



# Predicting prolonged non-suicidal self-injury behaviour and suicidal ideations in adolescence – the role of personal and environmental factors

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## Abstract

Suicide is one of the leading causes of death among adolescents and repetitive suicidal ideations (SI) and non-suicidal self-injury (NSSI) often precede it. In order to improve recognition of youth who are at high risk of suicide, current study aims to identify which individual variables (personality, self-concept and adverse childhood experiences – ACE) predict prolonged NSSI and SI from middle to late adolescence. A 3-year longitudinal study was conducted with 1101 Croatian adolescents (aged 15–17). 181 students (72.4% females) reported either NSSI or SI or both in T1 and were included in all waves of the study. Analyses are focused on differentiation between adolescents who continue with NSSI/SI and those who stop with it in a 3-year period. Results showed that adolescents with prolonged NSSI/SI had more ACE, especially domestic violence, worse family financial status, higher neuroticism and lower results on self-concept variables. The prediction model of classification of those who have prolonged NSSI or SI was better for SI than NSSI, with predictors explaining 31% of variation in SI. Adolescents who experienced more ACE and report more neuroticism have a higher chance of prolonged SI, while youth who perceive better family financial status and have better relationships with parents have a greater chance to stop with it. For NSSI only neuroticism was a significant predictor. Considering significant variables which could predict prolonged NSSI and/or SI, data presented in this paper have both scientific and practical contribution in understanding, treating and preventing adolescents' mental health problems.

**Keywords** Non-suicidal self-injury · Suicidal ideation · Adolescence · Self-esteem · Personality · Adverse childhood experiences

## Introduction

Adolescence is a developmental period with an elevated risk for both non-suicidal self-injury (Klonsky et al., 2011) and suicidal thoughts (ideations) and attempts, which could lead to suicide (Miller, 2011). Suicide is one of the leading causes of death among adolescents aged 15–19 years

(Curtin & Heron, 2019). Studies on these mental health problems have greatly increased in the last decade, indicating that one of the key priorities for health service providers, as well as national governments, is to better identify youth who are at high risk of suicide. Duarte et al. (2020) propose that identifying adolescents who deliberately injure themselves is a key factor for early intervention.

According to the American Psychiatric Association (2013), non-suicidal self-injury (NSSI) is defined as the direct and intentional destruction of one's body tissue (e.g., repetitive cutting or burning), conducted neither with lethal intent nor in adherence to religious or cultural customs. Usually, it begins between 12 and 14 years of age (Cipriano et al., 2017), and adolescents and young adults are at the greatest risk of engaging in these behaviours. Over the whole period of adolescence, in community samples, the lifetime prevalence of NSSI is between 8% and 47% (Klonsky et

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al., 2011; Cipriano et al., 2017; Plener et al., 2018). In the last decade, these problems have been increasingly frequent (Geulayov et al., 2016).

Although NSSI excludes suicidal intent by definition, various researchers have found a direct association between deliberate self-harm and suicide attempts. According to Duarte et al. (2020), more than 90% of adolescents with suicide attempts also report deliberate self-harm, while Nock et al. (2006) found that 70% of adolescents engaging in NSSI also reported a suicide attempt and 55% reported multiple suicide attempts. This pattern of behaviour was found in adults as well; Hawton et al. (2003) and Chan et al. (2016) concluded that adults who have histories of self-harming behaviours are at greater risk of future suicide and suicide attempts. This risk is even greater after repeated episodes of self-harm (Zahl & Hawton, 2004), and the repetition of self-harm is rather common, especially in clinical populations. Hawton et al. (2012) claimed that 12-month recidivism of self-harm episodes occurred in 15–25% of hospitalized adolescents, and repetition is also common in non-clinical samples (Hawton, 2002), although in current literature there are lack of studies that focus only on non-clinical samples. Lüdtke et al. (2017) found that repetitive NSSI is more common in female and older adolescents.

Suicidal ideation (SI) can be defined as passive thoughts about wanting to be dead or active thoughts about killing oneself without suicidal behaviour (Posner et al., 2007), and NSSI is a strong predictor of SI (Klonsky et al., 2011, 2013). SI peaks during adolescence and young adulthood, with an international lifetime prevalence of 12.1–33% (Turecki & Brent, 2016). In a large UK-based cohort of 16-year-olds, the lifetime prevalence of SI was 9.6% (Mars et al., 2019; Biswas et al., 2020) found that the prevalence of SI among 12- to 17-year-olds in 82 countries was 14%, although there was significant global variation (e.g., 8% in Asia, 11% in Europe, and 21% in Africa). The pooled prevalence of SI among adolescents was highest in upper-middle-income countries (17.0%), followed by high-income countries (13–14%), including Croatia. Repetitive SI usually precedes suicide but does not necessarily lead to it (Miller, 2011). The risk of SI is higher for female adolescents, older ones, and those of lower socioeconomic status (Biswas et al., 2020).

