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Body image as a predictor of nonsuicidal self-injury in women: A longitudinal study

Emma B. Black [a,b,*], Maria Garratt [c], Gavin Beccaria [c], Helen Mildred [b], Marcella Kwan [a]

[a] The University of Queensland, Australia
[b] Deakin University, Australia
[c] University of Southern Queensland, Australia

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ABSTRACT

Objectives: To determine whether Body Image Dissatisfaction (BID) predicted NonSuicidal Self-Injury (NSSI) cross-sectionally and longitudinally, independent of comorbidity between NSSI and Disordered Eating (DE). Another aim was to determine whether BID could predict number of NSSI methods present.
Method: Adult females completed measures of NSSI and DE ($n = 283$); and a longitudinal sample ($n = 106$) completed these measures again one year later.
Results: BID was a small yet significant predictor of NSSI both cross-sectionally and longitudinally. Poorer BID significantly explained a greater number of NSSI methods cross-sectionally and longitudinally.
Conclusions: BID explains unique variance in NSSI (including increased number of methods), and is not a function of comorbidity with DE. This has the potential to influence theory, as well as inform early intervention initiatives for BID in females. Further research is required to determine other variables implicated in this relationship, as well as whether these findings are applicable to other groups such as adolescents and males.

1. Introduction

NonSuicidal Self-Injury (NSSI) involves deliberately injuring one's body in the absence of suicidal intent [1]; common behaviours include cutting and scratching oneself, and NSSI typically initiates in early adolescence [2]. It can comprise a single episode, or a clinically significant ongoing pattern of behaviour, now considered by the American Psychiatric Association [1] as NSSI Disorder, a disorder requiring further investigation. There is evidence that there may be key differences in severity for those with continuing versus extinguished NSSI [3]. Severity of NSSI has been conceptualised in terms of frequency and number of methods [4,5], both of which have predicted subsequent or continuing NSSI [4,6]. Engaging in a higher number of NSSI methods has also been linked to suicide attempts [7–10]. Given this key finding, and evidence that frequency reports may not be reliable [11], number of NSSI methods may be a key severity and risk indicator.

NSSI can often co-occur with Disordered Eating (DE) [12]; comorbidity rates with clinical eating disorders are also high [13], although figures widely vary [14]. A key risk factor for DE is negative body image, or Body Image Dissatisfaction (BID) a multidimensional construct comprising negative perceptions, cognitions, affect, and behaviours towards one's body [15]. BID is prevalent in women, even those in normal weight ranges [16], as well as middle [17] and older ages [18], and remains relatively stable across the lifespan [19,20]. It is both a theoretical [21,22] and empirical risk factor for DE, with longitudinal studies supporting this [23,24]. Disordered eating is theorized to stem from both negative affect and BID [21,22]. The Dual Pathway Model [22,25] specifies that sociocultural pressure to be thin, along with internalizing an unrealistic thin ideal, leads to BID. In turn, BID leads to restricting food and increases negative affect, and both of these variables predict bulimic symptoms (bingeing and purging). There is empirical longitudinal support for this model [23,24].

Overlapping with DE theory, NSSI also has affect regulation models (e.g.: [26,27]). These essentially propose that NSSI is used to relieve or avoid negative affect, and have empirical support [28,29]. Negative attitudes towards the body have also been theorized to predict suicidal or self-destructive behaviour, in conjunction with other variables [30]. There is some empirical support for this hypothesis [31], although Orbach's theory and evidence did not specifically consider the NSSI construct.

A small number of studies have explored whether negative attitudes towards the body are related to NSSI (see [32–36]), and some studies have specifically explored body image [37–39,41]. It has been consistently demonstrated across studies that negative body attitudes are significantly linked to NSSI, although one study found an indirect relationship mediated by negative affect [34]. It is of particular interest in this paper to explore whether BID can predict NSSI, as it can for DE.

Research examining BID and NSSI has determined that BID is significantly worse in people with NSSI as compared to controls [37,41]. Duggan

* Corresponding author at: PO Box 496, Darling Heights, QLD 4350, Australia.
E-mail address: emma.black4@gmail.com (E.B. Black).

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et al.'s study recruited undergraduate college students, matching a sample of people with NSSI ($n = 101$) to people without NSSI, by age and gender, and found this pattern consistent across both genders, although females tended to have greater BID generally. Ross et al. [41] recruited 12–17 year olds from two schools ($n = 59$ with NSSI and $n = 57$ as the comparison group), and found that those with NSSI also had significantly higher DE and BID than controls. Similarly, a study of undergraduate college women determined that women with DE only, or NSSI and DE, had significantly higher BID than those with NSSI only [39]. This research appears to indicate that whilst BID and NSSI may be significantly related, that this could be a function of the comorbidity between DE and NSSI. It was also not determined whether BID could predict NSSI.

One study examined the relationship between BID and NSSI in a sample of females admitted for inpatient treatment of a clinical eating disorder ($N = 422$), determining that BID explained unique variance in NSSI in this population [38]. This relationship was small ($r = 0.12$) but significant, leading the authors to hypothesise that it could simply be a function of higher BID present in those with a clinical eating disorder. As no comparison group of people with NSSI and no DE was included, it is therefore unclear whether this is an accurate conclusion.

