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Longitudinal Development of Non-Suicidal Self-Injury Disorder in Adolescence: Prospective prediction of stability and change by identity development, depression, trauma, and resilience

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Introduction

Non-suicidal self-injury (disorder)

Non-suicidal self-injury (NSSI) is defined as the deliberate and direct destruction of body tissue without suicidal intent (International Society for the Study of Self-Injury 2018). Common methods of self-injury include intentional carving, cutting, burning, or scratching one's own skin (Klonsky et al. 2014). NSSI tends to occur first in adolescence, typically between the ages of 14 and 15 (Gandhi et al. 2018), and has become increasingly common in this age group over the last decades (Gillies et al. 2018). Whilst exact prevalence rates fluctuate significantly based on sociodemographic correlates (Brunner et al. 2014), a recent meta-analysis estimated the current aggregate 12-month prevalence of NSSI to be 23.2% in community adolescents (Xiao et al. 2022)

The high prevalence rate of NSSI constitutes an important public health concern, as 50 to 75% of those with a history of NSSI make a suicide attempt at some point in their life (Nock et al. 2006). However, not all adolescents who engage in NSSI experience negative mental health consequences to the same extent and, in 2013, the DSM-5 (APA, 2013) proposed six diagnostic criteria aiming to describe a subgroup of individuals engaging in more repetitive, severe NSSI, referred to as NSSI disorder (NSSI-D).

Although some of the diagnostic criteria of NSSI-D are still under scrutiny (Zetterqvist 2015), prevalence of NSSI-D by its current definition has been estimated between 5.6 and 7.6% in community adolescents (Zetterqvist 2015; Buelens et al. 2020b). In most studies, NSSI-D was significantly more common in girls compared to boys (Zetterqvist 2015). Importantly however, the prevalence of so-called subclinical or subthreshold-NSSI (i.e., individuals engaging in recent NSSI, but not meeting all NSSI-D diagnostic criteria) has only been investigated by proxy so far, with either altered or incomplete diagnostic criteria and only in undergraduate students. Specifically, some researchers used only criterion A, the NSSI-D frequency criterion which requires a minimum of five days with NSSI acts in the past year. Using this criterion as the only screener, subthreshold-

NSSI prevalence was 3.9% in undergraduate students (Brausch et al. 2016). Another study in college students reported a 8.8% subthreshold-NSSI prevalence rate based on all DSM-V criteria, but with criterion A altered to the number of acts of NSSI, rather than the number of days of NSSI in the past year (Kiekens et al. 2018). To the best of our knowledge, studies on the prevalence rate of subthreshold-NSSI in community adolescents are lacking.

Non-suicidal self-injury (disorder) throughout adolescence: Longitudinal evidence

Studies on the stability of NSSI-D over time are very scarce, but recent research in specific populations has provided some preliminary results. For instance, in a small sample of 12 help-seeking adolescents with NSSI-D without any comorbidity, 50% did not meet the frequency criterion (i.e., having engaged in NSSI for at least five days in the past 12 months) for NSSI-D one year later (Ghinea et al. 2020). In the same study, now in a sample of 225 help-seeking adolescents with NSSI-D *with* comorbid diagnoses, 20% did not meet the frequency criterion for NSSI-D anymore one year later (Ghinea et al. 2020). This pioneering study provides a first indication of NSSI-D stability, but was limited by its small sample size and the use of only the frequency criterion to determine presence of NSSI-D at follow-up, rather than the full set of diagnostic criteria. Moreover, no subgroup without NSSI or subthreshold group was included, limiting the conclusions that could be drawn.

Predicting the transition to NSSI(-D) based on related variables

Besides longitudinal stability, changes over time (i.e., transitions from one NSSI subgroup to another) are diagnostically and clinically relevant, particularly when the field could uncover external variables that could predict such change. Previous studies have identified, among others, identity development, depressive symptoms, traumatic experiences, and resilience as either established or plausible prospective predictors of NSSI.

First, Gandhi et al. (2017) found *identity confusion* to predict an increase in NSSI over time. Identity confusion is defined by the normative but distressing feeling of uncertainty and

incoherence, which temporally disables the individual to commit to a workable set of personal convictions (Schwartz et al. 2009, 2013). On the other hand, decrease in NSSI has been predicted by *identity synthesis*, which refers to the sense of internal coherence and continuity over time and context, as well as the development of personal goals, plans, and beliefs (Luyckx et al. 2015; Gandhi et al. 2017). Second, Buelens et al. (2019) provided longitudinal evidence for *depressive symptoms* as a prospective predictor for NSSI in community adolescents. Finally, adverse life experiences or *trauma* prospectively predicted an increase in NSSI over time, whereas *resilience*, predicted a decrease in NSSI over time in some studies, but not others (Hankin and Abela 2011; Valencia-Agudo et al. 2018; Muehlenkamp and Brausch 2019). Even though all these variables have been prospectively associated with NSSI, no research is currently available on their predictive value in the transition from one severity-based subgroup of NSSI to another.

Research aims and hypotheses

To address the gaps in the literature as described above, the aim of the current study was three-fold: (1) describing the distribution of NSSI groups ranging in severity (i.e., no-NSSI, subthreshold-NSSI, NSSI-D) and studying group differences in terms of gender, age, identity, depressive symptoms, trauma, and resilience, (2) investigating the stability of NSSI groups over two one-year intervals, and (3) investigating the transition from one NSSI group to another over two one-year intervals and predicting this change based on gender, age, identity, depressive symptoms, trauma, and resilience.