There is consistent evidence that depressive symptoms, feeling of entrapment, emotion regulation difficulties, earlier self-injuring behaviour, earlier suicide attempts, and other mental health problems predict continuing and prolonged NSSI and suicidality (e.g., Marshall et al., 2013; Prinstein et al., 2010; Xavier et al., 2017). Since these constructs can also be seen as symptoms of suicidality, in this study we sought to broaden the potential pool of predictors for prolonged NSSI and SI by introducing variables that are easily detected and measured, making them suitable for practical

interventions, not only in clinical but, more importantly, in community settings where the universal and selective prevention is more suitable. Furthermore, we focused on personal and environmental factors that are not necessarily indicators of poor mental health, but states or circumstances that often precede mental health problems. Selection of relevant predictors was based on the theoretical frameworks of the integrated theoretical model of the development and maintenance of self-injury (Nock, 2009), the integrated motivational–volitional model of suicidal behaviour (O'Connor, 2011), and the interpersonal theory of suicide (Van Orden et al., 2010). All of these include some aspects of adverse childhood experiences (i.e., childhood abuse), intrapersonal (i.e., low self-esteem or high neuroticism), and interpersonal (i.e., lack of supportive relationships with parents, teachers and friends) vulnerability factors as risk factors for the occurrence and maintenance of both SI and NSSI. These selected variables will be discussed in the text that follows.

Both NSSI and SI have been previously linked to adverse childhood experiences (ACEs), which significantly affect an individual's mental health (Petruccioli et al., 2019). Although the operationalisation of ACEs is not always uniform, Hillis et al. (2004) noted that ACE measures usually include exposure to emotional or psychological abuse, physical abuse, sexual abuse, parental intimate partner violence, living with a substance-abusing, mentally ill, or criminal household member, and parental separation or divorce. Systematic reviews (Serafini et al., 2017; Cipriano et al., 2017) found that childhood maltreatment is a significant risk factor for NSSI and is positively correlated with the frequency of NSSI (Wang et al., 2020). According to Björkstam et al. (2016) and Cromer et al. (2018), indicators of childhood household dysfunction, especially those related to domestic violence, are associated with an increased risk of self-harm. Moreover, if more than one of those indicators is present (for example, different types of violence), the risk of adolescents' self-harm is even greater. Cromer et al. (2018) found that the association between cumulative victimization and the subsequent development of SI during adolescence could be mediated by depressive symptoms. Finally, Cluver et al. (2015) controlled for baseline suicidality and sociodemographics and confirmed a strong, graded relationship between cumulative ACEs and all adolescent suicide-related behaviours (including SI) 1 year later.

Studies on the link between NSSI or SI and adolescents' personality characteristics are relatively uncommon. Junker et al. (2019) found that neuroticism and psychoticism in adolescents presented a risk of future self-harm hospitalisation, while extroversion and positive self-esteem reduced the risk. Mars et al. (2019) explored the nature of the transition from SI or NSSI to suicide attempts (SAs)

among adolescents and found that, among youth with SI at the age of 16, the future risk of SAs was associated with higher openness, while for those with NSSI, SAs were predicted with lower levels of extraversion. Regarding other aspects of personality, adolescents with repetitive NSSI show lower levels of self-directedness (Lüdtke et al., 2017; Tschan et al., 2017), persistence, and cooperativeness and higher levels of novelty-seeking and harm avoidance compared to clinical controls with mental disorders but no NSSI (Tschan et al., 2017). However, whether these findings can be confirmed with adolescents from the general population remains unknown (Lüdtke et al., 2017). In adults, high neuroticism shows prominent and independent risk effects for SI both in mood disorder patients and community controls. Additionally, introverted personality traits showed independent risk effects on suicidality regardless of diagnosis (Su et al., 2018).

Low self-esteem is commonly connected to depression and is one of its symptoms. In the context of suicidality and NSSI, depression is one of the most-studied variables (Marshall et al., 2013; Chan et al., 2016). Xavier et al. (2017) proposed that adolescents with NSSI have depressive symptoms, which reflect their negative self-views, and failing to control their self-harm behaviour may result in them experiencing depressive symptoms and feelings of defeat and, consequently, engaging in NSSI again. Wang et al. (2020) found that lower self-esteem was correlated with higher NSSI frequency and that self-esteem mediated the relationship between childhood maltreatment and NSSI. Two more studies (Andrews et al., 2013; Tatnell et al., 2014) demonstrated that the combination of intra- and interpersonal variables seems to influence the onset of NSSI among adolescents, namely, low self-esteem, being female, higher attachment anxiety, poor problem-solving, greater psychological distress, and lower perceived family support.

