



Research paper

Non-suicidal self-injury trajectories among adolescents during the COVID-19 pandemic: The role of parenting dimensions and stress reactions

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ABSTRACT

Background: The literature on the trajectories of NSSI behavior during the pandemic is scarce and mainly short-term. Furthermore, studies have not explored the buffering mechanisms that may have altered risk trajectories during this vulnerable period. This study aims to analyze the univariate change of NSSI during adolescence and to examine the alteration of the univariate growth due to the time-varying effect of COVID-19-related stress, parenting dimensions (i.e., positive and negative parenting), and their interaction.

Methods: Participants included 830 Italian adolescents (44.2 % females; $M_{\text{age}} = 14.52$; $SD = 0.80$), who participated in at least one time point of data collection, from a three-wave longitudinal study (T1: from December 2019 to January 2020; T2: December 2020; T3: December 2021).

Results: The Latent Growth Curve Analyses show a linear increase in NSSI over time. In regards to time-varying, at T1, the results highlight that higher levels of negative parenting are associated with higher levels of NSSI at the same time point. Instead, at T2, results show that pandemic stress is associated with higher levels of NSSI at T2. Regarding the interaction effect, positive parenting significantly buffered the effect of COVID-19 stress on NSSI at both T2 and T3.

Limitations: Only some dimensions of parenting style (i.e., positive and negative parenting) are included.

Conclusions: This study attempts to deepen the trajectory of NSSI behavior during the two years of the pandemic and examine the changes caused by the time-varying effects, thus providing suggestions for designing programs to prevent engagement in NSSI.

1. Introduction

Non-suicidal self-injury (NSSI), defined as direct and deliberate self-inflicted damage to body tissues without suicidal intent, is a risky behavior that can lead to negative mental health outcomes, particularly during adolescence (Kiekens et al., 2018). The literature highlights the critical role of interpersonal and intrapersonal factors in the onset and maintenance of NSSI (e.g., Tatnell et al., 2014), with stressful events recognized as important contributors to NSSI behavior (e.g., Liu et al., 2016).

Literature on the trajectories of NSSI behavior over time into the pandemic is scarce and it is mainly short-term. Studies have not explored which buffering mechanisms may alter risk trajectories during this vulnerable period. In particular, we are interested in evaluating the role played by parents during the pandemic, when, at least in Italy, adolescents had limited reference contexts.

Given these premises, the present study aims first to examine the univariate change in NSSI over two years during adolescence. In addition, we shall observe the change in univariate growth due to the time-varying effect of COVID-19-related stress, different parenting dimensions (i.e., positive, and negative parenting), and their interactions.

1.1. Trajectories of non-suicidal self-injury in adolescence and the impact of COVID-19-related stress

Previous studies have shown that self-injury generally occurs in early adolescence, between the ages of 11 and 15, with an increase between the ages of 15 and 16 (i.e., middle adolescence) and a subsequent decrease in late adolescence/early adulthood (e.g., Plener et al., 2015; De Luca et al., 2023). Findings from the growth curve analyses suggest that NSSI may be a transient phenomenon that declines in mid-to-late adolescence (e.g., Barrocas et al., 2015).

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Adverse life events represent risk factors for the initiation and maintenance of NSSI, especially when these events are perceived as particularly stressful (e.g., Liu et al., 2016), contributing to altering its trajectory. Indeed, for those adolescents who have experienced stressful life events, NSSI behaviors may be used as a maladaptive coping strategy to avoid distressing emotional states (Chapman et al., 2006) and to down-regulate the onset of negative emotions such as anxiety and depression (e.g., Gratz and Roemer, 2008). In fact, according to the Experiential Avoidance Model (EAM), individuals who have difficulty managing and controlling negative emotions may adopt NSSI as a means of emotion regulation (e.g., Chapman et al., 2006), given the crucial function of NSSI in releasing and expressing emotions.

Among negative life events, the COVID-19 pandemic is undoubtedly a highly stressful life event that has affected mental health (e.g., Cheng et al., 2023) and likely exacerbated pre-existing vulnerabilities or risk situations (e.g., internalizing symptoms, previous history of mental illness). Therefore, the pandemic may have affected the NSSI trajectory, altering the trend over time. To date, little is known about the trajectory of NSSI during the pandemic period. Most studies have analyzed the trend by comparing the prevalence of this behavior before and after the pandemic (e.g., Zetterqvist et al., 2021; Vatandoost et al., 2023; Wang et al., 2023a, 2023b). For example, Zetterqvist et al. (2021) reported that the lifetime prevalence of NSSI among high school students in Sweden increased to 27.6 % during the 2020–2021 pandemic compared with 2011 and 2014 (17.2 % and 17.7 %, respectively). In addition, Vatandoost et al. (2023) showed that the overall prevalence of NSSI in schools in Belgium and Iran was 35.2 % before the pandemic and 43.8 % in November 2020. Wang et al. (2023a, 2023b) showed that the prevalence rate of NSSI, in Chinese high school students, was 27.2 % before the COVID-19 pandemic with an increase of 10.3 % during the pandemic. In addition, most of the existing studies used a short-term longitudinal design, either during the pandemic or about a year later. The changes in the individual and social environments due to the restrictions of the COVID-19 pandemic disrupted adolescent developmental tasks (e.g., Rajkumar, 2020), leading to the emergence and increase of negative outcomes such as NSSI behavior (e.g., Branje and Morris, 2021; Xiao et al., 2022). A recent systematic review and meta-analysis (Cheng et al., 2023) of the global prevalence of self-harm (i.e., including suicidal behavior) during the COVID-19 pandemic showed high heterogeneity according to subgroup analysis. Specifically, studies conducted in Asia, cross-sectional studies, studies that involved adolescents and females, clinical samples, and individuals with mental health symptoms (e.g., depressive, and anxiety symptoms) reported a higher prevalence of self-harm. These heterogeneities also characterize the more recent literature, where an exacerbated effect of the COVID-19 pandemic on NSSI one year after the pandemic outbreak has been found by some studies (Wang et al., 2023a, 2023b; Zetterqvist et al., 2021), but not in others (e.g., Vatandoost et al., 2023).