First, we tentatively hypothesised that between 3.9 and 8.8% of our sample would be classified in the subthreshold-NSSI group, based on studies in undergraduate students (Brausch et al. 2016; Kiekens et al. 2018), between 5.6 and 7.6% of our sample would be classified in the NSSI-D group (Zetterqvist 2015; Buelens et al. 2020b), and between 80.2 and 92.7% of our sample would be classified in the no-NSSI group. We hypothesised the NSSI-D group to be significantly older, contain significantly more girls, and score significantly higher on average depressive symptoms and trauma scores compared to both other groups (Zetterqvist, 2015). Moreover, we hypothesised the

subthreshold-NSSI group to score higher on identity confusion and lower on identity synthesis and resilience compared to the no-NSSI group (Gandhi et al. 2015; Garisch and Wilson 2015). Since no previously published research was available regarding identity and resilience in relation to NSSI-D, we did not posit any hypotheses regarding potential group differences on these variables.

Second, we hypothesised a stability of 97% in the no-NSSI group and a stability of 38% in the subthreshold-NSSI group based on research in community adolescents (Gandhi et al. 2017). Although no data on the stability of NSSI-D in community adolescents is currently available, we tentatively hypothesised the stability of NSSI-D in our sample to be between 20 and 50% based on a study in help-seeking adolescents (Ghinea et al. 2020).

Third and finally, we hypothesised that identity confusion, depressive symptoms, and trauma would predict an aggravated prognosis (i.e., transition from no-NSSI to either subthreshold-NSSI or NSSI-D or both), based on previous studies on these prospective predictors of exacerbated NSSI (Hankin and Abela 2011; Gandhi et al. 2017; Valencia-Agudo et al. 2018; e.g., Buelens et al. 2019). In similar vein, we hypothesised that identity synthesis and resilience would predict an improved prognosis (i.e., transition from NSSI-D to sub-threshold-NSSI or no-NSSI, or both), based on previous results suggesting prospective associations with decreased NSSI (Garisch and Wilson 2015; e.g., Gandhi et al. 2017). In both cases, none of the previous research took severity-based subgroups of NSSI into account nor investigated the transition from one subgroup to another, which is why we could not make hypotheses more specific regarding prediction of either subthreshold-NSSI or NSSI-D.

Method

Participants and procedure

The current longitudinal study was part of the LIA project (Longitudinal research on Identity in Adolescence) in which eight secondary schools participated, all located in Flanders, Belgium (Buelens et al. 2020b, a). Students from all six grades within the Belgian secondary school system

were recruited, which is equivalent to US grades 6 through 12. Across all eight schools, a total of 2313 students[1] received active parental consent. 93.5% of these students eventually participated in the research project, resulting in a total of 2162 students at T1 (*M* = 15.00 years, *SD* = 1.88, range = 10 – 21, 53.9% girls). One year later, at T2, 89.22% of these students participated again (*n* = 1929, *M* = 16.00 years, *SD* = 1.8, range = 11 – 22, 55.2% girls) and, at T3, 90.77% of this group participated for the last time (*n* = 1751, *M* = 16.57 years, *SD* = 1.83, range = 12 – 23, 56.3% girls).

All measures were assessed at all time points. The data collection took place during school hours, with the researchers present at all time. At each measurement wave, students received an assent form, a questionnaire booklet, and an envelope. After signing the assent form and filling out all questionnaires, the students returned these documents in a sealed envelope to the researchers. Students who were absent on the day of assessment, had changed schools or graduated by T2/T3 were contacted by e-mail to complete an online version of the questionnaire[2]. All participants received a movie ticket as compensation and were handed a letter with contact details of the school counsellor and several mental health services. A unique code was assigned to each student and was used throughout the entire study to ensure anonymity. The study was approved by the Ethics Committee at the University of Leuven.

Measures

NSSI. Twelve-month NSSI prevalence was assessed using a single-item screening measure '*Have you engaged in self-injury without the intent to die in the past year?'*. Those who marked *yes,* responded to follow-up questions assessing each of the six NSSI-D criteria, with the wording of these questions matching the DSM-5 criteria as closely as possible (see Buelens et al. 2020b). Based on these responses, participants were classified in one of the following three groups: (1) no-NSSI (i.e., respondents without 12-month NSSI), (2) subthreshold-NSSI (i.e., respondents with 12-month

[1] Using the equivalent US grades, students were in the following grades at T1: 20.0% grade 1, 17.4% grade 2, 18.8% grade 3, 21.0% grade 4, 14.8% grade 5, 8.0% grade 6.
[2] Respectively at T1, T2, and T3, online participation was 2.2% (n = 340), 18.5% (n = 287), and 54.27% (n = 546).

NSSI but without meeting all DSM-5 criteria), and (3) NSSI-D (i.e., respondents meeting all DSM-5 criteria).

Depressive symptoms. Depressive symptoms were assessed with the 16-item depression subscale of the Symptom Checklist-90-Revised (Derogatis 1977), rated on a 5-point Likert scale. Cronbach's alpha was .93, .94, and .94 respectively at T1, T2, and T3.