To date, only four studies have examined BID and NSSI; however, none of these have investigated whether BID predicts NSSI independently of DE. The current study aimed to address this gap by recruiting adult women to allow examination of established/entrenched behaviours. One aim is to identify whether BID explains unique variance in NSSI after DE has been controlled for, and whether it can predict NSSI over time (as it can predict DE in DE models). Another aim involved determining whether BID is linked to more severe NSSI. Specifically, it was hypothesised that: (1) BID will explain unique variance in NSSI; (2) greater BID will predict greater number of NSSI methods/greater severity (lifetime prevalence); (3) BID will predict the continuation and presence of NSSI over time; and (4) BID will predict a higher number of NSSI methods present over a one year period.

2. Method

2.1. Participants

Two hundred and eighty-five women participated initially (at Time 1, or T1), and agreed to a one year follow up (Time 2, or T2). Two cases were removed (see Data Preparation). In this initial, 'Cross-sectional sample', participants ranged in age from 18 to 73 years ($M = 27.87$). As this was an international sample, country of residence and ethnicity are reported in Table 1.

At T2, 14 participants were not contactable, as emails were returned. Of those participants reached, 109 completed the questionnaire at T2, a response rate of 40.2%. At T2, two participants did not provide a contact name or address, which meant their responses could not be matched to T1. Another case was also removed during data cleaning (see Data Preparation), leaving $n = 106$ participants. This formed the Longitudinal Sample; participants ranged in age from 18 to 67 years ($M = 29.52$ years). Participant ethnicity and country of residence are reported in Table 1. This paper shares a dataset with Black and Mildred [40].

Pearson's Chi Square was employed to determine if there were any significant differences between the Cross-sectional and Longitudinal samples on key variables (age, country of residence, NSSI, DE, and BID): none were identified. A subsequent Pearson's Chi Square also determined that there were no significant differences between those who participated at T2 ($n = 106$) and those who did not ($n = 177$) on these same key variables.

2.2. Materials

Participants completed a demographics section, along with the Deliberate Self-Harm Inventory DSHI [42] and BULImia Test Revised (BULIT-R; [43]). The DSHI measures frequency, intensity, and duration of different NSSI acts with 17 items, and uses dichotomous and free responses. Test-retest reliability of the DSHI has been found to be strong over a 2–4 week period, and there is evidence for construct, discriminant, and convergent validity [42]. In the current study, Cronbach's alpha was 0.79.

The BULIT-R is a 36-item multiple-choice inventory assessing DE. The BULIT-R has strong psychometric properties [43–47], with very high internal consistency (from 0.92 to 0.98). An overall score can be obtained by summing 28 items, with responses ranging from 28 to 140. Scores above 104 indicate that a diagnosis of Bulimia Nervosa (BN) is likely [43,46,47]. As this study was interested in behaviour, three existing items asking about the frequency of compensation methods (5, 18, 25) had a sub-item added in asking participants to indicate which compensatory behaviour/s they were referring to when answering positively (strict dieting, fasting, laxatives, diuretics, self-induced vomiting, and vigorous exercise). In the current study, internal consistency of the original BULIT-R was 0.97; with the added sub-items, $\alpha = 0.96$.

The BULIT-R has several factors [43,48,49], although varying solutions have been found across different populations. Consistent across groups however, is a Body Image factor, although it loads with other items and this varies across populations; for example, in African Americans, BID loads with BULIT-R control items, and in Caucasian Americans, with extreme weight loss items [48]. BID items identified by factor analysis [43] are presented in Table 2. This variable includes negative cognitions, affect, and perceptions of ones' body.

2.3. Procedure

Information about the study was placed on a variety of websites, including those dedicated to self-injury or eating disorders. Participants self-recruited by following the web link to the survey. Participants viewed a consent form and confirmed they agreed to participate, were female, and 18 years or older prior to being taken to the survey. An e-mail ($n = 274$, 96.5%) or postal address ($n = 11$, 3.5%) was provided to allow a follow-up one year later. After invitation, follow up responses were received within 11–16 months of T1 ($M = 12.18$ months). Completing and returning/submitting the survey was taken as evidence of

Table 1
Participant country of residence and ethnicity.

Cross-sectional sample				Longitudinal sample			
Country	*n*(%)	Ethnicity	*n*(%)	Country	*n*(%)	Ethnicity	*n*(%)
Australia	115(40.6)	Caucasian	250(88.3)	Australia	50(47.2)	Caucasian	92(86.8)
United States of America	91(32.2)	Mixed Heritage	8(2.8)	United States of America	33(31.1)	Mixed Heritage	4(3.8)
United Kingdom	40(14.1)	Not disclosed	8(2.8)	United Kingdom	12(11.3)	Not disclosed	5(4.7)
Not disclosed	17(6.0)	Other	9(3.2)	Canada	3(2.8)	Hispanic	2(1.9)
New Zealand	7(2.5)	Hispanic	6(2.1)	New Zealand	3(2.8)	Mediterranean	
Other[a]	7(2.5)	Jewish	2(0.7)	Other[b]	5(4.5)		
Canada	6(2.1)						

[a] 'Other' countries included Turkey ($n = 1$), Norway ($n = 1$), Paraguay ($n = 1$), South Africa ($n = 1$), Germany($n = 1$), Netherlands ($n = 1$), and Lebanon ($n = 1$).
[b] 'Other' countries included Spain ($n = 1$), Norway ($n = 1$), Paraguay ($n = 1$), South Africa ($n = 1$), or not reported ($n = 1$).

Table 2
Body image dissatisfaction variable from bulimia test revised items: item number and content description.

Item number	Description
4	Satisfaction with body shape and size
7	Obsession with body shape and size
12	Preoccupation with weight and body shape
14	Tormented by the possibility of being fat or gaining weight
24	Hating appearance after eating

consent. Ethical approval for this study was provided by the ethics committees of two Australian Universities.