In addition, concerning the specific impact of pandemic stress, some studies have reported an association between COVID-19-related stress and NSSI, suggesting that the pandemic may have led to engagement in NSSI (e.g., Xiao et al., 2022). In addition, a recent longitudinal study (De Luca et al., 2022) found that COVID-19-related stress was associated with a higher likelihood of NSSI engagement (i.e., occurrence), particularly among youth with pre-existing vulnerabilities.

1.2. The buffering role of parenting dimensions

According to the theoretical person-environment framework of risk factors for NSSI (e.g., Hawton et al., 2012; Fox et al., 2015), multiple circumstances may have combined to form a cumulative effect. Among these, triggers may have been related not only to stressful life events (e.g., Liu et al., 2016) but also to dynamics within the family structure (e.g., Wang et al., 2022).

Given the emphasis in the developmental literature on the importance of timing in causal processes, we consider it crucial to examine the

impact of time-varying predictors (i.e., short-term effects) on the univariate growth of NSSI. Thus, the role of time-varying predictors of positive and negative parenting, COVID-19-related stress, and their interaction are assessed concurrently with NSSI. In this way, these factors have more short-term and potentially time-varying effects on the predicted levels of NSSI measured at each time point. Particularly in the pandemic situation, the consideration of the time-varying effect is very important to capture short-term mechanisms during the different stages of the pandemic itself. Indeed, the COVID-19 pandemic was characterized by an uneven pattern that depended on the spread of the virus, which led to continuous changes in the restrictive measures adopted, especially in Italy.

Undoubtedly, regardless of COVID-19, family plays an important role in the development of adolescents (e.g., Baetens et al., 2021). Theoretical and empirical studies have found that adolescents who can benefit from positive and supportive interpersonal relationships may be protected from engaging in NSSI (e.g., Garisch and Wilson, 2015). While positive parenting is recognized as a protective factor against the occurrence of negative outcomes, poor quality parenting represents a risk factor for adolescent mental health and well-being, contributing to engagement in risky behavior such as NSSI (e.g., Di Pierro et al., 2012). Specifically, positive parenting is associated with lower levels of NSSI, whereas highly controlling parenting and harsh parental punishment are associated with higher levels of NSSI (e.g., Victor et al., 2019; Fong et al., 2022). In addition, a recent study found that negative parenting styles and adverse childhood experiences contributed to the onset of NSSI behaviors in adolescents (Liu et al., 2020).

The family is the most proximal and important system in influencing the development of children and adolescents (Bronfenbrenner, 1986); this is especially true during times of catastrophe or stressful events such as the COVID-19 pandemic (Cobham et al., 2016). Exposure to stressful situations related to the changes caused by the pandemic may have led to different outcomes and reactions and its impact could be varied depending on the different stages of the pandemic. On the one hand, some studies show that the early months of the pandemic had a major impact on family mental health, weighing on parents' wellbeing, and increasing child behavior problems (e.g., Patrick et al., 2020). In addition, the onset of the pandemic may have made it difficult for parents to manage their relationship with their children in addition to providing adequate emotional support (Prime et al., 2020; Carosella et al., 2021). On the other hand, the pandemic created unique conditions for adolescents to spend more time with their families, which is likely to have a variable impact on adolescents' mental health and well-being depending on family dynamics and individual perceived stress. This is particularly true in the early stages of the pandemic (e.g., during the outbreak of the pandemic and the following months). Notably, in Italy, high schools turned to fully or partially remote learning until the end of the year 2020. Spending more time together may be an opportunity for some families to provide additional resources and support, shaping engagement in NSSI as an emotion regulation strategy (Taliaferro et al., 2020). Indeed, individuals who can benefit from positive and supportive interpersonal relationships may be protected from engaging in NSSI (e.g., Hankin and Abela, 2011).

To date, few studies in the literature have focused on the impact of parenting on NSSI engagement. Specifically, Carosella et al. (2021) note the importance of family support as a potential protective factor against engagement in NSSI during the early months of the pandemic, highlighting that females who received less support were more at risk of engaging in NSSI behavior. Instead, Wang et al. (2023a, 2023b) found that emerging NSSI and sustained NSSI subgroups had lower perceived family functioning compared to subjects without NSSI. Only one study examined the effect of the pandemic between 2021 and 2022, on a clinical sample of patients with NSSI (Zhu et al., 2022), finding a significant positive association between negative parenting practices and NSSI among Chinese adolescents.