Trauma. In the 15-item version of the Trauma Experience Checklist (Nijenhuis, Van der Hart, & Vanderlinden, 1999a) the participant is asked to indicate for 15 traumatic events (1) whether or not the event happened to him/her, (2) how old they were when the event occurred, and (3) the degree of impact on a 5-point scale ranging from 1 (none) to 5 (an extreme amount). We used the weighted sum score (see Nijenhuis et al. 1999) which accounts for experienced impact and the participant's age (i.e., ages six and under are given a greater weight), resulting in a score range between 1 and 28.

Identity. Identity was assessed by the Erikson Psychosocial Stage Inventory (EPSI; Rosenthal, Gurney, & Moore, 1981; Schwartz, Zamboanga, Wang, & Olthuis, 2009). The EPSI consists of six items on identity synthesis (e.g., "I know what kind of person I am") and six items on identity confusion (e.g., "I feel mixed up"), using a 5-point Likert scale. In our sample, Cronbach's alpha for synthesis was .74, .79, and .80 at respectively T1, T2, and T3, and .67, .74, and .79 for confusion at respectively T1, T2, and T3.

Resilience. Resilience was assessed with the Brief Resilience Scale (BRS; Smith et al. 2008) consisting of six items on a five-point Likert scale. Cronbach's alpha was .88, .90, and .91 at respectively T1, T2, and T3.

Analytic strategy

Associations between categorical variables were analysed using Pearson χ^2 statistic and cross-tabulations where adjusted standardised residuals (ASR) were used to detect cells with more (ASR > 0) or less cases than expected by chance (ASR < 0; Bergman et al., 2003). Residuals exceeding

|2| indicated a significant deviation from the null hypothesis. Differences between groups on continuous variables were analysed using (M)ANOVA or Welch *F*-statistic with Tukey or Games-Howell post-hoc tests performed as appropriate. To visualise the shifts between NSSI groups, a Sankey Diagram was generated using Displayr (Bock 2021), with the width of each arrow proportional to the shift rate. Multinomial logistic regression analysis with age, gender, and all external variables as predictors and membership states of NSSI group as outcome variable was performed. Variance inflation factor (VIF) was used to assess possible multicollinearity between all continuous independent variables, with a VIF index above 3 indicating problematic multicollinearity.

Results

Missings. First, using two separate logistic regression models indicated that missingness at T2 was positively associated with age (Beta [S.E.] = 0.24[0.40], Wald's statistic [df = 1] = 34.94, $p < 0.001$, OR = 1.27) and males had higher odds of dropping out than females (Beta [S.E.] = -.42 [0.16], Wald's statistic [df =1] = 7.22, p = 0.007, OR = .66). The remaining preceding variables were not significantly associated with drop-out at T2. Similarly, at T3, drop-out was positively predicted by age (Beta [S.E.] = .20[0.04], Wald's statistic [df = 1] = 24.58, p < 0.001, OR = 1.22) and males had higher odds of dropping out than females (Beta [S.E.] = -0.64 [0.16], Wald's statistic [df =1] = 15.94, p < .001, OR = .53). Additionally, missingness at T3 was negatively associated with resilience at T2 (Beta [S.E.] = -0.20[0.10], Wald's statistic [df = 1] = 3.96, $p = 0.047$, OR = .82). Given that missingness at neither T2 or T3 was related to the grouping variables (i.e., NSSI(D criteria), we proceeded with including those participants who could be assigned to an NSSI group at all measurement times (final sample size N = 1552). Second, all external variables showed very low rates of missingness (i.e., between 0 and 1.61%) and a nonsignificant Little's Missing Completely At Random test (χ^2 (264) =264.96, $p = .472$) indicated that all missing values could be reliably estimated. Therefore, the Expectation Maximization (EM) algorithm was used to impute all missing data in the external variables. The resulting final sample for the current manuscript consisted of 1552 students at T1 (*M* = 14.41, *SD* = 1.77, 54.5% girls), 1552 students at T2 (*M* = 15.42, *SD* = 1.77, 54.5% girls), and 1552 students at T3 (*M* = 16.42, *SD* = 1.78, 54.5% girls).

Aim 1: Cross-sectional description of severity-based NSSI groups

1.1. Non-suicidal self-injury groups.

On average, the no-NSSI group consisted of 87.46% of the total sample, the subthreshold-NSSI group of 5.50%, and the NSSI-D group of 7.05% (see Table 1 for prevalence and age/gender descriptives). At T1, significant age differences emerged between NSSI groups ($F(2, 1549) = 3.32$, $p = .036$) with Tukey HSD post-hoc tests indicating that participants in the no-NSSI group were on average significantly younger than participants in the NSSI-D group. However, this significant age difference did not persist at T2 ($F(2, 1549) = .47$, $p = .624$) nor T3 ($F(2, 1549) = 2.15$, $p = .117$). At T1, significant gender differences emerged between NSSI groups (χ^2 (2) =51.78, $p < .001$), with significantly more boys than expected by chance in the no-NSSI group ($AR_{boys} = 6.9$), and significantly more girls than expected by chance in the subthreshold-NSSI group ($AR_{girls} = 3.1$) and the NSSI-disorder group ($AR_{girls} = 6.3$). The same pattern was observed at T2 (χ^2 (2) =53.21, $p < .001$) and T3 (χ^2 (2) =67.54, $p < .001$).