2.4. Data preparation and analysis

Missing data were missing randomly: Little's MCAR was not significant χ^2 (1, 2474) = 2499.86, $p > .01$ and was relatively small across variables (the largest percentage reached 2.8%), therefore mean replacement was used.

Several variables were computed in data preparation. A BID variable was created by summing relevant items (see Table 2); response range was 5–25, with high scores indicating higher BID. Internal consistency of this subscale was high ($\alpha = 0.93$). Item-total correlations ranged from 0.75 to 0.86 ($M = 0.81$). Removal of single items resulted in Cronbach's alpha being very close to the overall alpha value (*Range* = 0.90–0.92), indicating the scale was homogenous. Exploratory factor analysis of BID items indicated that all items loaded on a single factor (with an eigenvalue >1), accounting for 77.8% of the scale's variance.

Several one way ANOVAs were conducted at T1 to determine if there were significant variations in BID on key demographic variables. As these were independent analyses, no corrections were made to the alpha rate. Participants residing in Australia or New Zealand ($n = 122$) were not significantly different from those residing in America, Europe, or other countries ($n = 144$) on BID, $F(1, 261) = 3.86$, $p > .05$. Caucasian participants ($n = 250$) did not significantly differ from non-Caucasian participants ($n = 25$) on BID, $F(1, 270) = 1.27$, $p > .05$. Participants with DE ($n = 178$) had significantly greater BID than participants without DE ($n = 105$), $F(1, 281) = 87.27$, $p < .001$. BID scores were significantly elevated in participants with NSSI ($n = 229$) as compared to those without NSSI ($n = 51$), $F(1, 278) = 5.64$, $p < .05$. In addition, a Pearson's correlation determined that age was not significantly correlated with BID ($r = -0.05$, $p > .05$).

NSSI items were summed to obtain lifetime number of methods present (*Range* 1–17), as per DSHI scoring. One-year prevalence of NSSI was calculated at both T1 and T2, based on quantitative and qualitative responses. Current prevalence of disordered eating behaviours was also determined, by summing relevant items: Bingeing (using items 2, 8, 9, 21, 23, 32, and 34); Restricting (5 and positive sub-item, 18 and positive sub-item, 19, 25 and positive sub-item, and 29); Purging (5 and positive sub-item, 6, 15, 18 and positive sub-item, 25 and positive sub-item, 26, 27, 31, and 36), and Compensatory Exercise (5 and positive sub-item, 11, 18 and positive sub-item, 20, and 25 and positive sub-item). A score of >45% on any item, with positive endorsement of at least one sub-item, was used as a cut-off, above which the behaviour was considered to be present and engaged in. Finally, an overall DE variable was also computed: positive scoring on any of the above variables (Bingeing, Restricting, Purging, and Compensatory Exercise) resulted in a positive score on this variable. This overarching dichotomous variable was used to indicate whether an individual currently engaged in *any* disordered eating behaviour.

Two-tailed Pearson's correlations between variables determined that multicollinearity and singularity were not present. Excluding dichotomous variables, no variable violated the assumption of normality. Variables were assessed for multicollinearity using variance inflation factors (VIF); all VIF values were below two, so there were no indications of multicollinearity among the predictor variables [50]. In the Cross-sectional Sample, two cases were removed during data cleaning, one for a large amount of missing data, and another for using free response sections on the DSHI inappropriately (repeatedly writing their name). This left a sample of $n = 283$. In the Longitudinal sample, one multivariate outlier was identified and removed, leaving $n = 106$ participants.

Hierarchical logistic regressions were employed to evaluate whether BID explained unique variance in NSSI cross-sectionally, and longitudinally, using the Cross-sectional ($n = 283$) and Longitudinal ($n = 106$) samples. In a cross-sectional analysis, a DE variable was entered and controlled in an initial step, followed by BID in a second step. In a longitudinal analysis, BID at Time 1 was used to predict the presence of NSSI at T2. As a prior history of NSSI is the strongest longitudinal predictor for continuing NSSI [51], baseline NSSI was not controlled. This was due to it being expected to account for the most variance in the model, which would hinder identification of any other psychosocial predictors. Sample size was adequate for these analyses, with $N = 64$ required to detect a medium effect size for a power level of 0.80 [52]. Simple linear regressions were also used to evaluate whether BID predicted number of NSSI methods both cross-sectionally and longitudinally.

3. Results

3.1. Descriptive statistics

3.1.1. Cross-sectional sample

Most of the sample (82.9%) had self-injured at least once, using up to 15 different methods ($M = 4.3$ methods). The most common methods were cutting (67.5%) and scratching (46.6%). Frequency reports were categorised to minimise variability, consistent with Zielinski, Hill, and Veilleux's [53] precedent. Number of cutting episodes were: 0 ($n = 94$); 1 ($n = 6$); 2–5 ($n = 26$); 6–19 ($n = 19$); and 20+ ($n = 138$). Of those who had ever cut themselves ($n = 191$), 41.9% had required medical intervention for the resulting injury on at least one occasion.

Responses on the overall BULIT-R score at T1 ranged from 28 to 138 ($M = 75.45$; $SD = 29.91$), with 22.6% of participants obtaining scores above 104, indicating BN criteria were likely to be met. Most of the sample had DE present (62.9%); the most common behaviour was bingeing (54.1%), followed by restricting (26.1%).

