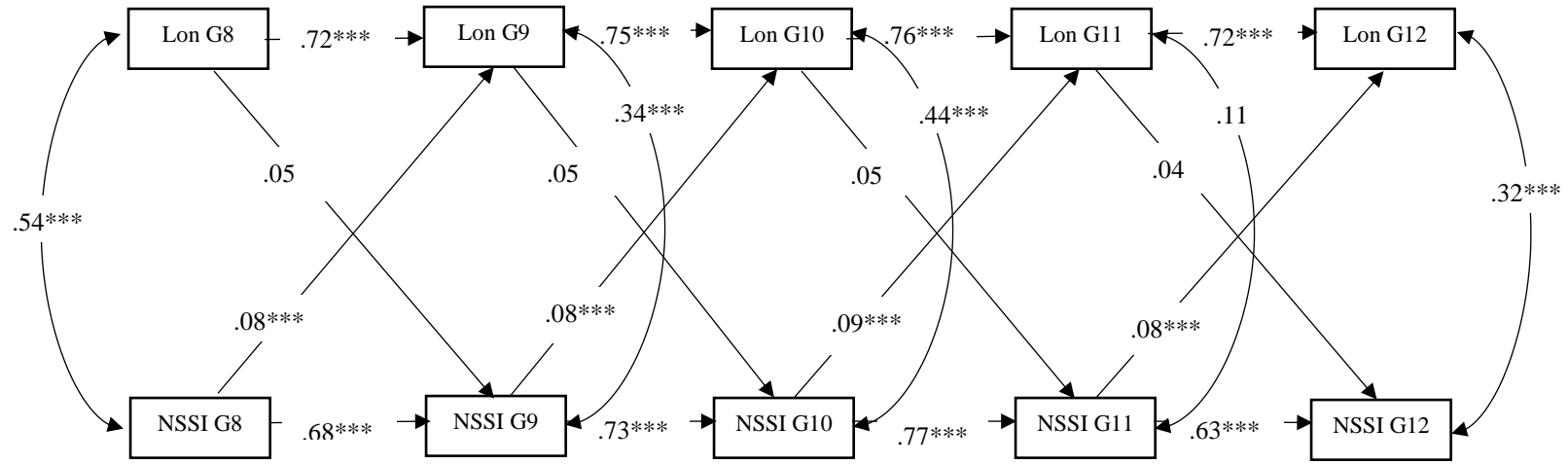

Note. FS= friendship stress; NSSI= non-suicidal self-injury; G= School grade. Standardized estimates are reported.
*p <.05; **p <.01; ***p <.001

Figure 2.6

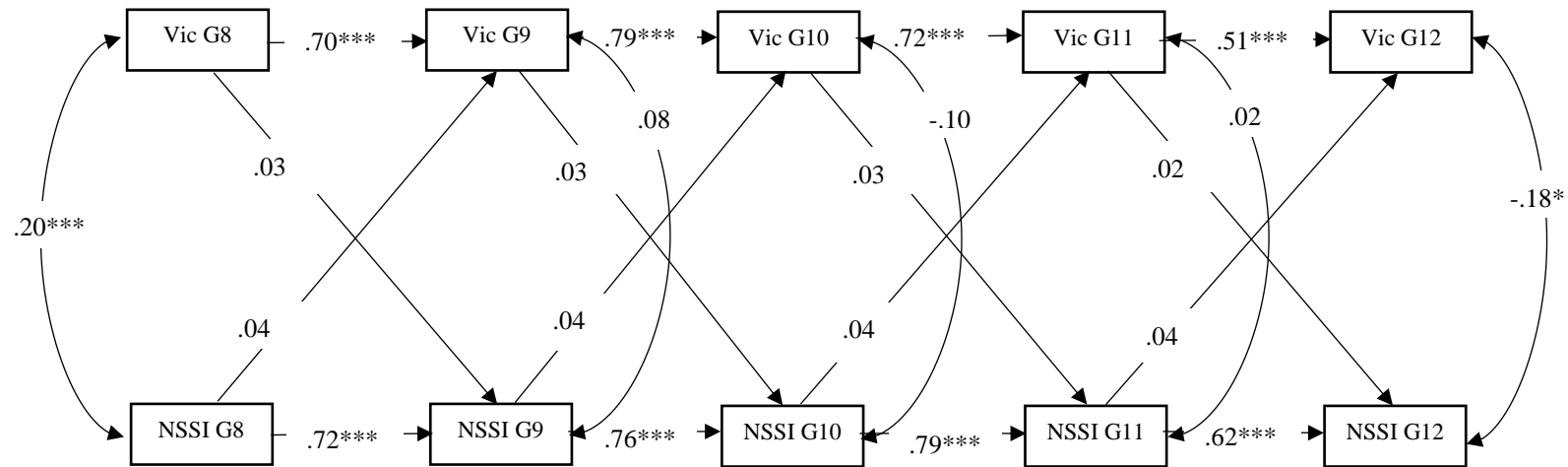*Diagram of Final Cross-Lagged Panel Models between Loneliness and Non-Suicidal Self-Injury.*