Among the interpersonal variables, positive relationships with family and friends are consistently linked with improved mental health and well-being during adolescence (Moore et al., 2018; Biswas et al., 2020). In their population-based study of 82 countries, Biswas et al. (2020) found that higher levels of parental control were positively correlated with adolescents' SI. Parental understanding and monitoring, alternatively, negatively predict adolescents' mental health problems. Hankin and Abela (2011) found that maternal and youth depressive symptoms, low social support, and negative cognitive styles predicted the repetition of NSSI in adolescents over a period of 2.5 years. In another large international longitudinal study, low parental belongingness, but not peer belongingness, predicted a greater likelihood of adolescent SI 12 months later (Barzilay et al., 2019). Conversely, another study reported that having no close friends and experiencing peer conflict were

associated with a greater risk of adolescent SI (Biswas et al., 2020). Furthermore, both cross-sectional and longitudinal studies report that higher levels of peer support predict the reduced onset of depressive symptoms over time (Allen et al., 2006). In conclusion, the literature is generally consistent in finding that perceived social support from parents and peers plays an important role in the development of adolescent SI and NSSI (King & Merchant, 2008).

Regarding school variables, Madjar et al. (2017) found that perceptions of the peer school climate, teachers' psychological support, and a sense of school belongingness were more negative in adolescents with repetitive NSSI than in the non-NSSI group. Miller et al. (2015) accounted for parent and close friend support and found that the perception of low school support independently predicted greater severity of SI. The relationship between lower perceived school support and SI was the strongest among those who perceived lower parental support.

In this study we are focusing simultaneously on different interpersonal variables (parental, school and peers), which contribute both to theoretical and practical guidelines in prevention and treatment of NSSI and SI in adolescence. These microsystems are easily accessible through community interventions and can be gateway to youth who are at risk of mental health problems. Furthermore, since in most studies clinical samples were used, in our research we are extending the focus on general student population in middle adolescence, developmental period crucial for developing internalising problems, which enables us to detect youth at risk but with not yet developed seriously mental health disorders. A further contribution of this study is its longitudinal data, which provides an opportunity to focus on those adolescents who are at greater risk of NSSI or SI and follow them through the challenging years of adolescence. Repetitive, prolonged NSSI or SI are important risk factors for future suicidal behaviour (Zahl & Hawton, 2004; Miller, 2011; Voss et al., 2019) and, if we want to prevent suicide, understanding which adolescents are at greater risk for prolonged NSSI/SI is important. Therefore, this study focused on two main questions:

1. Which individual variables (personality, self-concept domains and adverse childhood experiences) are the best predictors of prolonged self-injuring behaviours from middle to late adolescence?
2. Which individual variables (personality, self-concept domains and adverse childhood experiences) are the best predictors of prolonged suicidal ideation from middle to late adolescence?

## Methods

### Participants

The data presented in this paper are part of a larger research project intended to investigate the effects of family economic hardship on adolescent development and family relationships [(Family economic hardship, psychosocial problems and educational outcomes of adolescents in the time of economic crisis). In this study, we used a representative sample of first-grade pupils from 29 secondary schools in northern and central Croatia<sup>1</sup>.

Data were obtained over 3 years (in the first, second, and third grades of secondary school, that is, from 15- to 17-year-olds) and 1,101 students participated in the first wave of sampling (T1). Out of that sample, 171 (15.5%) students had purposely injured themselves without wanting to commit suicide at least once and 218 (19.8%) students had suicidal thoughts. In a further analysis, we included 181 students whose data were obtained in all three waves of the study and who reported NSSI, suicidal thoughts, or both in T1. Their mean age was 15.12 years old ( $SD=0.455$ ) in the first grade. The sample included 131 (72.4%) females, and 42% of the students attended high schools ( $n=76$ ), while others attended 3-year ( $n=45$ ) and 4-year ( $n=60$ ) vocational schools. More than half of the sample ( $n=147$ , 63%) perceived the financial status of their families as equal to that of peers' families, while 35 (19.3%) reported being financially worse and 32 (17.7%), financially better than their peers. Most of the students lived in two-parent families ( $n=147$ , 81.2%).

### Measures

*Sociodemographic data* collected for this sample were gender, age, type of school, family structure (biological parents live together, divorced or separated parents, or one or both parents passed away) and adolescents' perception of their families' financial status compared to that of peers' families on a 5-point scale (1 – much worse than their peers; 5 – much better than their peers).

*Non-suicidal self-injury (NSSI)* and *suicidal ideation (SI)* were assessed by two items: how often in the past 12 months participants had purposely injured themselves without wanting to take their lives and whether they thought about committing suicide. Participants responded on a 6-point scale (1 – never; 6 – several times a week).