Theoretical and empirical work highlights that positive and

supportive interpersonal relationships may protect adolescents from engaging in NSSI (e.g., [Hankin and Abela, 2011](#)). Indeed, higher levels of perceived social support from family, or other significant relationships are associated with lower levels of NSSI among adolescents (e.g., [Hankin and Abela, 2011](#)). According to the stress-buffering hypothesis model ([Cohen and Wills, 1985](#)), social support can buffer the negative impact of stressful events on mental health outcomes and risk behaviors ([Rueger et al., 2016](#)), including NSSI (e.g., [Liu et al., 2022](#)). Previous work has found support for the stress-buffering model, underlying how high levels of positive parenting may buffer the effects of stress on mental health outcomes and risk behaviors (e.g., [Hagan et al., 2019](#)). However, to date, no studies have examined the buffering role of the family (i.e., parenting style) in the relationship between stress and NSSI. Only one study has examined the moderating role of social support (i.e., peer support and family support together) in the relationship between stress and NSSI, but found no significant effects ([De Luca et al., 2022](#)).

1.3. The current study

The present study aimed (1) to analyze the univariate change in NSSI over three-time points during adolescence and (2) to examine the alteration of the univariate growth due to the time-varying effect of COVID-19-related stress, different parenting dimensions (i.e., positive, and negative parenting), and the interaction between them (i.e., positive parenting X COVID-19 related stress; negative parenting X COVID-19 related stress). Adolescents may have reported an increase in NSSI over the three years following the pandemic. This scenario could occur both because there is some evidence that NSSI generally shows a peak during adolescence (i.e., between 15 and 16 years old) (e.g., [Gillies et al., 2018](#); [De Luca et al., 2023](#)), and because the COVID-19 pandemic may have affected this trajectory (e.g., [Wang et al., 2023a, 2023b](#); [Zetterqvist et al., 2021](#)). Regarding the time-varying effect, we expect that positive and negative parenting would be associated with lower and higher levels of NSSI respectively. Specifically, we hypothesize that one year after the pandemic outbreak (T2), when restrictions were still in place, routine normal activities were limited, and education was predominantly remote, parenting is associated with NSSI behavior. We hypothesize that positive parenting is associated with lower levels of NSSI. In contrast, in the longer term, two years after the pandemic (T3), when routines returned to normal, we hypothesize that the association between parenting and NSSI is weaker than at T2. Regarding the pandemic stress, adolescents with higher levels of COVID-19-related stress levels may engage in higher levels of NSSI during the pandemic (T2). On the contrary, we hypothesize that in the long term two years later, stress is no longer associated with NSSI. Finally, we hypothesized that positive parenting would buffer the effects of pandemic stress on engagement in NSSI, representing a protective factor during stressful life events, especially during the early stages of the pandemic. Specifically, we can suppose that adolescents who experienced high levels of stress during the pandemic, but who also benefited from positive parenting, may have reported lower levels of NSSI than those who did not benefit from positive parenting. Therefore, having a positive parenting style may be an important protective factor in times of crisis.

2. Method

2.1. Participants and procedure

Participants were recruited from a longitudinal research project, that began in the 2019–2020 school year on risk behavior in adolescence. Middle and high schools (i.e. first and second year) were invited by the Regional Education Office to participate in this research project. Schools that agreed to participate were included in the data collection. A total of twelve schools (four middle schools and eight high schools) joined the project, thus participating in the first data collection (T0). Subsequently, following the outbreak of the COVID-19 pandemic and related

organizational difficulties, four middle schools and three high schools did not participate in the subsequent surveys. Therefore, a total of five schools participated in all three data collections. The students who participated in the data collection were a general sample, not selected for specific characteristics.

Preliminary approval by the school principal and students' parents was required to obtain informed consent. Only students who had their parents' consent participated in the research.

Participants included 830 adolescents (45.8 % females), enrolled, at baseline in Grades 9 and 10 of high schools in Tuscany (Italy), who participated in at least one time point of data collection.

The mean age was 14.52 years (SD = 0.80) at the baseline, ranging from 12 to 20 years.¹ Most participants were Italians (89.4 %), and the remaining adolescents (10.6 %) came from different countries. Most participants lived in a two-household family, with both biological parents (84.90 %), 13.50 % of them lived in a single-parent household, and 1.60 % with others from biological parents (e.g., adopted mother).

Specifically, three waves of data collection were conducted. The first data collection occurred in January/February 2020, before the first COVID-19 outbreak in Italy (T1; $N = 625$). Subsequently, participants were assessed approximately one year later in December 2020²/January 2021, during the third COVID-19 wave (T2; $N = 504$). Finally, the third wave of data was collected two years after the first wave in December 2021 (T3; $N = 462$). At T1, data were collected at school (i.e., in person) under the supervision of a research assistant. At T2, data collection occurred online (i.e., not in person) because of COVID-19 restrictions. Most of the schools were in distance learning except for a few schools that provided mixed teaching with half the class in person and half the class at a distance. At T3, data collection was both in person and online following the availability and provisions of the schools involved. Research assistants were available online to introduce the survey to the participants and answer any questions. In December 2021, all schools were back in school and attending classes fully in person.

The retention rate between consecutive assessments ranged between 54 % and 64 % (51 % between T1 and T3). Specifically, of the 625 participants at T1, 402 also participated at T2 and 320 at T3. Study attrition was mainly due to schools' difficulties related to the COVID-19 situation, which negatively impacted data collection conditions. To compare participants with and without missing data, [Little \(1988\)](#) Missing Completely at Random (MCAR) tests were performed. The test emerged to be not significant ($\chi^2(59) = 61.624, p = .3821$), suggesting that data were likely missing at random ([Bollen, 1989](#)).