Table 1. *Prevalence (percentage, frequency), age and gender descriptives for NSSI groups*

	T1 N = 1552	**T2** N = 1552	**T3** N = 1552
No-NSSI	87.8% (n = 1362) *M* = 14.39, *SD* = 1.78 46.64% girls	87.0% (n = 1350) *M* = 15.43, *SD* = 1.79 46.69% girls	87.6% (n = 1360) *M* = 16.42, *SD* = 1.76 46.15% girls
Subthreshold-NSSI	5.9% (n = 91) *M* = 14.30, *SD* = 1.64 66.67% girls	5.2% (n = 81) *M* = 15.46, *SD* = 1.78 61.17% girls	5.4% (n = 84) *M* = 16.69, *SD* = 1.89 73.08% girls
NSSI-D	6.4% (n = 99) *M* = 14.85, *SD* = 1.70 82.50% girls	7.8% (n = 121) *M* = 15.27, *SD* = 1.65 81.76% girls	7.0% (n = 108) *M* = 16.16, *SD* = 1.89 83.97% girls

1.2 External variables.

Means, standard deviations, and between-group comparisons of the external variables are provided in Table 2, where the letter keys mark significant differences between NSSI groups. The no-NSSI group displayed an overall more adaptive pattern on all external variables: at all measurement times, respondents in the no-NSSI group reported significantly less trauma, less depressive symptoms, less identity confusion, more identity synthesis and more resilience compared to the subthreshold-NSSI or NSSI-D group. Moreover, the subthreshold-NSSI group displayed a more adaptive pattern compared to the NSSI-D group at most measurement times: those in the subthreshold-NSSI group reported significantly less trauma (T1), less depressive

symptoms (T1/2/3), less identity confusion (T1/2), more identity synthesis (T1/2), and more resilience (T1/2/3) compared to those in the NSSI-D group.

Table 2. *Means and standard deviations compared between NSSI groups*

	No-NSSI (A)		**Subthreshold-NSSI (B)**		**NSSI-D (C)**	
	M	*SD*	M	*SD*	M	*SD*
T1						
Trauma	3.23	*3.45*	6.03 **> A**	*4.63*	7.74 **> A B**	*5.47*
Depression	1.67	*.63*	2.30 **> A**	*.95*	3.03 **> A B**	*.90*
ID Confusion	2.51	*.65*	2.88 **> A**	*.75*	3.31 **> A B**	*.66*
ID Synthesis	3.76 **> B C**	*.64*	3.45 **> C**	*.74*	2.92	*.80*
Resilience	3.29 **> B C**	*.84*	2.83 **> C**	*.89*	2.22	*.75*
T2						
Trauma	3.06	*3.49*	7.14 **> A**	*5.75*	7.59 **> A**	*6.33*
Depression	1.69	*.66*	2.63 **> A**	*.95*	3.30 **> A B**	*.85*
ID Confusion	2.49	*.70*	3.12 **> A**	*.76*	3.39 **> A B**	*.70*
ID Synthesis	3.75 **> B C**	*.65*	3.27 **> C**	*.72*	2.74	*.76*
Resilience	3.32 **> B C**	*.87*	2.70 **> C**	*.84*	2.27	*.84*
T3						
Trauma	3.02	*3.67*	6.68 **> A**	*5.82*	7.90 **> A**	*6.20*
Depression	1.75	*.71*	2.65 **> A**	*.98*	3.18 **> A B**	*.88*
ID Confusion	2.46	*.76*	3.13 **> A**	*.77*	3.38 **> A**	*.73*
ID Synthesis	3.75 **> B C**	*.66*	3.15 **> C**	*.79*	2.95	*.76*
Resilience	3.29 **> B C**	*.88*	2.60 **> C**	*.87*	2.27	*.75*

Note. Results are based on two-sided tests assuming equal variances. For each significant pair, the key of the smaller category appears in the category with the larger mean. Tests are adjusted for all pairwise comparisons using Bonferroni correction.

Aim 2: Longitudinal NSSI group stability

In the cross-tabulation of NSSI group membership at each interval (Table 3), all adjusted standardised residuals exceeded |2|, indicating significant discrepancies between the observed

and expected frequencies at the one-year intervals T1 – T2 (χ^2 (4) =452.31, p < .001), T2 – T3 (χ^2 (4) =554.79, p < .001) and the two-year interval T1 – T3 (χ^2 (4) =332.95, p < .001). First, the no-NSSI group showed very high stability: out of the 1362 participants who were classified as no-NSSI at T1, 93.5% (n = 1273) remained in the no-NSSI group at T2. Second, out of the 91 participants who classified as subthreshold-NSSI at T1, 25.3% (n = 23) remained in the subthreshold-NSSI group at T2. Finally, out of the 99 participants who classified as NSSI-D at T1, 47.5% (n = 47) remained classified as NSSI-D at T2. Similar stability percentages were found at the T2 – T3 interval for no-NSSI (94.6%), subthreshold-NSSI (24.7%), and NSSI-D (50.4%) and even at the two-year T1 – T3 interval (no-NSSI (92.8%), subthreshold-NSSI (26.4%) and NSSI-D (41.4%)).