3.1.2. Longitudinal sample

This sample was a subset of the cross sectional one (participants at T1), comprising those who participated in the study again at T2. Whilst a large proportion of participants in both the cross sectional and longitudinal samples engaged in NSSI ($n = 236$ and 77, respectively), the purpose of using this subsample was to examine the relationship of BID to NSSI maintenance and number of methods over time. Similar descriptive statistics were reported by longitudinal participants: At T1, 83.8% of longitudinal participants had engaged in NSSI at least once in their lifetime (*Range* = 1–15, $M = 4.32$, *Mode* = 3). The most common behaviours reported for lifetime and one year prevalence were cutting and scratching. For people who had ever cut themselves ($n = 77$), 45.5% of this group had required medical treatment for the resulting injuries on at least one occasion. Number of cutting episodes were: 0 ($n = 32$); 2–5 ($n = 3$); 2–5 ($n = 5$); 6–19 ($n = 4$); 20+ ($n = 62$). Number of scratching episodes were: 0 ($n = 50$); 2–5 ($n = 2$); 6–19 ($n = 17$); and 20+ ($n = 37$). Six participants reported having scratched themselves severely enough to require medical treatment for the resulting injuries.

Responses on the BULIT-R ranged from 28 to 133 ($M = 72.89$, $SD = 30.15$), $n = 24$ (22.6% of the sample) were likely to meet criteria for BN, based on their score. Seventy participants at T1 reported DE (66%); 50% of the sample reported engaging in binge-eating, making it the most common DE behaviour reported. Restricting was the second most common behaviour, reported by 42% of the sample. At T1, 66% of the sample had both DE and NSSI present. Between T1 and T2, 30.5% of participants ($n = 32$) had initiated at least one new NSSI method (*Mode* = 1); two participants reported up to seven new NSSIs. At T1, the majority of these

cases ($n = 30$) had reported a history of NSSI, with only two participants initiating NSSI for the first time between T1 & T2. Comparing one year prevalence for number of methods at both T1 and T2 provided a measure of change over time (Table 3). At T2, 72.6% of participants had self-injured (12 month prevalence); over a third of participants had increased their self-injury, whilst approximately over a quarter had reduced or ceased their NSSI.

3.2. Regression analyses

3.2.1. Cross-sectional sample

3.2.1.1. Hypothesis 1: Body image dissatisfaction will explain unique variance in nonsuicidal self-injury. This model tested whether BID explained unique variance in NSSI, after DE was controlled by entering it into the model in a first step. Using the Cross-sectional Sample ($n = 283$), BID was a highly significant, although small, predictor of NSSI. DE did not explain significant variance in NSSI. This model also had low explanatory power, as Nagelkerke's pseudo R^2 accounted for approximately 6% of the variance. The overall chance classification rate of cases was 60.4%; the current model barely improved on this, to 61.4%. Positive prediction of cases engaging in NSSI was 81.7%, and negative prediction was 30.6%. BID was a significant predictor of having engaged in NSSI in the prior year at T2, independent of DE (Table 4). For every point increase in BID, the likelihood of NSSI presence in the preceding year increased by 8%.

3.2.1.2. Hypothesis 2: Higher body image dissatisfaction will predict the presence of a higher number of nonsuicidal self-injury methods. In addition to evaluating whether BID could uniquely explain variance in NSSI, BID's predictive capacity for number of NSSI methods was also investigated. A simple linear regression demonstrated that BID significantly predicted number of NSSI methods, with good fit to the data (Table 5). For every point increase in BID score, number of NSSI methods increased by 2.1. Whilst significant, it appears the effect size was modest, and only a small amount of variance was explained.

3.2.2. Longitudinal sample

3.2.2.1. Hypothesis 3: Body image dissatisfaction will predict the continuation and presence of nonsuicidal self-injury over time. In the longitudinal model, Nagelkerke's pseudo R^2 indicated that the model accounted for approximately 23% of variance in T2 NSSI. The overall chance prediction rate was 65.1%, with this model correctly classifying a higher rate, at 74.5%. Positive prediction of cases engaging in NSSI at T2 was strong, at 85.5%, and negative prediction of cases was 48.6%. Table 6 indicates that BID was a significant predictor of having engaged in NSSI in the prior year at T2, independent of DE. DE did not significantly predict T2 NSSI. Table 6 indicates that DE did not significantly predict T2 NSSI. BID at T1 was a significant predictor of having engaged in NSSI in the prior year at T2, independent of DE. For every point increase in BID score, there was a 12% increase in the likelihood of engaging in NSSI in the previous year.

3.2.2.2. Hypothesis 4: Body image dissatisfaction will predict a higher number of nonsuicidal self-injury methods over a one year period. A simple linear regression was also conducted, where BID at T1 was entered as a predictor of T2 number of NSSI methods (Table 7). Results showed that T1 BID significantly predicted T2 number of NSSI methods with good fit to the data. For every point increase in BID score, number of NSSI methods increased by 0.13. Whilst significant, the effect size was modest, and only a small amount of variance in NSSI methods was explained.

Table 3
Changes in the pattern of nonsuicidal self-injury between Time 1 and Time 2.

Nonsuicidal self-injury pattern	N(%)
Never self-injured	17(16)
Discontinued	12(11.3)
Reduced	16(15.1)
Maintained	19(17.9)
Increased	40(37.7)
Initiated	2(1.9)

Table 4
Hierarchical logistic regression analysis predicting one year (Time 2) prevalence of nonsuicidal self-injury from Time 1 Variables.