Note. Lon= loneliness; NSSI= non-suicidal self-injury; G= School grade. Standardized estimates are reported.
p <.05; **p* <.01; ***p* <.001

Figure 2.7

Diagram of Final Cross-Lagged Panel Models between Peer Victimization and Non-Suicidal Self-Injury.

Note. Vic= peer victimization; NSSI= non-suicidal self-injury; G= School grade. Standardized estimates are reported.
*p <.05; **p <.01; ***p <.001

Additional Information on Random Intercept Cross-Lagged Panel Model (RI-CLPM) with Friendship Stress, Depression and NSSI

Similarly to the main RI-CLPMs, also in all models including depressive symptoms we examined time-invariance of parameter estimates. First, we examined whether the autoregressive paths of friendship stress (Model 2), depression (Model 3) and NSSI (Model 4) could be constrained to be equal over time, by comparing these models to a model with all parameters freely estimated over time (Model 1). The constraints on the autoregressive paths of friendship stress and depression did not worsened the model fit; however, constraining the autoregressive paths of NSSI to be equal over time worsened the model fit (see Table S10). Then, we examined whether the concurrent associations (i.e., within-time residual covariances and variances) (Model 5) could be constrained to be equal over time (note that time-invariance of all within-time residual covariances and variances was tested in one-step). These equalities constraints worsened the model fit (see Table S10). Next, we examined whether cross-lagged effects could be constrained to be equal over time, separately from NSSI to friendship stress (Model 6), from friendship stress to NSSI (Model 7), from depression to friendship stress (Model 8), from friendship stress to depression (Model 9), from depression to NSSI (Model 10) and from NSSI to depression (Model 11). Adding equality constrained over time to the cross-lagged effects did not worsened the model fit, with the exception of the cross-lagged from friendship stress to depression. Therefore, in the final model (Model 12) the autoregressive paths for NSSI, the concurrent associations (i.e., within-time residual covariances and variances) and the cross-lagged effects from friendship stress to depression were freely estimated over time, all other parameters were fixed to be equal over time. This model had a good fit to the data (Table S2) and fitted the data equally well as the model with all freely estimated parameters (Model 1). Thus, this model (Model 12) was retained as final model and is displayed in Figures S4.

Table 2.10

Model Fit Indices and Model Fit Comparisons of Random-Intercept Cross-Lagged Panel Models with Friendships Stress, Depression and Non-Suicidal Self-Injury