Table 3. *Observed and expected crosstabulation count for NSSI-groups at all intervals.*

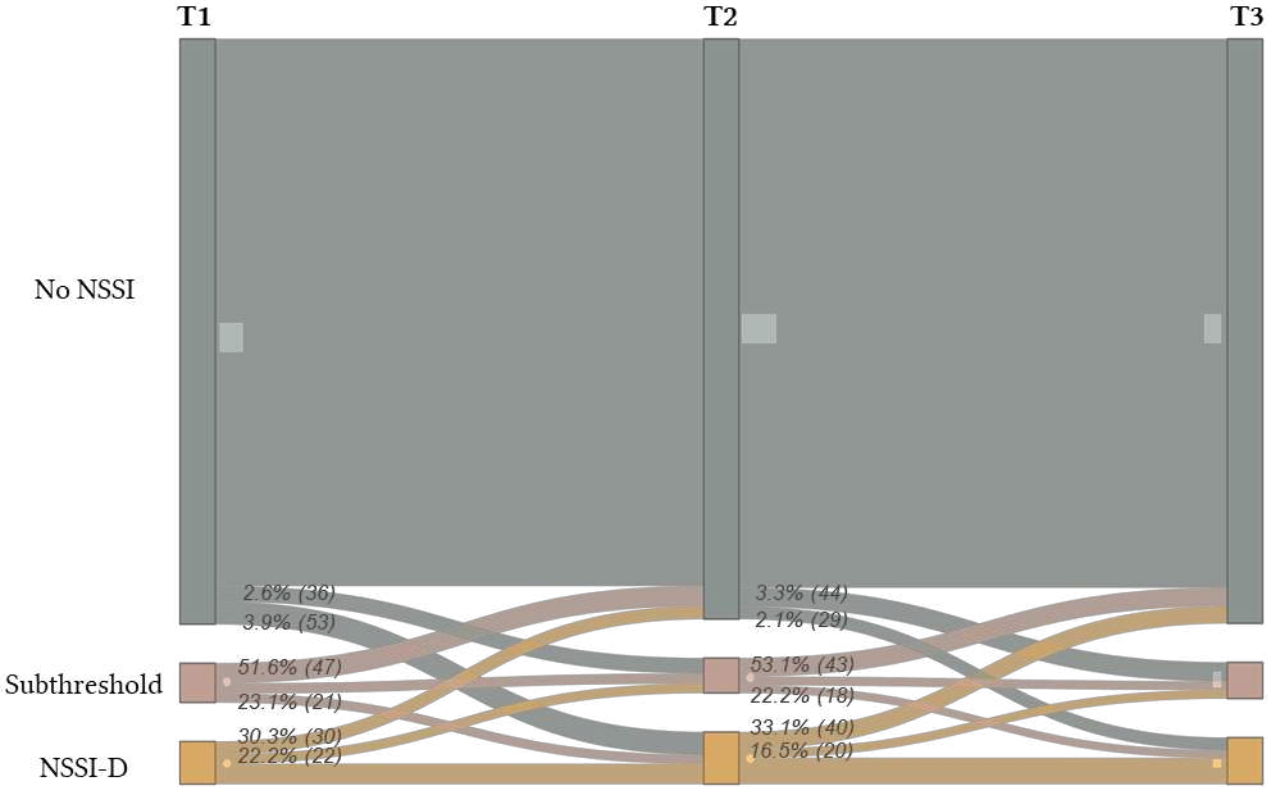
T1 – T2 (one-year interval)			
	T2 no-NSSI n = 1350	T2 sub-NSSI n = 81	T2 dis-NSSI n = 121
T1 no-NSSI n = 1362	n =1273 [*1184.7*] **93.5%** AR = 20.3	n =36 [*71.1*] 2.6% AR = -12.2	n =53 [*106.2*] 3.9% AR = -15.4
T1 sub-NSSI n = 91	n =47 [*79.2*] 51.6% AR = -10.3	n =23 [*4.7*] **25.3%** AR = 8.9	n =21 [*7.1*] 23.1% AR = 5.6
T1 dis-NSSI n = 99	n =30 [*86.1*] 30.3% AR = -17.3	n =22 [*5.2*] 22.2% AR = 7.9	n =47 [*7.7*] **47.5%** AR = 15.2
T2 – T3 (one-year interval)			
	T3 no-NSSI n = 1360	T3 sub-NSSI n = 84	T3 dis-NSSI n = 108
T2 no-NSSI n = 1350	n =1277 [1183] **94.6%** AR = 21.5	n =44 [73.1] 3.3% AR = -9.7	n =29 [93.3] 2.1% AR = -19.3
T2 sub-NSSI n = 81	n =43 [71.0] 53.1% AR = -9.7	n =20 [4.4] **24.7%** AR = 7.9	n =18 [5.6] 22.2% AR = 5.5
T2 dis-NSSI n = 121	n =40 [106.0] 33.1% AR = -19.0	n =20 [6.5] 16.5% AR = 5.6	n =61 [8.4] **50.4%** AR = 19.6
T1 – T3 (two-year interval)			
	T3 no-NSSI n = 1360	T3 sub-NSSI n = 84	T3 dis-NSSI n = 108
T1 no-NSSI n = 1362	n =1264 [1193.5] **92.8%** AR = 16.6	n =47 [73.7] 3.5% AR = -9.1	n =51 [94.8] 3.7% AR = -13.3

T1 sub-NSSI n = 91	n =51 [79.7] 56.0% AR = -9.4	n =24 [4.9] **26.4%** AR = 9.1	n =16 [6.3] 17.6% AR = 4.1
T1 dis-NSSI n = 99	n =45 [86.8] 45.5% AR = -13.2	n =13 [5.4] 13.1% AR = 3.5	n =41 [6.9] **41.4%** AR = 13.9

Note. Observed count [*Expected count*]. Within-group percentages at preceding timepoint. ASR = Adjusted standardised residuals. Residuals exceeding |2| indicate a significant discrepancy between observed and expected count. Stability percentages in bold. Sub-NSSI = subthreshold-NSSI, dis-NSSI = NSSI-D.