Step	B(S.E.)	OR (95% CI)
0: Constant	−0.58 (0.32)	
1: Disordered eating at Time 1	−0.34 (0.30)	0.71(0.40, 1.28)
2: Body image dissatisfaction at Time 1	0.58 (0.32)	1.08(1.03, 1.13)***

Note. OR = Odds Ratio; B = Regression Coefficient; CI = Confidence Interval; S.E. = Standard Error.
*** $p < .001$

4. Discussion

In this sample, BID was a significant, although very small, predictor of NSSI presence cross-sectionally. This mirrors findings in a prior cross-sectional study of females with clinical eating disorders, where BID was also a small but significant predictor [38]. Whilst both studies recruited females, there were several key differences: Muehlenkamp used an inpatient sample with clinical eating disorders, of which the most common was Anorexia Nervosa, whilst in the current study only 22.6% of participant were likely to meet criteria for eating disorder (specifically, BN). The current study had a higher proportion of participants with NSSI (82.9% vs. 34.60%) and higher mean age ($M = 27.87$ years vs. $M = 21.60$ years). The current sample, whilst international, was predominantly from Western, English-speaking countries; Muehlenkamp's data was collected in Belgium. Constructs were also measured differently between studies. Despite this heterogeneity, the findings regarding BID that explained NSSI were similar. Due to the small number of studies in this area, further research is required to determine if this finding is robust.

The current study had a specific scope, aiming to determine whether BID could uniquely predict NSSI. Given the small relationship obtained, it is likely that other variables are also involved in this relationship. Muehlenkamp et al. [38] had a broader scope, testing several pathways to NSSI; one significant pathway involved childhood abuse, low self-esteem, and BID predicting NSSI. This may not represent the full picture of how BID may be implicated with NSSI, however. For example, it is well-established that NSSI is used to relieve negative affect [28,54], and studies which have examined body regard have found that this mediates negative affect and NSSI [33], or that body regard and NSSI are mediated by negative affect [34]. Consistent with this, other studies have found heightened negative affect in those with BID [37], or that affect dysregulation was only present in those with NSSI who had poor body regard [35]. The current study did not assess negative affect, affect dysregulation, or self-esteem, all of which appear implicated in the relationship between NSSI and body attitudes.

Interestingly, whilst BID was a marginal predictor of NSSI both cross-sectionally and longitudinally, the longitudinal model explained greater variance in NSSI (23%, as compared to 6%) and performed better at classifying cases with NSSI, whilst the cross-sectional model did not perform better than chance. BID is therefore stronger at explaining NSSI

Table 5
Simple linear regression predicting number of nonsuicidal self-injury methods at Time 1.

Variable	*df*	*F*	*t*(95%CI)	*R*	R^2
Body image dissatisfaction at Time 1	1, 275	21.02**	4.05 (1.08, 3.1)***	0.27	0.07

df = degrees of freedom; CI = confidence interval.
*** $p < .001$.
** $p < .01$.

Table 6
Hierarchical logistic regression analysis predicting one year prevalence of nonsuicidal self-injury at Time 2.

Step	B (S.E.)	OR (95% CI)
0: Constant	−1.44 (0.56)	
1: Disordered eating at Time 1	0.58(0.60)	1.78 (0.58, 5.54)
2: Body image dissatisfaction at Time 1	0.11(0.05)	1.12 (1.02, 1.224)**

Note. OR = odds ratio; B = regression coefficient; CI = confidence interval; S.E. = standard error.
** p = .01

maintenance over time. One possibility for this finding is that the self-selected longitudinal sample, whilst similar to the cross sectional sample at T1, were in fact as a group more severe at T2. The sample composition is a function of attrition between T1 and T2; and whilst 11.3% of participants ceased NSSI between T1 and T2, greater proportions maintained (17.9%) or increased (37.7%) their NSSI. These factors may have resulted in a more concentrated sample of women with entrenched NSSI at T2, thus explaining the stronger relationship between BID and NSSI over time.

The heterogeneity present in the NSSI 'maintainers' was not captured in the regression. It is possible that BID predicts a greater number of NSSI methods in general, but may predict some patterns (e.g., maintaining, increasing, reducing, or initiating NSSI) more strongly than others over time. If this were the case, these relationships would be obscured in the current analyses, and could account for the weakened prediction of methods over time. No prior studies have examined whether BID predicts NSSI across time, or whether it predicts number of NSSI methods. One longitudinal study that measured body objectification and NSSI in an early adolescent (11–13 years) mixed gender group ($N = 120$) found that those with NSSI (past or present) had greater body shame and body surveillance across time than those without NSSI [32]. Participants with current NSSI had significantly higher body surveillance as compared to those who had ceased NSSI at one year follow up. It is possible therefore that the onset of BID occurs prior to that of NSSI. Bodily surveillance and body esteem (i.e., shame) comprise part of the BID construct [55]. The current findings are therefore consistent with Duggan et al.'s results. It was also consistent with other prior longitudinal research that DE did not predict NSSI over time [56,57].

This study's key finding was that there is a relationship between poorer BID and more severe NSSI, as indicated by a greater number of NSSI methods. This is an important finding given that number of methods is a measure of severity, as well as being significantly linked to suicide attempts [7–10]. If this finding is robust, identifying the presence of negative BID could potentially provide an early intervention point for suicide risk in women. At first glance, this appears likely to be a result of shared underlying or overlapping pathology such as an eating disorder or Borderline Personality Disorder (BPD). Earlier analyses however did clarify that this relationship is independent of disordered eating. People with BPD have more severe NSSI than those with NSSI and no BPD diagnosis [56,57], and people with BPD are also significantly more likely to have BID than controls [58,59]. Sansone et al.'s study found this relationship occurred independently of comorbidity between BPD and eating disorder. The presence of BPD was not assessed in the current study and may explain why BID was linked to more severe NSSI. Further research is required to evaluate whether BID and NSSI severity are uniquely related, or the function of another variable such as BPD.