Models	χ^2	df	p	CFI	TLI	RMSEA	$\Delta\chi^2$	Δdf	p
	Model fit indices						Difference test		
Model 1	89.707	84	.315	.998	.996	.009			
Model 2	96.252	88	.257	.997	.995	.010	8.286	4	.082
Model 3	94.442	88	.300	.998	.996	.009	6.622	4	.157
Model 4	101.137	88	.160	.995	.991	.013	14.018	4	.007
Model 5	128.519	108	.087	.992	.989	.015	40.122	24	.021
Model 6	93.592	88	.322	.998	.996	.009	4.452	4	.348
Model 7	92.408	88	.353	.998	.997	.008	2.756	4	.559
Model 8	92.462	88	.352	.998	.997	.008	1.932	4	.748
Model 9	99.202	88	.195	.996	.993	.012	12.795	4	.012
Model 10	94.208	88	.306	.998	.996	.009	5.300	4	.258
Model 11	92.954	88	.338	.998	.997	.008	4.502	4	.342
Model 12	**118.096**	**112**	**.328**	**.998**	**.997**	**.008**	**29.451**	**28**	**.390**

Figure 2.8

Final Between- and Within-Person Effect of the Random-Intercept Cross-lagged Panel Model with Friendship Stress, Depression and NSSI
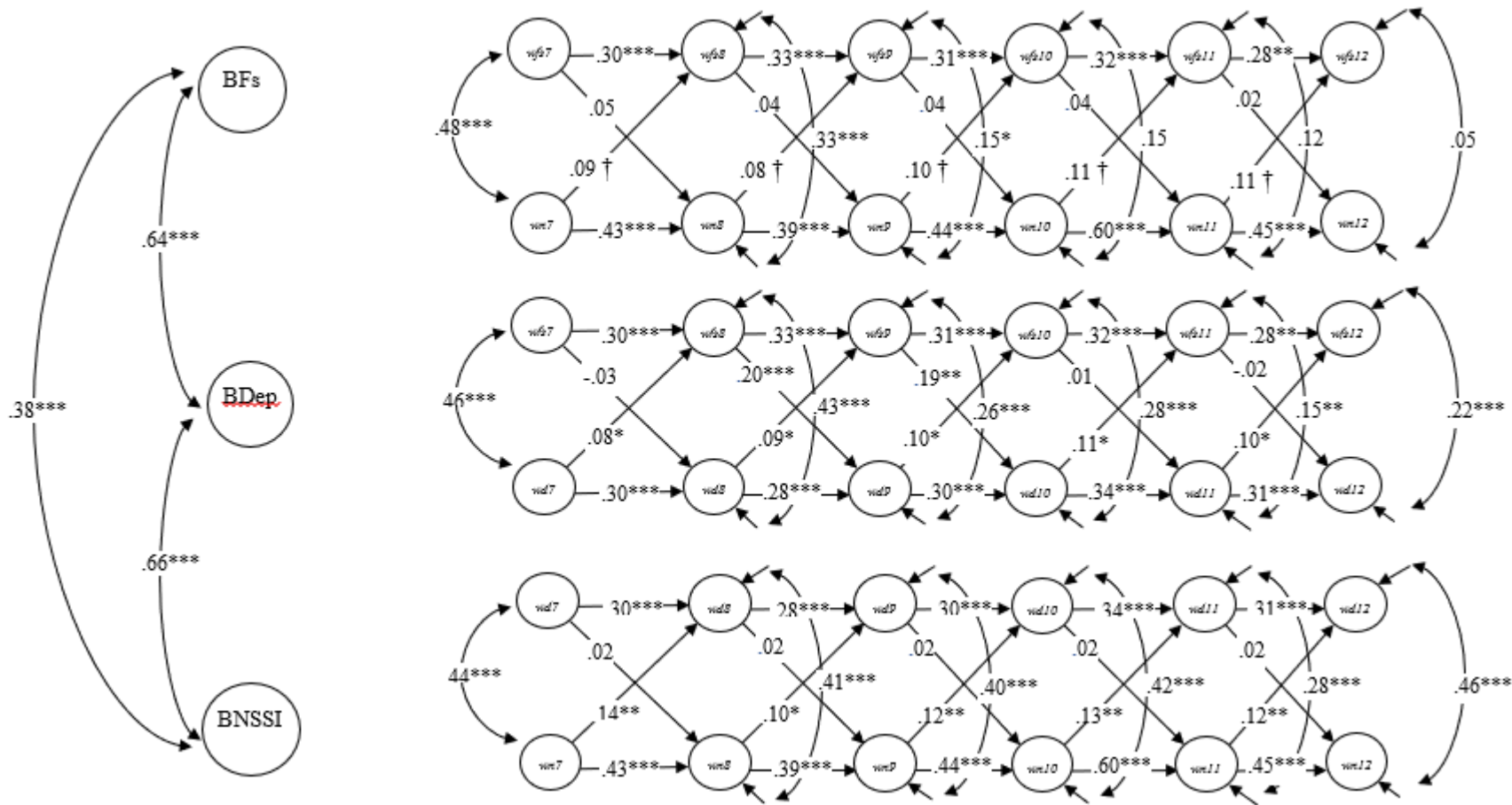
Note. BFs= Between-person random intercept for friendship stress; BNSSI= Between-person random intercept for NSSI; BDep= Between-person random intercept for depression. wfs7-wfs12 = within-person latent factors for friendship stress from Grade 7 to 12. wnssi7-wnnsi12 = within-person latent factors for NSSI from Grade 7 to 12. wd7-wd12 = within-person latent factors for depression from Grade 7 to 12. Standardized estimates are reported. *p <.05; **p <.01; ***p <.001. †<.07