Aim 3: Longitudinal NSSI group transitions

Figure 1. *Sankey transition flow diagram*



Note. The width of the arrows is linearly proportional to the number of individuals remaining in/transitioning between each NSSI group. Percentages within each source group and the corresponding frequencies (in brackets) are provided on the respective arrow. For the sake of clarity, only percentages of group transition, not group stability, are provided.

3.1 Visualisation of NSSI group transition

The Sankey diagram (Figure 1) visualises the data flow between NSSI groups over time (see Table 3 for observed and expected frequencies, percentages, and adjusted standardised residuals). From the no-NSSI group, 2.6% transitions towards the subthreshold-NSSI group, while 3.9% transitions towards the NSSI-D group over the course of one year (T1 – T2). From the subthreshold-NSSI group, more than half (51.6%) transitions towards the no-NSSI group,

while 23.1% transitions towards the NSSI-D group over the course of one year (T1 – T2). Finally, from the NSSI-D group, 30.3% transitions towards the no-NSSI group and 22.2% transitions towards the subthreshold-NSSI group over the course of one year (T1 – T2). Very similar transition percentages can be observed at the second time interval (T2 – T3; see Figure 1).

3.2 External variables predicting NSSI group transition.

Finally, we aimed to predict these transitions from one NSSI group to another by using multinomial logistic regression analyses with age, gender, and all external variables at the T-minus 12 months timepoint as predictors, and membership states of NSSI group at T as outcome variable. Thus, variables at T1 were used to predict groups at T2, variables at T2 were used to predict groups at T3. In each regression, the stability category (e.g., no-NSSI T1 → no-NSSI T2) was used as the reference category. At all measurement times, all VIF indices were below 3, indicating no multicollinearity issues between continuous independent variables. Therefore, no interaction terms were included. Below, we only discuss significant results that could be replicated at both time intervals (T1 → T2 *and* T2 → T3). All non-significant results and results that could not be replicated can be found in Table 4.

No-NSSI → Subthreshold-NSSI. First, *identity confusion* was associated with an increased likelihood to belong to the no-NSSI → subthreshold-NSSI category, in comparison to belonging to the stable no-NSSI → no-NSSI category both at the first interval (B = .844, SE = .350, Wald $\chi2$ (1) = 5.82, p = .016) and the second interval (B = .820, SE = .318, Wald $\chi2$ (1) = 6.63, p = .010). Second, *trauma* was associated with an increased likelihood to belong to the no-NSSI → subthreshold-NSSI category both at the first interval (B = .112, SE = .039, Wald $\chi2$ (1) = 8.45, p = .004) and the second interval (B = .124, SE = .034, Wald $\chi2$ (1) = 13.53, p < .001).

No-NSSI → NSSI-D. *Age* was associated with a decreased likelihood to belong to the no-NSSI → NSSI-disorder category, in comparison to belonging to the stable no-NSSI → no-NSSI category, both at the first interval (B = -.288, SE = .089, Wald $\chi2$ (1) = 10.44, p = .001) and the second interval (B = -.442, SE = .130, Wald $\chi2$ (1) = 11.54, p < .001).

NSSI-D → No-NSSI. *Male gender* was associated with an increased likelihood to belong to the NSSI-D → no-NSSI category, in comparison to belonging to the stable NSSI-D → NSSI-D category, both at the first interval (B = 2.39, SE = 1.16, Wald $\chi2$ (1) = 4.25, p = .039), and the second interval (B = 1.60, SE = .66, Wald $\chi2$ (1) = 5.79, p = .016).