*Adolescents' personality traits* were assessed with the NEO Five-Factor Inventory (NEO FFI; Costa & McCrae, 1992). It consists of 60 items and participants respond on a 5-point scale (1 – strongly disagree; 5 – strongly agree). A higher total indicates a higher level of the trait. The Cronbach's alphas were 0.65 (openness to experience), 0.78 (extraversion), 0.72 (agreeableness), 0.81 (neuroticism), and 0.85 (conscientiousness). The lower reliability of the 'openness to experience' trait aligns with the reliability reported in other studies (Bratko et al., 2002; Sneed et al., 2002).

The indicators of *adverse childhood experiences (ACEs)* were obtained from the Experienced Stressful Events Questionnaire (Ajduković et al., 2011), the Experienced Parental Violence Questionnaire (Ajduković et al., 2016), and a modified version of the ISPCAN Child Abuse Screening Tool – Children's Version (Zolotor et al., 2009). The ACE score represents the number out of nine extremely stressful events that the participant experienced (parental divorce, the physical illness or injury of a family member, the psychological problems of a family member, the death of a family member, family members' addiction problems, family members' problems with the law, psychological abuse in the family, physical abuse in the family, and witnessing violence between parents). Most of the participants experienced one (29.3%) or two (26%) ACEs, while 2.8% experienced seven. The most common experiences were witnessing violence between parents (41.9%), the death of a family member (40.5%), the physical illness or injury of a family member (40%), and psychological abuse (39.2%).

*Self-concept* variables were assessed using subscales of the Self-Description Questionnaire II (SDQ-II, Marsh 1992): general self-esteem (GSE, 10 items), physical appearance (PA, 8 items), relationship with parents (RP, 8 items), relationship with peers (RPE, composite of relationship with same-sex peers, 10 items, and opposite-sex peers, 8 items), and school competence (SC, 10 items). Participants responded on a 6-point scale (1 – doesn't describe me at all; 6 – fully describes me). The subscale results were converted into mean scores, with higher scores representing more positive perceptions of a specific self-concept domain. The subscale reliabilities were high (Cronbach's alpha of  $GSE=0.89$ ;  $PA: \alpha=0.87$ ;  $RP: \alpha=0.87$ ;  $RPE: \alpha=0.84$ ;  $SC: \alpha=0.86$ ).

### Procedure

The data were collected from February 2016 to May 2018. The questionnaire was administered in the students' classrooms. The study was approved by the Ethical Review Board of the Faculty of Law, University of Zagreb, and the relevant educational authorities. Both students and

<sup>1</sup> In Croatia, all children attend an 8-year primary school program from about 7 to 14 years of age. Most of them continue with secondary school, which is not obligatory and lasts from 3 to 5 years, depending on the specific educational program.

their parents were informed about the study in detail and informed consent was obtained from the participants. Their anonymity throughout all three waves of the study was ensured by assigning each student a unique code that could not be linked to their identity.

## Data analysis

All analyses were performed using IBM SPSS Statistics for Windows. Preliminary analyses included testing the differences in categorical and continuous variables (using chi-squared and *t*-tests) between those adolescents who reported prolonged NSSI or SI and those who reported no NSSI or SI in the last 12 months in T3. All analyses were conducted for two samples – those who reported NSSI in T1 and those who reported SI in T1<sup>2</sup>. Two binary logistic regression analyses (LRAs) were used to answer the two main study questions. The first LRA was used to predict prolonged NSSI – whether adolescents who injured themselves in T1 still had NSSI in T3 or not. In the second LRA, the same sample was analysed to predict prolonged SI. The predictors in both analyses were variables measured in T2 (perception of family financial status, personality traits, ACEs, and self-concept variables) that showed statistical significance in the preliminary analyses. The results are reported with 95% confidence intervals. The Hosmer-Lemeshow goodness-of-fit (GOF) test and the Nagelkerke pseudo-R-squared measure were used to assess model fitness. Missing data were handled with listwise deletion.

## Results

Differences in sociodemographic variables and specific ACEs between adolescents with prolonged NSSI or SI and those whose NSSI or SI had ceased (no reported NSSI or SI in the last 12 months in T3) are presented in Table 1. For the NSSI sample, the only significant difference was found for witnessing interparental violence; children who did not witness parental violence had a greater chance of ceasing NSSI. For SI, this trend was even more obvious. Adolescents who were psychologically or physically abused by their parents were at greater risk of prolonged SI. Finally, more participants whose biological parents did not live together had prolonged SI. All size effects were small to moderate, with the largest for witnessing violence between parents.