Missing data were handled using the Full Information Maximum Likelihood estimation (FIML, [Acocck, 2005](#)) that allows retaining cases with missing data, therefore avoiding potentially biased parameter estimates through pairwise or listwise deletion ([Schafer and Graham, 2002](#)). The study received ethical approval from the University of Florence Ethics Committees for Research.

2.2. Measures

Non-suicidal self-injury (NSSI) was measured at three-time points

¹ The frequency of the age was as follow: 1 (0.1 %) had 12 years old; 12 (1.5 %) had 13 years old; 479 (57.9 %) had 14 years old; 245 (29.5 %) had 15 years old; 75 (9.1 %) 16 years old; 10 (1.2 %) 17 years old; 4 (0.5 %) 18 years old, and 1(0.1 %) 20 years old.

² The second survey took place almost a year after the first when new restrictive and containment measures were introduced. With the Decree of November 3, 2020, in consideration of the particularly widespread nature of the pandemic and the increase of COVID-19 cases 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. During the survey, most of the schools that participated in the project were in distance learning, while others were in mixed mode teaching.

using six items that assessed different types of NSSI behavior (e.g., cutting/carving, burning; [Prinstein, 2008](#); [Giletta et al., 2012](#)). Participants were asked to indicate on a five-point Likert scale from “never” to “10 + times” how many times in the previous year they intentionally engaged in each of these behaviors, without suicidal intent. A total score of NSSI was computed by the sum of participants’ answers to the six items, with higher scores indicating higher levels of NSSI engagement. The internal consistency (McDonald’s omega, ω) ranged between 0.85 and 0.86 across time points.

2.3. Time-varying covariates

COVID-19 related perceived stress. COVID-19-related stress was measured at T2 and T3 using the Perceived Stress Scale (PSS-10; [Cohen et al., 1983](#); Italian version by [Mondo et al., 2019](#)). This scale included ten items rated on a 5-point Likert scale from 0 (‘Never’) to 4 (‘Very often’). The scale was preceded by a brief text explaining what a stressful event is and that a health emergency due to COVID-19 can be defined as a stressful event. A total PSS-10 score was computed by averaging across the ten items so that higher scores reflected higher levels of stress. The internal consistency (McDonald’s omega, ω) was 0.87 at T2 and 0.88 at T3.

Parenting dimensions. Different parenting dimensions were measured at three-time points using the Alabama Parenting Questionnaire short form (APQ; [Frick, 1991](#); Italian version by [Esposito et al., 2013](#)). The scale was composed of fifteen items rated on a five-point Likert scale ranging from 1 (‘never’) to 5 (‘ever’). It included five different subscales; in this study, we considered the positive parenting dimension (i.e., the average score of positive parenting and parental involvement), and the negative parenting dimension (i.e., the average score of inconsistent discipline and corporal punishment). Higher scores indicate higher levels of positive and negative parenting. The poor monitoring/supervision referring more to a control dimension and not to positive or negative parenting was not included in this study. The internal consistency (McDonald’s omega, ω) ranged between 0.80 and 0.81 across time points.

2.4. Plan of analysis

First, descriptive analyses, including bivariate correlations (Pearson’s r) and prevalence of NSSI behaviors, were computed to examine associations between all study variables and NSSI prevalence over time among participants who completed all three assessments.

All the analyses were conducted with Mplus 8.0 ([Muthén and Muthén, 1998-2017](#)). Latent Growth Curve Analysis (LGCA; [Duncan and Duncan, 1994](#); [McArdle, 1988](#); [Meredith and Tisak, 1990](#)) was used to estimate and predict the longitudinal development of NSSI. LGCA is one of the most recommended approaches to examining individual differences in continuous trajectories over time (e.g., [Ferrer and McArdle, 2003](#); [Burant, 2016](#)). The variables observed repeatedly within this frame can be used to estimate the unobserved underlying trajectory defined by two latent growth factors: the intercept and the slope. Univariate LGCMs allow an examination of the initial level of a target outcome (i.e., the intercept), its rate of linear change or trends (i.e., the slope), and the association between the initial level of the outcome and its rate of change (i.e., the correlation between the intercept and the slope). In the current study, the factor loading of the NSSI variable was fixed at 1.0 to represent the starting point of the trajectory, while the three terms of each latent slope variable were fixed at 0, 1, and 2 for T1, T2, and T3 respectively. First, to examine the growth of NSSI over time, a univariate unconditional growth model was estimated (model 1). A conditional model was then estimated, extending the unconditional model to include the direct effects of time-varying covariates (i.e., COVID-19-related stress, parenting dimensions, and the interaction between them) on NSSI (model 2). Each repeated measure of NSSI was regressed on the respective time-specific covariates. Finally, for the

interaction that emerged significant, we explored whether the parenting dimension moderated the association between COVID-19-related stress and NSSI. The significant two-way interactions were plotted.

Model fit was evaluated with the Maximum Likelihood Ratio Test Statistic (χ^2), the Root Mean Square Error of Approximation (RMSEA), the Comparative Fit Index (CFI), and the Tucker-Lewis Index (TLI). Recommended cut-off points for these measures are 0.08 ([Browne and Cudeck, 1992](#)) or 0.06 ([Hu and Bentler, 1998](#)) for RMSEA, 0.90 or 0.95 for CFI and TLI ([Bollen, 1989](#)) and 0.08 or 0.06 for SRMSR ([Hu and Bentler, 1998](#)). The Maximum Likelihood Robust (MLR) estimation was used for all models.