Table 4. *Multinomial logistic regressions for group transitions*

		T1 – T2				**T2 – T3**			
		B	SE	Wald	Sig	B	SE	Wald	Sig
No - Sub	Age	-.158	.102	2.389	.122	.041	.091	.199	.656
	Trauma	**.112**	**.039**	**8.449**	**.004**	**.124**	**.034**	**13.534**	**.000**
	Resilience	-.061	.231	.070	.791	-.081	.209	.151	.698
	ID confusion	**.844**	**.350**	**5.821**	**.016**	**.820**	**.318**	**6.634**	**.010**
	ID synthesis	-.155	.322	.230	.631	.447	.326	1.878	.171
	Depression	.514	.297	2.985	.084	.186	.280	.443	.506
	Male gender	.051	.377	.018	.892	-.827	.391	4.483	.034
No – Dis	**Age**	**-.288**	**.089**	**10.443**	**.001**	**-.442**	**.130**	**11.543**	**.001**
	Trauma	.045	.039	1.363	.243	.070	.045	2.374	.123
	Resilience	**-.400**	**.194**	**4.273**	**.039**	-.130	.246	.277	.599
	ID confusion	-.164	.286	.329	.567	.299	.390	.587	.443
	ID synthesis	.158	.279	.320	.571	.117	.401	.084	.772
	Depression	**1.058**	**.244**	**18.773**	**.000**	.604	.332	3.317	.069
	Male gender	-.486	.337	2.080	.149	-.670	.481	1.940	.164
Sub - No	Age	-.006	.168	.001	.970	-.382	.204	3.487	.062
	Trauma	-.031	.065	.226	.634	.074	.069	1.139	.286
	Resilience	-.265	.362	.535	.464	-.250	.476	.276	.599
	ID confusion	.040	.512	.006	.938	**-1.338**	**.596**	**5.039**	**.025**
	ID synthesis	.251	.503	.249	.618	-1.099	.593	3.439	.064
	Depression	-.683	.384	3.168	.075	**-1.192**	**.456**	**6.847**	**.009**
	Male gender	-.305	.621	.241	.623	-.062	.722	.007	.932
Sub - Dis	Age	-.261	.207	1.593	.207	-.070	.208	.114	.735
	Trauma	.055	.071	.594	.441	**.164**	**.074**	**4.895**	**.027**
	Resilience	-.177	.434	.166	.683	-.583	.528	1.220	.269
	ID confusion	.692	.607	1.300	.254	-.974	.659	2.182	.140
	ID synthesis	.383	.570	.452	.501	.115	.724	.025	.874
	Depression	-.472	.448	1.111	.292	-.721	.504	2.047	.152
	Male gender	-.789	.778	1.030	.310	-1.004	.919	1.193	.275
Dis - No	Age	-.037	.154	.058	.810	-.005	.139	.001	.973
	Trauma	-.016	.051	.100	.751	-.064	.039	2.771	.096
	Resilience	-.247	.415	.355	.552	-.121	.309	.154	.695
	ID confusion	.158	.502	.099	.753	.285	.425	.448	.503
	ID synthesis	.629	.479	1.727	.189	.778	.420	3.433	.064
	Depression	-.324	.372	.759	.384	.084	.318	.070	.792
	Male gender	**2.386**	**1.158**	**4.248**	**.039**	**1.595**	**.663**	**5.790**	**.016**
Dis – Sub	Age	-.026	.173	.023	.879	.130	.170	.583	.445
	Trauma	.005	.060	.008	.928	.012	.042	.080	.777
	Resilience	-.429	.462	.861	.353	-.126	.376	.113	.737
	ID confusion	.665	.598	1.236	.266	-.524	.509	1.059	.303
	ID synthesis	**1.633**	**.573**	**8.123**	**.004**	.158	.524	.091	.763
	Depression	-.228	.425	.287	.592	-.269	.392	.469	.493
	Male gender	**2.875**	**1.201**	**5.731**	**.017**	.663	.854	.602	.438

Note. No = no-NSSI group, Sub = Subthreshold-NSSI group, Dis = NSSI-D group. ID = Identity. In each regression, the stability category (e.g., no-NSSI T1 → no-NSSI T2) is used as the reference

category. Individual significant statistics are marked in bold, variables with significant statistics at both intervals are marked in bold.

Discussion

In the current study, we aimed (1) to describe three severity-based Non-Suicidal Self-Injury (NSSI) groups (i.e., no-NSSI, subthreshold-NSSI, NSSI-D) in terms of cross-sectional prevalence and differences in gender, age, identity, depressive symptoms, trauma, and resilience. Then, we investigated (2) the longitudinal stability of the NSSI groups over two one-year intervals and (3) the longitudinal transition from one NSSI group to another over the two one-year intervals and the prospective prediction of these transitions based on gender, age, identity, depressive symptoms, trauma, and resilience.

Cross-sectional prevalence of severity-based NSSI groups

Between 6.4% and 7.8% of our large sample of community adolescents was classified in the NSSI-disorder (NSSI-D) group. These percentages replicate earlier research (Zetterqvist 2015), which reinforces the finding that, using the current set of diagnostic criteria, the prevalence rate of NSSI-D in Western-European middle-class community adolescents ranges between 5.6 and 7.8%. Furthermore, between 5.2% and 5.9% of our sample was classified in the subthreshold-NSSI group. These percentages fall within the hypothesised range of 3.9 and 8.8%, even though this hypothesis was based on research in undergraduate students (Brausch et al. 2016; Kiekens et al. 2018). Taken together, these prevalence results seem to indicate that the often cited NSSI age effect (i.e., NSSI being much more common in adolescence compared to young adulthood; Mohl, 2019) might be largely allocated to NSSI-D -and *not* subthreshold NSSI- prevalence being higher among adolescents. Further research will be necessary to replicate these findings. Finally, and in line with previous research (Zetterqvist 2015; Plener et al. 2016), girls were more likely to engage in NSSI on a subthreshold level (av. 67% girls) and in particular on a disorder level (av. 82% girls).

Cross-sectional differences between severity-based NSSI groups

Remarkably, all external variables (trauma, depressive symptoms, identity confusion, identity synthesis, and resilience) consistently differentiated at all measurement times between no-NSSI and subthreshold-NSSI. Specifically, when comparing these two groups, trauma, depressive symptoms, and identity confusion were always significantly higher in the subthreshold-NSSI group, whereas identity synthesis and resilience were always significantly higher in the no-NSSI group. This finding both replicates and extends previous findings: NSSI has been

positively associated before with trauma, depressive symptoms and identity confusion (Kaess et al. 2013; Garisch and Wilson 2015; Gandhi et al. 2017) and negatively with identity synthesis and resilience (Garisch and Wilson 2015; Gandhi et al. 2017), but our findings show that these associations still hold if only a less severe (subthreshold) group is considered while the more severe (NSSI-D) group is taken out of the equation.