Table 7
Simple linear regression predicting number of nonsuicidal self-injury methods at Time 2.

Variable	*df*	*F*	*t*(95%CI)	*R*	R^2
Body image dissatisfaction at Time 1	1, 103	7.67**	2.77(0.39, 3.8)**	0.26	0.07

df = degrees of freedom; CI = Confidence Interval.
** $p < .01$.

The finding that BID predicted number of NSSI methods also provides indirect support for Orbach's [30] theory that self-destructive behaviour is driven by disregard for one's body: it follows that the greater the disregard, the greater the severity of harm. Orbach's model however proposes a causal relationship, and the current results found that the variance explained in number of methods weakened over time, contrary to this theory. The current study however did not aim to measure causation, and employed an adult sample. It is well-established that NSSI typically commences in adolescence (e.g., [2]), so this would have not been captured within the current study. This may explain why the longitudinal prediction of number of methods weakened over time, as compared to cross-sectional analyses. Replicating this study with an adolescent sample that captures the initiation of self-injury could illuminate whether BID predicts NSSI more strongly over time when it first commences.

An interesting pattern of results was obtained in this study, in that BID predicted NSSI presence better across time, than it did cross-sectionally. NSSI severity however, was predicted more strongly cross-sectionally, with this effect weakening over time. Complicating this picture further, over a third of the sample increased their number of methods between T1 and T2. This study was the first (to our knowledge) to examine the longitudinal relationship between BID and NSSI, and it is currently unknown what this specific longitudinal relationship may involve, i.e., whether it may predict NSSI commencement, maintenance, or worsening. The current study found small prediction of NSSI presence and number of methods over time; however, it is also possible that BID may predict NSSI commencement. Secondly, the relationship may not be unique, but rather a function of another variable (as previously discussed). Further longitudinal research is required to identify whether BID could predict NSSI commencement, as well as clarifying how other variables (such as negative affect or BPD) may be implicated in the relationship between BID and NSSI presence, or number of methods, over time.

4.1. Implications

The current findings have several implications: BID may potentially represent an early intervention point for more severe NSSI. This could prevent deterioration in mental health and NSSI symptomatology, as well as providing evidence to support content development for early intervention and prevention programs targeting negative BID in girls and young women. There are also implications for theory: firstly, Orbach's [30] could be extended to specifically address or include BID and NSSI. Additionally, DE models such as the Dual Pathway Model, may also have applicability to NSSI. This model specifies that sociocultural pressure to be thin, along with internalizing an unrealistic thin ideal, leads to BID. In turn, BID leads to restricting food and increases negative affect, and both of these variables predict DE. Given the relationship obtained between BID and NSSI, and the well-established relationship between negative affect and NSSI, this model may also hold some explanatory power for NSSI. Research evaluating this is warranted, as it may allow for both prevention of, as well as early intervention, for both NSSI and number of NSSI methods.

4.2. Strengths and limitations

This study utilised a self-recruited sample from the internet, which can increase the risk of bias. Web-based recruitment has however been used by a number of studies examining DE (e.g.: [60,61]) and NSSI (e.g.: [62–64]), as well as BID (e.g.: [55]). The current recruitment strategy at T1 was successful in terms of attracting a high proportion of participants with NSSI (82.9%) and DE (62.9%; and 22.6% likely to meet criteria for BN). Another positive to undertaking web-based research concerns disclosure: there is evidence undertaking data collection by computer may increase disclosure of sensitive topics [65,66]. Given that one study found that 57% of people with NSSI had never disclosed their self-injury to others [67], and the stigmas attached to both DE

[68] and NSSI [69], this recruitment strategy may have facilitated disclosure on these sensitive topics. A limitation of this recruitment strategy however is that participants may not be representative of either community or clinical samples. Further, the international sample that was recruited demonstrated significant variability in BID, depending on their country of residence, which would influence outcomes of results.

Another limitation to the current study was the attrition rate between T1 and T (59.8%). This attrition rate was likely the result of the large gap (one year) between T1 and T2, as well as only sending out one invitation to participants, with no prompts or follow-up e-mails. Despite lacking retention strategies, the response rate was only slightly below rates obtained in other longitudinal research [70]. Further, there were no significant differences on key variables (such as NSSI) between those who participated at T1 and at T2, nor between those who participated at T2 and those who dropped out.

There was adequate power for all analyses, although another limitation involves the relatively smaller longitudinal sample. BID was assessed by summing relevant BULIT-R items; other measures of BID have the potential to obtain different findings. Finally, by recruiting an adult sample, there was no opportunity to investigate the initiation of NSSI, and whether BID has a role in predicting the onset of this behaviour.

4.3. Conclusions

The current study found that BID significantly predicted the presence of NSSI, both cross-sectionally and over time. Number of NSSI methods was significantly predicted by poorer BID, although this effect was smaller across time. This is particularly important, given that having a higher number of NSSI methods has been linked to suicide risk. Further research examining the roles of other variables (such as affect dysregulation and BPD) in this process is required. Longitudinal research with those in early or pre-adolescence is required to evaluate whether BID both precedes, and also can predict NSSI commencement. Models of DE which explain the initiation of DE through BID may also potentially hold relevance for explaining NSSI. Further research can help determine whether BID may form an early intervention point for reducing or preventing NSSI presence and/or severity.