The differences in the continuous variables measured in T2 between adolescents who had prolonged NSSI or SI and those who did not are presented in Table 2. In the NSSI sample, adolescents who continued NSSI from T1 to

T3 perceived their family's financial status as worse than their peers', had higher neuroticism and lower extraversion scores, had lower self-esteem, were less satisfied with their physical appearance, and perceived their school competence as worse than those who did not. In the SI sample, adolescents with suicidal ideations in T3 not only perceived lower family financial status and had higher neuroticism and lower self-esteem but also had more ACEs and worse relationships with their parents. The size effects were medium to large, with the largest for neuroticism in the NSSI sample.

Table 3 presents the odds from the multivariate prediction of the likelihood of a child engaging in prolonged NSSI or SI. Because the  $\beta$  coefficients in log-odds units are difficult to interpret as a measure of change, they were converted into odds ratios (ORs). The column titled  $\text{Exp}(\beta)$  provides the OR of engaging in prolonged NSSI or SI among the subsample in a specific category compared to the reference category (the sample that ceased NSSI or SI). In both LRAs, Hosmer-Lemeshow chi-squared GOF tests were non-significant, indicating that the models are good and the explanatory variables included in them are appropriate. To avoid the effects of potential suppressor variables, only the predictors with statistically significant *t*-tests (see Table 2) are included in the models. For NSSI, the model correctly classified 72% of the adolescents into groups of those with prolonged NSSI and those who ceased NSSI. According to the Nagelkerke pseudo-R-squared, all of the predictors together explained 25% of the variation in NSSI. For SI, the model correctly classified 70% of adolescents into groups of those with prolonged SI and those whose SI stopped, while the predictor variables explained 31% of the variation in SI.

Neuroticism is the only significant predictor of prolonged NSSI when controlling for other relevant variables. For each increase in the neuroticism scale score, the odds of prolonged NSSI increase by 2%. According to the results of the second LRA, adolescents have a greater chance of prolonged SI if they experienced more adverse childhood experiences and have higher results on the neuroticism scale. Conversely, youth who perceive a better family financial status and have a better relationship with their parents have a greater chance of ceasing SI.

## Discussion

In this study, we tested which individual variables (personality, self-concept domains, and adverse childhood experiences) most accurately predict prolonged self-injury behaviours and prolonged suicidal ideation.

In our longitudinal study, out of 1,101 15-year-olds from the initial sample, 15.5% had purposely injured themselves without wanting to commit suicide at least once and 19.8%

<sup>2</sup> 59 participants are in both subsamples because they had both NSSI and SI in T1.

**Table 1** Differences in sociodemographic variables and ACEs between adolescents with and without prolonged NSSI or SI

VARIABLE			Sample with NSSI in T1 (n = 104)			Sample with SI in T1 (n = 136)			Cramer's V
			NSSI in T3		$\chi^2$	SI in T3		$\chi^2$	
			No (n = 63)	Yes (n = 41)		No (n = 68)	Yes (n = 68)		
<b>Socio-demographic variables</b>	<b>Gender</b>	Female	42	33	2.359	47	52	0.928	
		Male	21	8		21	16		
	<b>Type of school</b>	High school	26	19	0.660	28	26	2.145	
		4-year vocational	20	10		28	23		
	3-year vocational	17	12		12	19			
<b>Adverse childhood experiences (ACEs) in T2</b>	<b>Biological parents live together</b>	No	12	7	0.065	6	20	9.082**	0.26
		Yes	51	34		61	48		
	<b>Parental divorce</b>	No	53	38	1.302	63	59	0.204	
		Yes	7	2		3	4		
	<b>Physical illness or injury of family member</b>	No	32	21	0.007	43	37	0.739	
		Yes	28	19		23	27		
	<b>Psychological problems of family member</b>	No	49	27	2.641	58	52	1.635	
		Yes	11	13		7	12		
	<b>Death of family member</b>	No	37	22	0.271	41	32	2.582	
		Yes	23	17		23	32		
	<b>Addiction problems of family member</b>	No	52	32	0.794	60	51	2.661	
		Yes	8	8		6	12		
	<b>Family member had problems with law</b>	No	53	37	0.463	62	61	0.120	
		Yes	7	3		4	3		
<b>Psychological abuse in family</b>	No	36	24	0.020	49	31	9.836**	0.27	
	Yes	27	17		19	37			
<b>Physical abuse in family</b>	No	53	30	1.303	59	48	4.102*	0.18	
	Yes	10	10		9	18			
<b>Witnessing violence between parents</b>	No	39	14	7.584**	0.27	46	26	12.007***	0.30
	Yes	23	26			21	41		