3. Results

3.1. Descriptive analysis

Table 1 reports bivariate correlations, means, and standard deviations for all study variables. Among adolescents who participated at all three time points ($N = 229$), 32.5 % reported NSSI at Time 1, 35.9 % at T2, and 37.7 % at T3.

3.2. Unconditional model of non-suicidal self-injury

First, as shown in **Tables 2 and 3**, the unconditional univariate LGCA was tested for NSSI (i.e., Model 1). Results showed that both the intercept and slope of NSSI were positive and significant, suggesting, on average, a linear increase in NSSI over time.

Additionally, the intercept and slope variances were significant, suggesting the presence of interindividual differences in the levels of NSSI over time. Finally, the correlation between the intercept and the slope was not significant.

3.3. Conditional growth model: time-varying covariates

The predictive value of time-specific variables such as COVID-19-related stress, parenting dimensions (i.e., positive, and negative parenting), and the interaction between them was evaluated by adding time-varying covariates to the previous model (see **Table 3 and Fig. 1**).

Specifically, at T1 before the outbreak of the COVID-19 pandemic, results showed that higher levels of negative parenting were associated with higher levels of NSSI at the same time point ($\beta = 0.287$; 95 % CI [0.068, 0.505]). On the contrary, positive parenting was not associated with NSSI.

Instead, both at T2, and T3, neither positive nor negative parenting was associated with lower or higher levels of NSSI at T2 and T3 respectively. Instead, as concerns COVID-19 related-stress, results showed that both at T2 and T3 pandemic stress was associated with higher levels of NSSI (T2: $\beta = 0.428$; 95 % CI [0.090, 0.766]; T3: $\beta = 0.856$; 95 % CI [0.134, 1.578]).

Fig. 2 displays the interaction effect of COVID-19-related stress and positive parenting on NSSI both at T2 and T3. A significant and positive interaction emerged between COVID-19-related stress and positive parenting on NSSI at T2 and T3 (T2: $\beta = -0.440$; 95 % CI [-0.699, -0.181]; T3: $\beta = -0.664$; 95 % CI [-1.206, -0.123]). Specifically, at T2, the results showed that as COVID-19-related stress increased, NSSI behaviors significantly decreased in adolescents with high levels of positive parenting ($\beta = -0.576$; 95 % CI [-0.758, -0.058]), while remaining stable in the group with low levels of positive parenting ($\beta = 0.168$; 95 % CI [-0.241, 0.430]). Instead, at T3, the results showed that as COVID-19-related stress increased, NSSI behaviors significantly increased in adolescents with low levels of positive parenting ($\beta = 0.885$; 95 % CI [0.207, 1.563]), while remaining stable in the group with high levels of positive parenting ($\beta = -0.014$; 95 % CI [-1.180, 1.152]). Finally, the interaction between COVID-19-related stress and negative parenting on NSSI was not significant both at T2 and T3.

Table 1
Bivariate correlations (Pearson's r) among the study variable.

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
1. NSSI T1	–										
2. NSSI T2	0.582**	–									
3. NSSI T3	0.523**	0.690**	–								
4. Pos. Parenting T1	–0.308**	–0.217**	–0.244**	–							
5. Pos. Parenting T2	–0.286**	–0.314**	–0.300**	0.684**	–						
6. Pos. Parenting T3	–0.289**	–0.231**	–0.324**	0.599**	0.701**	–					
7. Neg. Parenting T1	0.248**	0.136**	0.178**	–0.163**	–0.137**	–0.129*	–				
8. Neg. Parenting T2	0.072	0.173**	0.034	–0.024	–0.045	–0.132*	0.483**	–			
9. Neg. Parenting T3	0.220**	0.169**	0.177**	–0.040	–0.129*	–0.074	0.509**	0.657**	–		
10. COVID stress T2	0.353**	0.393**	0.409**	–0.311**	–0.372**	–0.244**	0.166**	0.102*	0.137*	–	
11. COVID stress T3	0.281**	0.331**	0.402**	–0.293**	–0.263**	–0.265**	0.104	0.104	0.096*	0.689**	–
Mean	0.073	0.076	0.096	3.432	3.498	3.391	2.076	2.107	2.091	1.956	2.187
SD	0.128	0.135	0.152	0.747	0.738	0.757	0.592	0.599	0.598	0.727	0.751

Note. Pos. Parenting means Positive Parenting; Neg. Parenting means Negative Parenting.

** $p < .01$.

* $p < .05$.

Table 2
Fit indices for unconditional, and time-varying models.

Models	χ^2	df	p	CFI	RMSEA	SRMR
1. Unconditional model NSSI	1.773	1	0.183	0.995	0.031	0.013
2. Time-Varying model	0.194	1	0.659	1.000	0.000	0.001

Note. df: degree of freedom; CFI: Comparative Fit Index; RMSEA: Root Mean Square Error of Approximation; SRMR: Standardized Root Mean Squared Residual; AIC: Akaike's Information Criterion.

4. Discussion

This study contributed to the current literature by delving deeper into the trajectory of NSSI behavior during the two years of the pandemic and examining its change due to the time-varying effect of parenting styles (i.e., positive and negative parenting), COVID-19-related stress, and the interaction between them. The strong focus on a dynamic model able to capture the time-varying effect of COVID-19 perceived stress and the parenting role on the trajectory of NSSI during the pandemic adds value to the study, differentiating it from the published literature.