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References

[1] American Psychiatric Association. Diagnostic and statistical manual of mental disorders. . 5th ed.Arlington, VA: American Psychiatric Association; 2013.
[2] Martin G, Swannell SV, Hazell PL, Harrison JE, Taylor AW. Self-injury in Australia: a community survey. Med J Aust 2010;193:506–10. https://doi.org/10.1037/h0080369.
[3] Andrews T, Martin G, Hasking P, Page A. Predictors of continuation and cessation of nonsuicidal self-injury. J Adolesc Health 2013;53:40–6. https://doi.org/10.1016/j.jadohealth.2013.01.009.
[4] Glenn CR, Klonsky ED. Prospective prediction of nonsuicidal self-injury: a 1-year longitudinal study in young adults. Behav Ther 2011;42(4):751–62. https://doi.org/10.1016/j.beth.2011.04.005.
[5] Saraff PD, Pepper CM. Functions, lifetime frequency, and variety of methods of nonsuicidal self-injury among college students. Psychiatry Res 2014;219(2):298–304. https://doi.org/10.1016/j.psychres.2014.05.044.
[6] Kiekens G, Hasking P, Bruffaerts R, Claes L, Baetens I, Boyes M, et al. What predicts ongoing nonsuicidal self-injury?: a comparison between persistent and ceased self-injury in emerging adults. J Nerv Ment Dis 2017. https://doi.org/10.1097/nmd.0000000000000726.
[7] Anestis MD, Khazem LR, Law KC. How many times and how many ways: the impact of number of nonsuicidal self-injury methods on the relationship between nonsuicidal self-injury frequency and suicidal behavior. Suicide Life Threat Behav 2015;45:164–77. https://doi.org/10.1111/sltb.12120.
[8] Matney J, Westers NJ, Horton SE, King JD, Eaddy M, Emslie GJ, et al. Frequency and methods of nonsuicidal self-injury in relation to acquired capability for suicide among adolescents. Arch Suicide Res 2017:1–15. https://doi.org/10.1080/13811118.2017.1283266.
[9] Nock MK, Joiner Jr TE, Gordon KH, Lloyd-Richardson E, Prinstein MJ. Non-suicidal self-injury among adolescents: diagnostic correlates and relation to suicide attempts. Psychiatry Res 2006;144(1):65–72. https://doi.org/10.1016/j.psychres.2006.05.010.
[10] Turner BJ, Layden BK, Butler SM, Chapman AL. How often, or how many ways: clarifying the relationship between non-suicidal self-injury and suicidality. Arch Suicide Res 2013;17(4):397–415. https://doi.org/10.1080/13811118.2013.802660.
[11] Black EB, Mildred H. Characteristics of non-suicidal self-injury in women accessing internet help sites. Clin Psychol 2016. https://doi.org/10.1111/cp.12094 (Advance online publication).
[12] Yiu A, Turner BJ, Layden BK, Chapman AL, Zaitsoff SL. Prevalence and correlates of eating disorder symptoms in a community sample with non-suicidal self-injury. J Psychopathol Behav Assess 2014;37(3):504. https://doi.org/10.1007/s10862-014-9470-x.
[13] Kostro K, Lerman JB, Attia E. The current status of suicide and self-injury in eating disorders: a narrative review. J Eat Disord 2014;2(1). https://doi.org/10.1186/s40337-014-0019-x.
[14] Cucchi A, Ryan D, Konstantakopoulos G, Stroumpa S, Kaçar AS, Renshaw S, et al. Lifetime prevalence of non-suicidal self-injury in patients with eating disorders: a systematic review and meta-analysis. Psychol Med 2016;46(7):1345–58. https://doi.org/10.1017/S0033291716000027.
[15] Cash TF, Pruzinsky T. Body image: a handbook of theory, research, and clinical practice. New York: Guilford Press; 2002.
[16] Allaz AF, Bernstein M, Rouget P, Archinard M, Morabia A. Body weight preoccupataion in middle-age and ageing women: a general population survey. Int J Eat Disord 1998;23(3):287–94. https://doi.org/10.1002/(SICI)1098-108X(199804)23:3<287::AID-EAT6>3.0.CO;2-F.
[17] Jackson KL, Janssen I, Appelhans BM, Kazalauskaite R, Karavolos K, Dugan SA, et al. Body image satisfaction and depression in midlife women: the study of women's health across the nation (SWAN). Arch Womens Ment Health 2014;17(3):177–87. https://doi.org/10.1007/s00737-014-0416-9.
[18] Gagne DA, Von Holle A, Brownley KA, Runfola CD, Hofmeier S, Branch KE, et al. Eating disorder symptoms and weight and shape concerns in a large web-based convenience sample of women aged 50 and above. Results of the gender and body image (GABI) study. Int J Eat Disord 2012;45(7):832–44. https://doi.org/10.1002/eat.22030.
[19] Tiggerman M. Body image across the adult life span: stability and change. J Body Image 2004;1(1):29–41. https://doi.org/10.1016/S1740-1445(03)00002-0.
[20] Tiggerman M, Lynch JE. Body image across the life span in adult women: the role of self-objectification. Dev Psychol 2001;37(2):243–53. https://doi.org/10.1037//0012-1649.37.2.243.
[21] Heatherton TF, Polivy J. Chronic dieting and eating disorders: A spiral model. In: Crowther JH, Tennenbaum DL, Hobfoll SE, Stephens MAP, editors. The etiology of bulimia nervosa: the individual and familial context. Washington, DC, US: Hemisphere Publishing Corp; 1992. p. 133–55.
[22] Stice E. A prospective test of the dual-pathway model of bulimic pathology: mediating effects of dieting and negative affect. J Abnorm Psychol 2001;110(1):124–35. https://doi.org/10.1037/0021-843X.110.1.124.
[23] Dakanalis A, Timko CA, Carrà G, Clerici M, Zanetti MA, Riva G, et al. Testing the original and the extended dual-pathway model of lack of control over eating in adolescent girls. A two-year longitudinal study. Appetite 2014;82:180–93. https://doi.org/10.1016/j.appet.2014.07.022.
[24] Sehm M, Warschburger P. The dual-pathway model of binge eating: is there a need for modification? Appetite 2017;114:137–45. https://doi.org/10.1016/j.appet.2017.03.028.
[25] Stice E. Review of the evidence for a sociocultural model of bulimia nervosa and an exploration of the mechanisms of action. Clin Psychol Rev 1994;14(7):633–61. https://doi.org/10.1016/0272-7358(94)90002-7.
[26] Chapman AL, Gratz KL, Brown MZ. Solving the puzzle of deliberate self-harm: the experiential avoidance model. Behav Res Ther 2006;44:371–94. https://doi.org/10.1016/j.brat.2005.03.005.
[27] Suyemoto KL. The functions of self-mutilation. Clin Psychol Rev 1998;18(5):531–54. https://doi.org/10.1037/0021-843X.114.1.140.
[28] Klonsky ED. The functions of deliberate self-injury: a review of the evidence. Clin Psychol Rev 2007;27(2):226–39. https://doi.org/10.1016/j.cpr.2006.08.002.
[29] Nock MK, Prinstein MJ. A functional approach to the assessment of self-mutilative behaviour. J Consult Clin Psychol 2004;72(5):885–90. https://doi.org/10.1037/0022-006X.72.5.885.
[30] Orbach I. The role of the body experience in self-destruction. Clin Child Psychol Psychiatry 1996;1(4):607–19. https://doi.org/10.1177/1359104596014012.
[31] Orbach I, Gilboa-Schechtman E, Sheffer A, Meged S, Har-Even D, Stein D. Negative bodily self in suicide attempters. Suicide Life Threat Behav 2006;36(2):136–53. https://doi.org/10.1521/suli.2006.36.2.136.
[32] Duggan J, Heath N, Hu T. Non-suicidal self-injury maintenance and cessation among adolescents: a one-year longitudinal investigation of the role of objectified body consciousness, depression and emotion dysregulation. Child Adolesc Psychiatry Ment Health 2015;9:21. https://doi.org/10.1186/s13034-015-0052-9.
[33] Muehlenkamp JJ, Brausch AM. Body image as a mediator of non-suicidal self-injury in adolescents. J Adolesc 2012;35(1):1–9. https://doi.org/10.1016/j.adolescence.2011.06.010.
[34] Muehlenkamp JJ, Swanson JD, Brausch AM. Self-objectification, risk taking, and self-harm in college women. Psychol Women Q 2005;29(1):24–32. https://doi.org/10.1111/j.1471-6402.2005.00164.x.
[35] Muehlenkamp JJ, Bagge CL, Tull MT, Gratz KL. Body regard as a moderator of the relation between emotion dysregulation and nonsuicidal self-injury. Suicide Life Threat Behav 2013;43(5):479–93. https://doi.org/10.1111/sltb.12032.
[36] Nelson A, Muehlenkamp JJ. Body attitudes and objectification in non-suicidal self-injury: comparing males and females. Arch Suicide Res 2012;16(1):1–12. https://doi.org/10.1080/13811118.2012.640578.