Note: \*  $p < 0.05$ ; \*\*  $p < 0.01$ ; \*\*\*  $p < 0.001$

had suicidal thoughts, while 32.6% out of those subsamples had both NSSI and SI. The results showed that 39.4% of adolescents had repetitive NSSI during a 3-year period, and 50% had repetitive SI. Our results on the prevalence of NSSI and SI agree with those from other countries (Brunner et al., 2013; Turecki & Brent, 2016; Cipriano et al., 2017; Plener et al., 2018). However, these problems are greatly understudied in Croatia, where published data were mainly collected from clinical samples (Boričević Maršanić et al., 2013) or small convenience samples (Ercegović et al., 2018). Some new unpublished data from large Croatian samples showed that 14.5% of secondary school students had SI, 8.9% had a suicide plan, and 4.4% had attempted suicide (Ferić, 2019), while Tripković et al. (2017) found that 12.7% of adolescents demonstrated above-average self-harm. Boričević Maršanić et al. (2013) studied hospitalized adolescent offspring of male Croatian veterans with PTSD

and found a 61.5% prevalence of suicide attempts among them.

In our study, low perceived family financial status was the only clear sociodemographic risk factor for prolonged NSSI and SI. Adolescents from families with more financial stability may be less socially excluded, have greater social support, or be more likely to have their mental health problems recognized and receive appropriate, prompt professional help.

Although female adolescents are at a higher risk for internalising problems in general and NSSI and SI are more common among them (Lütke et al., 2017; Voss et al., 2019; Biswas et al., 2020), gender was not supported as a risk factor for continued NSSI or SI. This finding is consistent with some other sources (Xavier et al., 2017; Perez et al., 2021) indicating that both genders should be addressed to prevent future suicidal behaviour and NSSI.

**Table 2** Differences in continuous variables measured in T2 between adolescents with and without prolonged NSSI/SI

VARIABLE	NSSI/SI in T3	Sample with NSSI in T1 (n = 104)					Sample with SI in T1 (n = 136)				
		N	M	SD	<i>t</i>	Cohen's <i>d</i>	N	M	SD	<i>t</i>	Cohen's <i>d</i>
<b>Perceived family financial status</b>	No	62	3.06	0.539	1.959*	0.40	68	3.13	0.571	2.779**	0.47
	Yes	41	2.85	0.527			68	2.84	0.660		
<b>Neuroticism</b>	No	63	37.19	7.802	-4.157***	0.84	67	37.15	7.707	-3.500**	0.60
	Yes	41	43.54	7.298			68	41.59	7.019		
<b>Extraversion</b>	No	63	42.67	6.344	2.042*	0.41	67	41.84	6.723	1.785	
	Yes	41	40.05	6.455			68	39.71	7.128		
<b>Openness to experience</b>	No	63	37.05	5.881	-0.379		67	37.18	6.218	-1.263	
	Yes	41	37.51	6.450			68	38.59	6.728		
<b>Agreeableness</b>	No	63	38.60	6.509	0.508		67	38.90	6.544	0.069	
	Yes	41	38.00	4.853			68	38.82	5.474		
<b>Conscientiousness</b>	No	63	43.19	6.317	1.758		67	42.31	6.796	1.016	
	Yes	41	40.90	6.741			68	41.12	6.871		
<b>ACEs</b>	No	63	2.29	1.800	-1.462		68	1.69	1.427	-3.846***	0.66
	Yes	41	2.81	1.721			68	2.74	1.724		
<b>Self-esteem</b>	No	60	4.71	0.780	2.997**	0.59	66	4.60	0.772	2.389*	0.42
	Yes	40	4.18	1.002			64	4.23	0.987		
<b>Physical appearance</b>	No	61	4.04	0.883	1.956*	0.39	67	3.80	0.864	0.862	
	Yes	40	3.66	1.045			64	3.64	1.168		
<b>Relationship with parents</b>	No	61	4.68	0.944	1.393		67	4.79	0.723	3.950***	0.68
	Yes	40	4.41	0.988			64	4.18	1.039		
<b>Relationship with peers</b>	No	60	4.45	0.761	0.981		66	4.42	0.791	1.437	
	Yes	40	4.28	0.889			64	4.22	0.798		
<b>School competence</b>	No	61	4.38	0.771	2.439*	0.49	67	4.27	0.749	1.939	
	Yes	40	3.95	0.979			64	3.98	0.933		

Note: \*  $p < 0.05$ ; \*\*  $p < 0.01$ ; \*\*\*  $p < 0.001$

**Table 3** Summary of logistic regression analyses predicting prolonged NSSI and prolonged SI

Model	Variable	B	Exp ( $\beta$ )	95% C.I.	Hosmer-Lemeshow G.O.F. test	Nagelkerke pseudo-R-squared	% correctly classified
<b>Predicting prolonged NSSI (n = 104)</b>	Perceived family financial status	-0.371	0.690	0.277–1.715	2.877	0.25	71.7
	Neuroticism	0.098	1.103**	1.024–1.190			
	Extraversion	-0.003	0.997	0.912–1.090			
	Self-esteem	-0.518	0.596	0.273–1.299			
	Physical appearance	0.359	1.431	0.722–2.836			
	School competence	-0.211	0.810	0.426–1.539			
<b>Predicting prolonged SI (n = 136)</b>	Perceived family financial status	-0.912	0.402*	0.197–0.821	4.075	0.31	70.0
	Neuroticism	0.066	1.068*	1.004–1.136			
	ACEs	0.286	1.331*	1.016–1.743			
	Self-esteem	0.128	1.136	0.645–2.003			
	Relationship with parents	-0.725	0.484*	0.277–0.845			