Additional Information on Random Intercept Cross-Lagged Panel Model (RI-CLPM) with Loneliness, Depression and NSSI

The same procedure used for the models with friendship stress was followed. First, fixing the autoregressive paths of loneliness (Model 2) and depression (Model 3) to be equal over time did not worsen the model fit (see Table S11). However, a model with constrains on the autoregressive paths of NSSI (Model 4) did not converge; thus, it was decided to leave these paths free over time. Subsequently, as for the model with friendship stress, we examined whether the concurrent associations (i.e., within-time residual covariances and variances) (Model 5) could be all constrained to be equal over time. These equalities constraints worsened the model fit (see Table S11). Finally, all cross-lagged effects emerged to be time-invariant (see Models 6-11). Therefore, in the final model (Model 12) the autoregressive paths for NSSI and the concurrent associations were freely estimated over time, whereas the autoregressive paths for loneliness and depression as well as all cross-lagged effects were fixed to be equal over time. This model had a good fit to the data (Table S11) and fitted the data equally well as the model with all freely estimated parameters (Model 1). Thus, this model (Model 12) was retained as final model and is displayed in Figures S5.

Table 2.11

*Model Fit Indices and Model Fit Comparisons of Random-Intercept Cross-Lagged Panel
Models with Loneliness, Depression and Non-Suicidal Self-Injury*

Models	Model fit indices							Difference test		
	χ^2	df	p	CFI	TLI	RMSEA		$\Delta\chi^2$	Δdf	p
Model 1	66.070	48	.043	.991	.980	.021				
Model 2	68.123	51	.055	.991	.982	.020		1.469	3	.689
Model 3	69.233	51	.046	.991	.980	.021		3.667	3	.299
Model 4	-	-	-	-	-	-	-	-	-	-
Model 5	102.912	66	.003	.982	.971	.026		38.358	18	.004
Model 6	66.746	51	.069	.992	.984	.019		1.066	3	.785
Model 7	68.173	51	.054	.991	.980	.021		2.212	3	.529
Model 8	69.332	51	.045	.991	.981	.021		5.558	3	.135
Model 9	67.571	51	.060	.992	.983	.020		1.622	3	.654
Model 10	68.828	51	.049	.991	.982	.021		4.658	3	.199
Model 11	70.135	51	.039	.990	.980	.021		4.554	3	.208
Model 12	**77.053**	**72**	**.320**	**.997**	**.996**	**.009**		**20.143**	**24**	**.689**