In terms of the trajectory of NSSI over time, the results showed a significant increase in NSSI levels over time, from January 2019 to December 2021, albeit with a small effect. This finding appears to be consistent with some studies conducted during the pandemic period, which show that the pandemic affected risk behaviors such as NSSI, leading to an increase in NSSI over time (e.g., Cheng et al., 2023; Xiao et al., 2022; Wang et al., 2023a, 2023b). Specifically, Wang et al. (2023a, 2023b) showed a direct effect of the pandemic on adolescent mental health, highlighting a decline in NSSI due to the pandemic among high school students. Several restrictive measures imposed by the pandemic may have influenced behavior, leading adolescents to engage in it as a maladaptive coping strategy to manage negative emotions (e.g., Xiao et al., 2022).

This finding may also be related to the developmental period under consideration, i.e., adolescence. The onset of the behavior occurs around the age of 13, with an increase and peak between the ages of 15 and 16, followed by a decline in late adolescence (e.g., De Luca et al., 2023). The sample in this study was followed from ages 14 to 17, so the developmental trajectory of NSSI may also explain this trend. However, COVID-19-related stress may have increased NSSI growth acceleration, especially in its early phase. Finally, it's important to emphasize that differences in NSSI prevalence may be due to differences in subgroup analyses, methodology, and time of data collection (e.g., Wang et al., 2023a, 2023b; Cheng et al., 2023), suggesting the importance of using universal criteria in future studies.

Table 3
Growth curve parameters of unconditional models (Model 1 in Table 1) and effects of time-varying predictors on NSSI in the conditional model (Model 2 in Table 1).

	Unconditional Model	
	i NSSI	s NSSI
Mean (Unstandardized)	0.072 (0.005); [0.064, 0.080]***	0.014 (0.003); [0.007, 0.014]***
Variance (Unstandardized)	0.011 (0.002); [0.007, 0.011]***	0.002 (0.001); [0.001, 0.002]*
Correlation i-s NSSI	Estimate –0.046 (0.231); [–0.426, 0.334]	

	Conditional Model With Time-Varying Covariates		
	NSSI (T1)	NSSI (T2)	NSSI (T3)
Pos. par. T1	–0.104 (0.128); [–0.314, 0.107]		
Neg. par. T1	0.287 (0.133); [0.068, 0.505]*		
Pos. par. T2		0.133 (0.106); [–0.042, 0.307]	
Neg. par. T2		0.142 (0.115); [–0.046, 0.331]	
Covid-19 T2		0.428 (0.205); [0.090, 0.766]*	
Pos. par. T2 * Covid-19 T2		–0.440 (0.158); [–0.699, –0.181]**	
Neg. par. T2 * Covid-19 T2		0.111 (0.199); [–0.217, 0.439]	
Pos. par. T3			0.172 (0.204); [–0.164, 0.507]
Neg. par. T3			0.183 (0.252); [–0.231, 0.597]
Covid-19 T3			0.856 (0.439); [0.134, 1.578]†
Pos. par. T3 * Covid-19 T3			–0.664 (0.329); [–1.206, –0.123]**
Neg. par. T3 * Covid-19 T3			–0.131 (0.443); [–0.860, 0.598]

Note. Pos. par. means Positive parenting; Neg. par means Negative parenting; COVID-19 means Covid-19 stress. The value reported are Estimate, Standard Error, and 95 % CI.

*** $p < .001$.

* $p < .05$.

† $p < .055$.

The fluctuating effect of COVID-19-related stress on the trajectory of NSSI resulted in the model emphasizing a stronger effect at T2 as compared to T3. These results corroborate literature data by