Note: \*  $p < 0.05$ ; \*\*  $p < 0.01$ ; \*\*\*  $p < 0.001$

Nevertheless, adolescents who are less satisfied with their physical appearance (which is more common in girls) have a greater risk of prolonged NSSI. Oktan (2017) found that body image is a significant regressor of self-harm behaviour, while Muehlenkamp & Brausch (2011) concluded that body image mediates the relationship between negative affect and NSSI.

Like previously reported results (Björkenstam et al., 2016; Serafini et al., 2017; Cipriano et al., 2017; Cromer et

al., 2018), this study showed a higher risk of prolonged SI for adolescents who experienced more adverse childhood experiences. Moreover, of the types of ACE, only those relating to family violence (psychological and/or physical abuse by parents and witnessing violence between parents) differentiate adolescents with repetitive NSSI or SI from those who cease either. The family stress model (Conger & Conger, 2002) could explain the connection between the risk factors of lower financial status, living in single-parent

families, and experiencing domestic violence, and the increased risk for prolonged auto-aggressive behaviour. The model posits that parents who raise their children under economic pressure have higher emotional distress, which can negatively affect their parental skills, including by failing to recognise children's psychological needs and mental health changes. As internalised problems are relatively hard to notice (Stanger & Lewis, 1993), there is a higher chance that they will worsen and endure without being recognised.

We have confirmed that youth who have better relationships with their parents have a greater chance of ceasing SI. Cassels et al. (2018) found that family functioning at age 14 mediates the association between childhood adversity before the age of 5 and the onset of NSSI between ages 14 and 17, while Macalli et al. (2018) showed that a lack of parental support in childhood and adolescence is associated with an elevated risk for occasional or even frequent SI. The connection between poor family functioning and more frequent NSSI or SI has also been confirmed by other studies (Barzilay et al., 2019; Kostić et al., 2019; Biswas et al., 2020), indicating that working with the families of children who are at a heightened risk of suicide is necessary.

This study tested dimensions of personality and some aspects of self-concept as intrapersonal variables. Neuroticism, as in previous studies (Lüdtke et al., 2017; Junker et al., 2019; Mars et al., 2019), was confirmed as the most significant predictor of prolonged NSSI and SI. Moreover, when controlling for all other relevant variables, neuroticism was the only statistically significant variable to predict which adolescents would continue NSSI. When defining neuroticism, Eid and Diener (1999) pointed that its central part is negative emotionality and according to Kalokerinos et al. (2020) some scholars even use *emotional stability* as the inverse of neuroticism. Persons with high levels of neuroticism respond poorly to stress, interpret ordinary situations as threatening, and can experience minor frustrations as hopelessly overwhelming (Widiger & Oltmanns, 2017). All of these are also often present in adolescents with NSSI and SI. In addition, Xu et al. (2017) found that the association between neuroticism and adolescents' life satisfaction is partially mediated by positive and negative coping strategies and in our previous study we found that negative coping (such as rumination, avoidance and resignation) is predictive both for NSSI [Rezo Bagarić et al., 2023] and SI [Sušac & Rajhvajn Bulat, 2022]. Additionally, regarding personality, our finding that adolescents who continued with NSSI during a 2-year period (from T1 to T3) have lower extraversion scores corroborates Su et al.'s (2018) findings. Introversion could be connected to low self-esteem (Erol & Orth, 2011), which differentiates those who continue NSSI or SI from those who cease. Moreover, school competence was an important factor in predicting NSSI; those

who continue such behaviours perceive their competence in school as worse, as confirmed in previous studies (Andrews et al., 2013; Tatnell et al., 2014).

### Practical implications

Based on the current findings, we can propose specific interventions for (prolonged) NSSI and SI in adolescents according to different levels of intervention spectrum (Mrazek & Haggerty, 1994). On the universal intervention level aimed at all adolescents, it is important that suicidality itself is not a taboo and that youth have approachable adults with whom they can talk about these serious questions. Miller (2011) proposed several school-based interventions aimed at prevention of adolescent suicidal behaviour. School and community based workshops that aim to improve self-esteem and self-image in general, as well as social skills (especially for introverts as lower extraversion is a significant predictor of prolonged NSSI), are relevant and necessary for adolescent NSSI and suicide prevention. Similarly, as Junker et al. (2019) suggested, brief assessments of personality and self-esteem could be used to enrich the standard suicide risk assessment in adolescents and it could be done through regular school education.