Note. Model 4 did not converge

Figure 2.9

Final Between- and Within-Person Effect of the Random-Intercept Cross-lagged Panel Model with Loneliness, Depression and NSSI
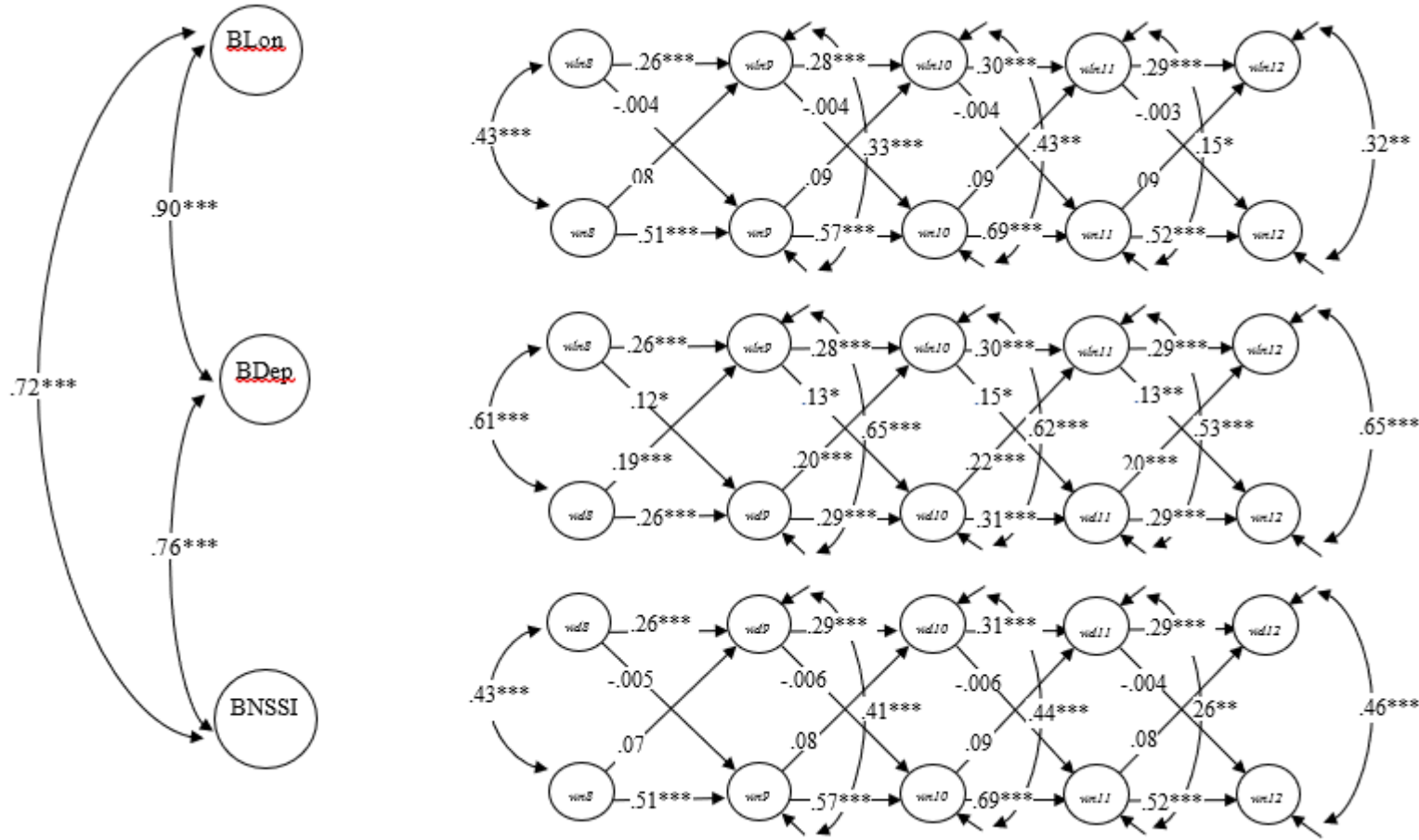
Note. BLn= Between-person random intercept for loneliness; BNSSI= Between-person random intercept for NSSI; BDep= Between-person random intercept for depression. wln8-wfs12 = within-person latent factors for friendship stress from Grade 8 to 12. wnssi8-wnnsi12 = within-person latent factors for NSSI from Grade 8 to 12. wd8-wd12 = within-person latent factors for depression from Grade 8 to 12. Standardized estimates are reported. *p <.05; **p <.01; ***p <.001