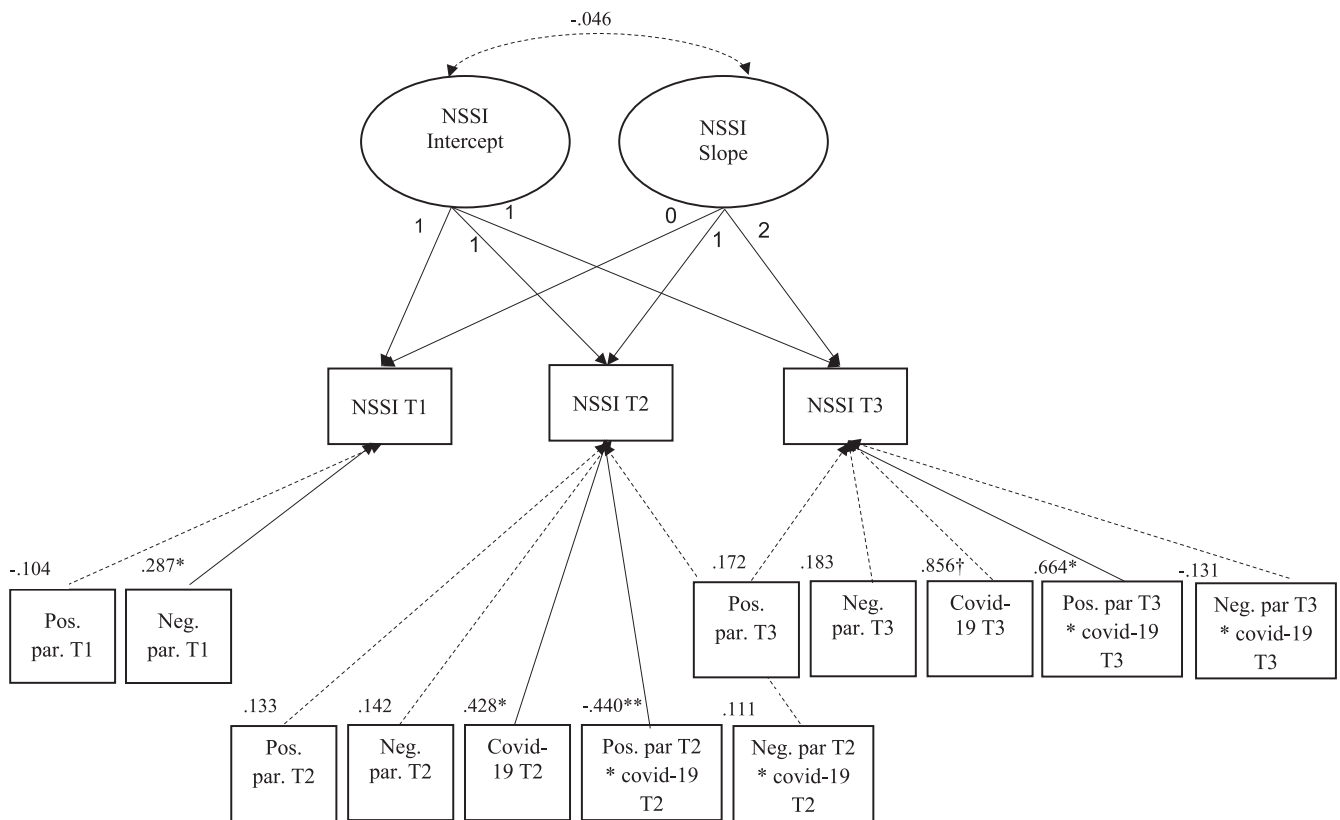


Fig. 1. Effects of time-varying predictors on the multivariate growth of NSSI.

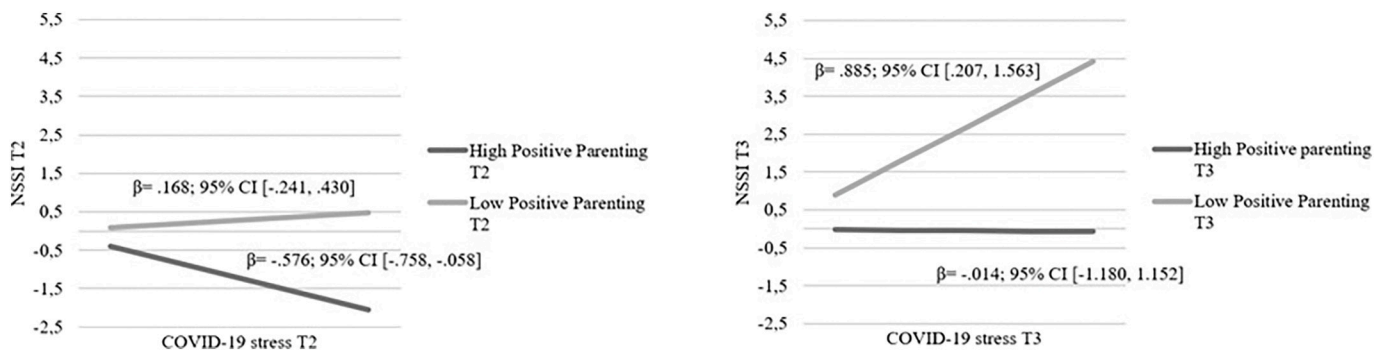


Fig. 2. Interaction between COVID-19 stress and Positive parenting on NSSI at T2 and T3.

highlighting that as perceived stress increased during the pandemic, NSSI enactment increased accordingly as well. Specifically, we can see that this association is stronger one year after the pandemic outbreak, suggesting that the psychological distress due to the environmental changes caused by the pandemic led to an increase in NSSI as a maladaptive and dysfunctional strategy for stress regulation (e.g., De Luca et al., 2022). In contrast, the results show that this association appears weaker two years after the pandemic, suggesting that the return to life routines may have mitigated the impact of stress as a catalyst for engaging in risk behaviors such as NSSI.

Findings related to the time-varying effect of parenting are particularly interesting and they showed whether parenting acted as a buffering mechanism against the exacerbated impact of COVID-19-related stress on NSSI. Looking at the pre-COVID period (T1), negative parenting was positively associated with NSSI. Adolescents who were subjected to negative parenting styles before the pandemic also reported higher levels of NSSI at the same time. This finding is consistent with the

literature suggesting that highly controlling parenting and harsh punishment are associated with higher levels of NSSI (e.g., Victor et al., 2019; Liu et al., 2020). According to the Four-Functional Model, interpersonal vulnerabilities (e.g., parenting dimensions) may make adolescents more prone to respond to challenging or stressful life events, resulting in difficulties in emotion regulation and thus increasing the likelihood of engaging in NSSI (Nock, 2009). In contrast, at one and two years after the onset of the pandemic (i.e., T2 and T3), findings indicated that the unique effects of positive and negative parenting styles on NSSI were not related to the likelihood of engaging in NSSI. Instead, a significant interaction was found between positive parenting and COVID-19-related stress on NSSI at both T2 and T3. This significant effect may explain that while negative parenting was a risk factor before the pandemic, it was no longer a unique risk factor for engaging in the behavior one and two years later because parenting styles interact with adolescents' perceived stress. The changes caused by the pandemic may have brought about a dynamic change as a function of the perceived

level of parenting.