The results that youth who are growing up in the families who have worse material situation, whose parents don't live together and who experienced domestic violence are at a higher risk of prolonged SI and/or NSSI should be the warning signs for social services professionals and social policy creators who are in charge for protection of children at risk. This selective prevention should assure that children and youth growing up in poverty or in single-parent family should not only receive family financial support but also unobtrusive monitoring and non-stigmatised professional support for their mental health. Moreover, children in families in which domestic violence is present should receive specific and continuous professional support for their emotional and psychological wellbeing (such as trauma enhanced interventions). Interventions with parents, such as improving communication skills, recognising children needs, providing possibilities for quality time with children and being open to different concerns and problems of children, are important not only for families at risk but also for the universal prevention with all parents.

For indicated prevention with youth who already have NSSI and/or SI, it is important to recognise these problems by parents, school and mental health professionals. Our results showed that children that have good relationship with parents are at lower risk of continuing with SI, which implies that professional help to adolescents with mental health problems should also include support and guidance to their parents. When it comes to neuroticism, which showed



to be a strongest single intrapersonal predictor of prolonged NSSI and SI, clinical intervention should aim to teach young people how to deal with emotional distress, develop emotional stability and effectively cope with life stressors and problems. One of the treatments of choice could be mindfulness training, which is effective in reducing both neuroticism (Spinhoven et al., 2017) and self-injury behaviour (Garisch et al., 2017), as well as learning the problem solving techniques in order to reduce *tunnel thinking* typical for suicidality (Matthews, 2013).

### Strengths and limitations

Besides its important findings and their practical implications, this study also had certain shortcomings. First, we used assessments from only one type of informant (adolescents). Although it has been suggested that for both problem behaviours and victimisation, cross-informant data should be included (Rescorla et al., 2013), over the last 20 years, studies have typically used only adolescents' self-reports to assess their mental health status. This is especially prominent in the assessment of different internalised problems because they are more private and less recognisable from other perspectives. Further, the criteria variables of NSSI and SI were measured with a single variable. Muehlenkamp et al. (2012) warned that an assessment using single-item questions measuring non-suicidal self-injury and deliberate self-harm leads to lower prevalence rates than an assessment with specific behaviour checklists, so the presented prevalence and incidence of NSSI and SI could be underestimated. On the other hand, measuring NSSI with the item *How often in the past 12 months you had purposely injured yourself without wanting to take your live* could lead to misunderstanding of the question and what NSSI means where students may have over-report certain actions (such as nail picking) as NSSI. Though this could make one of our criteria variables less feasible, since the prevalence of NSSI in this study is in line with other studies, we believe that such misunderstanding of the item meaning wasn't present among the participants. Finally, as we saw that family variables are rather important in explaining adolescents' auto-aggressive behaviours, future studies should broaden that construct by including not only the relationship with parents but also adolescents' support, communication, attachment, supervision, etc.

Despite these limitations, due to a large initial population-based sample from a country in transition (which are not very well-represented in the international literature), and a longitudinal study model that enables following participants at risk for NSSI and SI from middle to late adolescence, these results contribute to the extremely important topic of adolescents' mental health. As Cipriano et al.

(2017) stressed in their review, further explorations of NSSI should employ a longitudinal approach to examine the risk factors and progression of a potential NSSI disorder, and we can add that this is needed to predict suicidality as well. Continued monitoring of adolescents' mental health has become even more important under the living conditions during the Covid-19 pandemic. Zetterqvist et al. (2021) and in Croatian context our Croatian team [reference blinded for anonymity] showed that the prevalence of NSSI among adolescents has increased significantly during the pandemic. Additionally, Du et al. (2021) concluded that the pandemic has changed the influencing factors of this behaviour; family and school factors appear to have more impact on auto-aggressive behaviour than they did before the pandemic. We can conclude that the data presented in this paper have both scientific and practical value in understanding, treating, and preventing adolescents' mental health problems.

**Author contribution** All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by Linda Rajhvajn Bulat, Nika Sušac and Marina Ajduković. The first draft of the manuscript was written by Linda Rajhvajn Bulat and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

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**Data availability** The data that support the findings of this study are available on reasonable request from the corresponding author. The data are not publicly available due to privacy and ethical restrictions.

### Declarations

**Conflict of interest** On behalf of all authors, the corresponding author states that there is no conflict of interest.

**Competing interests** The authors have no competing interests to declare that are relevant to the content of this article.

**Ethics approval** The approval for conducting this study was obtained from the Ethical committee of Faculty of Law, University of Zagreb.

**Informed consent** Informed consent was obtained from all individual participants included in the study.

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