Additional Information on Random Intercept Cross-Lagged Panel Model (RI-CLPM) with Peer Victimization, Depression and NSSI

The same procedure used for the models with friendship stress and loneliness was followed. First, fixing the autoregressive paths of depression (Model 3) to be equal over time did not worsen the model fit (see Table S12). However, a model with constrains on the autoregressive paths of peer victimization (Model 2) and NSSI (Model 4) worsened the model fit. Next, constraining the concurrent associations (i.e., within-time residual covariances and variances) to be equal over time (Model 5) worsened the model fit (see Table S12). Finally, all cross-lagged effects, except the ones from NSSI to peer victimization (Model 6), emerged to be time-invariant (Models 7-11). Therefore, in the final model (Model 12) the autoregressive paths of peer victimization and NSSI, the concurrent associations and the cross-lagged effect from NSSI to peer victimization were freely estimated over time, whereas the autoregressive paths of depression and all other cross-lagged effects were fixed to be equal over time. This model had a good fit to the data (Table S12) and fitted the data equally well as the model with all freely estimated parameters (Model 1). Thus, this model (Model 12) was retained as final model and is displayed in Figures S6.

Table 2.12

Model Fit Indices and Model Fit Comparisons of Random-Intercept Cross-Lagged Panel
Models with Peer Victimization, Depression and Non-Suicidal Self-Injury

Models	χ^2	Model fit indices					Difference test		
		df	p	CFI	TLI	RMSEA	$\Delta\chi^2$	Δdf	p
Model 1	63.879	48	.062	.992	.982	.020			
Model 2	98.201	51	<.001	.976	.950	.033	38.703	3	<.001
Model 3	67.655	51	.059	.991	.982	.020	4.685	3	.196
Model 4	72.077	51	.028	.989	.978	.022	9.746	3	.030
Model 5	96.372	66	.009	.984	.975	.023	34.218	18	.012
Model 6	72.816	51	.024	.989	.977	.023	7.887	3	.048
Model 7	67.447	51	.061	.992	.983	.020	4.824	3	.185
Model 8	67.668	51	.059	.991	.982	.020	4.204	3	.240
Model 9	64.120	51	.103	.993	.986	.018	1.830	3	.608
Model 10	68.669	51	.050	.991	.981	.020	6.631	3	.085
Model 11	67.083	51	.065	.992	.983	.019	3.560	3	.313
Model 12	**79.411**	**66**	**.124**	**.993**	**.989**	**.016**	**20.090**	**18**	**.328**