Moreover, meaningful differences even emerged between the subthreshold-NSSI and NSSI-D group: the NSSI-D group was characterised by significantly more depressive symptoms and less resilience compared to the subthreshold-NSSI group. Other variables did differentiate between both groups (i.e., trauma and confusion being higher in NSSI-D, synthesis being higher in subthreshold-NSSI), but these results did not replicate consistently over different time points, suggesting that these differences could be somewhat less pronounced or less stable.

NSSI group stability over time

As hypothesised, the large majority (93.5% - 94.6%) of the no-NSSI group remained stable (i.e., did not start engaging in NSSI) over time (Gandhi et al. 2017). Membership to the subthreshold-NSSI group was much more fleeting (i.e., 25.3% - 23.7% remained in this group over the course of one year), which emphasises the more experimental or explorative nature NSSI can have in community samples (Mohl, 2019). Stability in the NSSI-D group was twice as high (i.e., 47.5% - 50.4% remained in NSSI-D over the course of one year; see also Buelens et al. 2020). Perhaps surprisingly, these community sample percentages are close to the 50% NSSI-D stability in a sample of help-seeking adolescents (Ghinea et al. 2020). However, it could be the case that, even though our sample consisted of adolescents who were attending public secondary schools, some of them might concurrently be in outpatient care and, since we did not obtain any record of this, resemble those in the sample of help-seeking (outpatient) adolescents of Ghinea and colleagues (2020).

Predicting NSSI group transition over time

First, our results showed that from the largely stable no-NSSI group, around 3% transitioned over the course of one year to either the subthreshold-NSSI group or the NSSI-D group. Importantly, these transitions, which can be considered as NSSI onset, could be predicted by some of the external variables included in this study. Namely, identity confusion and trauma were consistently associated with an increased likelihood to transition from no-NSSI to subthreshold-NSSI. This finding is particularly significant as it extends previous longitudinal

research where confusion and trauma operated as a prospective predictors of increased NSSI in general (Gandhi et al. 2017; Valencia-Agudo et al. 2018). Our findings now show that identity confusion and trauma predict the onset of *subthreshold* (i.e., more experimental, less severe) but not NSSI-*disorder* levels. Future research could investigate if operationalizations of identity development and traumatic experiences that cover the more pathological side of the spectrum (e.g., PTSD and "lack of identity"; Kaufman et al. 2014) are more relevant to predict NSSI-D. Particularly studying lack of identity could be clinically significant, given that this concept is closely related to disturbed identity functioning in BPD patients (e.g., 'I feel empty inside'; Kaufman et al., 2014).

Second, from the more unstable subthreshold-NSSI group, around 52% transitioned over the course of one year to the no-NSSI group and around 23% transitioned to the NSSI-D group. None of these transitions could be significantly predicted by any of the external. Nonetheless, this finding is of clinical importance, as it shows that roughly half of the community adolescents who present with this less severe, experimental NSSI completely cease engaging in the behaviour one year later. Without trivializing the behaviour, this finding might indicate the passing nature of subthreshold-NSSI for some individuals and advocates for differentiating between severity-based subgroups of NSSI when developing out-reach and prevention programmes.

Finally, our results showed that, from the NSSI-D subgroup, 32% transitioned over the course of one year to the no-NSSI group and 19% transitioned to the subthreshold-NSSI group. The transition from NSSI-D to no-NSSI could be predicted by male gender, a finding that was replicated at both one-year intervals. This finding adds to existing literature stating that NSSI-D is less common in boys (Zetterqvist 2015), as we can now tentatively add that boys additionally seem less likely to *remain* eligible for an NSSI-D diagnosis over the course of one year in adolescence.

Limitations

Although our research contributed significantly to the existing literature of stability and change of NSSI(-D), the current study was not without limitations. First, all our findings were based on self-report questionnaires, which could result in underreporting of NSSI as well as general reporting bias due to shared method variance (Podsakoff et al. 2003). Future research could opt for clinical diagnostic interviews to state who is and who is not eligible for an NSSI-D diagnosis. Additionally, clinical interviews would allow to exclude potential alternative

diagnoses (e.g., autism spectrum disorder, Lesch-Nyhan syndrome). Second, our findings are not generalisable to either clinical or outpatient samples, younger or older individuals, or non-Western European cultures. Specifically, NSSI prevalence rates are significantly higher in both clinical and outpatient samples, significantly lower in younger and older individuals, and significantly different in different ethnic groups (Al-Sharifi et al. 2015). Third, our research imposed categories (i.e., NSSI-D, subthreshold NSSI) upon our data. Future longitudinal research could use latent class analyses techniques to identify whether or not latent classes can be detected that resemble these imposed categories, for instance by investigating if the most "severe" latent class meets the diagnostic criteria for NSSI-D. Finally, our study design limited the conclusions that could be drawn with regard to age effects, as measurement points rather than age were used as units of time. Future research with a within-person design or accelerated longitudinal designs (such as e.g., Wang et al. 2017) could offer more definitive conclusions of age effects.

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