Specifically, as regards the buffering effects, the results show that one year after the pandemic outbreak (i.e., T2), as COVID-19-related stress increased, NSSI behavior tended to decrease among adolescents with high levels of positive parenting, while remaining stable in the group with low levels of positive parenting. This finding suggests that adolescents who experienced high levels of stress in response to the COVID-19 pandemic, but who benefit from positive parenting may be less likely to engage in NSSI without changing the trajectory. Therefore, positive parenting seems to have a protective role for adolescents who were more stressed by the pandemic. In fact, according to the stress-buffering model (Cohen and Wills, 1985), positive parenting can buffer the negative impact of stressful events on negative outcomes. In this specific period, spending more time together may be an opportunity for some families to serve as additional resources and support, shaping the engagement in NSSI as an emotion regulation strategy (Taliaferro et al., 2020). Moreover, these data are consistent with the study by Carosella et al. (2021), who found that family support was a protective factor for engagement in NSSI among female adolescents.

Conversely, two years after the pandemic (i.e., T3), results showed that adolescents who experienced high levels of stress in response to the COVID-19 pandemic and who had low levels of positive parenting were more likely to engage in NSSI, whereas high levels of positive parenting were no longer a protective factor for engagement in NSSI. This finding can be explained by considering the contextual contingency; indeed, by December 2021, students had returned to school and were increasingly resuming their previous routines. Therefore, it is possible that lowered levels of parental support prevented them from containing the stress associated with returning to normal routines after the pandemic. This may have led to difficulties in coping with the emotions caused by the stressful events experienced, leading adolescents to engage in NSSI to cope with stressful or difficult situations.

In sum, we can conclude that positive parenting (i.e., and not negative parenting) plays a positive role in buffering the impact of pandemic-related stress on the enactment of NSSI behavior. Having positive parenting can help count the effect of stressful events on the enactment of risk behaviors such as NSSI.

Conversely, negative parenting appears to be associated with NSSI engagement before the pandemic outbreak, while its effect disappears during the pandemic period and is no longer a risk factor. We can therefore speculate how pandemic-related changes may have contributed to the alteration of some processes related to parenting styles.

4.1. Strengths and limitations

This study has several strengths, including a three-wave design with data collected before and one and two years after the COVID-19 pandemic outbreak, which allowed us to examine possible changes in the trajectory of NSSI over time during middle adolescence. Many studies examining adolescent risk behaviors during the pandemic are either cross-sectional or do not include pre-pandemic measures of risk behaviors. In addition, the time-varying effects of COVID-19-related stress and parenting dimensions on NSSI were examined at each time point.

Despite the strengths of this study, it is important to consider some limitations when interpreting the results. First, limitations related to the study measures should be noted. Self-report assessment of NSSI may have been influenced by social desirability, respondent, and recall bias, or may have been subject to potential misinterpretation regarding the definition of NSSI. Therefore, the use of multi-method assessments of NSSI (i.e., quantitative assessment and qualitative assessment such as interviews) should be considered in future studies. In addition, demographic variables, such as gender, age, or family income, were not included as intervention variables. Besides, within the measure of perceived pandemic stress, no specific data related to COVID-19 infection in participants or family members were included in this study.

Similarly, other adverse childhood experiences (e.g., abuse or neglect, parental physical or mental illness) were not assessed. Future studies should include such information to control for the possible influence of adverse experiences on study variables such as NSSI and parenting. The dimension of poor supervision/control was not included in the study. Future studies may include all dimensions of parenting style. In addition, due to the limitations caused by the pandemic, the different methods of data collection (i.e., face-to-face vs. remote or mixed method) between the three waves of data collection may have influenced participants' responses. This may be particularly true for NSSI, as some adolescents may have been more likely to report engaging in NSSI in a given situation because it is a stigmatized behavior. Last, the study is culturally specific, and thus the findings may not be generalizable to other geographic regions or cultures due to local regulations that may have imposed specific restrictions during the pandemic.

5. Conclusions

The COVID-19 pandemic provided a unique natural context for examining the impact of adversity on NSSI, but the implications of this work extend beyond this unique event. The results of this study suggest both future research directions and implications on a preventive and clinical level.

First, the findings suggest the importance of identifying possible risk patterns of NSSI in adolescents in order to design targeted and tailored prevention strategies for NSSI engagement and to intervene in a range of related mechanisms and processes. Specifically, it would be important to better identify families at risk due to negative parenting practices and to investigate the association between several variables regarding the family environment (e.g., parenting style, family composition, family stressors) and NSSI engagement in adolescents, with a specific focus on those who are at risk.

Second, this study suggests how practical implications could include the importance of designing prevention programs that include the promotion of positive parenting practices, given the crucial role of positive parenting for adolescents experiencing high levels of stress. In addition, future interventions for adolescents with NSSI should be conducted at both the family and individual levels. Because NSSI may be used as an unhealthy coping strategy, these findings highlight the importance of teaching strategies for coping with adverse life events through tailored training programs that target adolescents with specific vulnerabilities.

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CRediT authorship contribution statement

Lisa De Luca: Writing – original draft, Software, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Annalaura Nocentini:** Writing – review & editing, Supervision, Methodology, Conceptualization. **Fulvio Tassi:** Writing – review & editing, Supervision, Conceptualization. **Ersilia Menesini:** Writing – review & editing, Supervision, Conceptualization.

Declaration of competing interest

The authors declare that there are no conflicts of interest.

Data availability

The data that support the findings of this study are available on request from the corresponding author.

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