Figure 2.10

Final Between- and Within-Person Effect of the Random-Intercept Cross-lagged Panel Model with Peer Victimization, Depression and NSSI
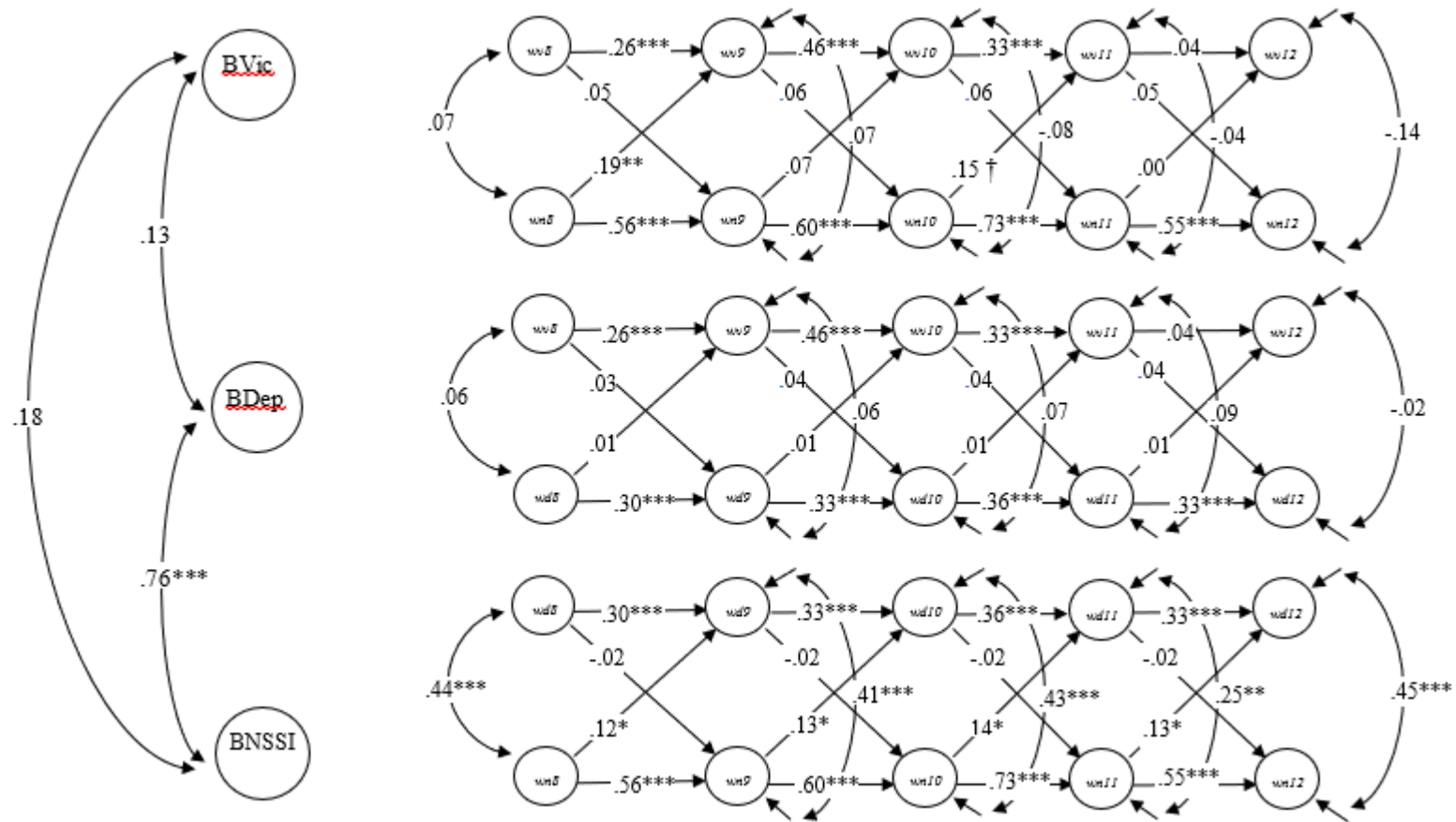
Note. BVic= Between-person random intercept for peer victimization; BNSSI= Between-person random intercept for NSSI; BDep= Between-person random intercept for depression. wv8-wv12 = within-person latent factors for friendship stress from Grade 8 to 12. wnssi8-wnnsi12 = within-person latent factors for nssi from Grade 8 to 12. Wd8-wd12 = within-person latent factors for depression from Grade 8 to 12. Standardized estimates are reported. *$p <$.05; **$p <$.01; ***$p <$.001. †$<$.08.

APPENDIX 3

CHAPTER 3 - NON-SUICIDAL SELF-INJURY IN ADOLESCENCE: THE ROLE OF PRE-EXISTING VULNERABILITIES AND COVID-19-RELATED STRESS

Additional Information on Sensitivity Analysis

To examine the robustness of the analysis we conducted sensitivity analysis on the mediation model between pre-existing vulnerabilities (i.e., prior history of NSSI; anxious and depressive symptoms; poor regulatory emotional self-efficacy) and NSSI at T2 through Covid-19 related stress, including only the schools and classes that participated in both data collection (N=693). The results of the mediation model with the sample of 693 are consistent with the results on the whole sample. Findings showed that Covid-19 related stress mediates the association between a prior history of NSSI (β=.065, SE=.020, p=.001), anxious/depressive symptoms (β=.164, SE=.028, p<.001), poor regulatory negative emotional self-efficacy (β=.104, SE=.030, p<.001) and the occurrence of NSSI. Specifically, findings showed a positive and significant effect of the previous history of NSSI (β= .383, SE=.044, p <.001), anxious/depressive symptoms (β=.006, SE=.061, p=.926), and poor regulatory negative emotional self-efficacy (β=-.158, SE=.063, p=.012) on Covid-19 related stress. Subsequent Covid-19 related stress was positively associated with the occurrence of NSSI (β=.420, SE=.061, p<.001). No significant indirect effects were found on the frequency of non-suicidal self-harm behavior (i.e., continuous variable).

As for the interaction effect between peer perceived support and Covid-19 related stress, we did not find a significant effect both on the presence of NSSI at T2 (β = -.010, SE = .060, p = .863) and on the frequency of NSSI at T2 (β = -.057, SE = .066, p = .390). Similar results were also found with respect to the interaction between perceived parental support and Covid-19-related stress on the presence of NSSI at T2 (β = -.055, SE = .066, p = .404) as well as on the frequency of NSSI at T2 (β = .018, SE = .079, p = .823).

Additional Information on Exploratory Analysis Related to Three-Way Interaction

We conducted a three-way interaction between social support at both waves and Covid-19 related stress to explore the possible changes of social support over time. Specifically, we tested the interactions between (1) social support (e.g., peer and parental support) at T1 and Covid-19 related stress; (2) social support at T2 and Covid-19 related stress; (3) social support at T1, social support at T2 and Covid-19 related stress, and finally (4) social support at T1 and social support at T2. Findings showed not significant effect of the different interactions considered both on the presence and frequency of NSSI at T2. Below the results for peer and parental support.

Peer Support
Findings showed not significant effect for the interaction between Covid-19 related stress and peer support at T1 both on the presence of NSSI at T2 (β = -.107, SE = .086, p = .214) and on the frequency of NSSI at T2 (β = -.106, SE = .131, p = .419).
No significant results were found for the interaction between Covid-19 related stress and peer support at T2 both on the presence of NSSI at T2 (β = .028, SE = .064, p = .663) and on the frequency of NSSI at T2 (β = -.045, SE = .076, p = .560).
As the interaction between Covid-19 related stress, peer support at T1 and peer support at T2 we did not find a significant effect both on the occurrence of NSSI at T2 (β = .119, SE = .139, p = .392) and on the frequency of NSSI at T2 (β = -.056, SE = .130, p = .668).
Finally, no significant results were found for the interaction between peer support at T1 and peer support at T2 both on the occurrence of NSSI at T2 (β = .025, SE = .091, p = .782) and on the frequency of NSSI at T2 (β = -.054, SE = .119, p = .646).

Parental Support
Similar results were also found for the perceived parental support. Specifically, we did not find a significant effect of the interaction between Covid-19 related stress and parental support at T1 both on the presence of NSSI at T2 (β = -.008, SE = .103, p = .938) and on the frequency of NSSI at T2 (β = -.119, SE = .153, p = .436).
As the interaction between Covid-19 related stress and parental support at T2 we did not find a significant effect both on the presence of NSSI at T2 (β = -.057, SE = .076, p = .455) and on the frequency of NSSI at T2 (β = .051, SE = .094, p = .589).
No significant effects were found for the interaction between Covid-19 related stress, parental support at T1 and parental support at T2 both on the occurrence of NSSI at T2 (β = .092, SE = .166, p = .579) and on the frequency of NSSI at T2 (β = -.054, SE = .166, p = .747).
Finally, similar results were found for the interaction between parental support at T1 and parental support at T2 both on the occurrence of NSSI at T2 (β = -.075, SE = .116, p = .518) and on the frequency of NSSI at T2 (β = .035, SE = .136, p = .795).