[37] Duggan J, Toste JR, Heath N. An examination of the relationship between body image factors and non-suicidal self-injury in young adults: the mediating influence of emotion dysregulation. Psychiatry Res 2013;206:256–64. https://doi.org/10.1016/j.psychres.2012.11.016.
[38] Muehlenkamp JJ, Claes L, Smits D, Peat CM, Vandereycken W. Non-suicidal self-injury in eating disordered patients: a test of a conceptual model. Psychiatry Res 2011;188(1):102–8. https://doi.org/10.1016/j.psychres.2010.12.023.
[39] Muehlenkamp JJ, Peat CM, Claes L, Smits D. Self-injury and disordered eating: expressing emotion dysregulation through the body. Suicide Life Threat Behav 2012;42:416–25. https://doi.org/10.1111/j.1943-278X.2012.00100.x.
[40] Black EB, Mildred H. Predicting impulsive self-injurious behaviour in a sample of adult women. J Nerv Ment Dis 2013;201(1):72–5. https://doi.org/10.1097/NMD.0b013e31827ab1da.
[41] Ross S, Heath NL, Toste JR. Non- suicidal self- injury and eating pathology in high school students. Am J Orthopsychiatry 2009;79(1):83–92. https://doi.org/10.1037/a0014826.
[42] Gratz KL. Measurement of deliberate self-harm: preliminary data on the deliberate self-harm inventory. J Psychopathol Behav Assess 2001;23:253–63 (doi:0882-2689/01/1200-0253/0).
[43] Thelen MH, Farmer J, Wonderlich S, Smith M. A revision of the bulimia test: the BULIT-R. Psychol Assess 1991;3:119–24.
[44] Brelsford TN, Hummel RM, Barrios BA. The BULIT-R: a psychometric investigation. Psychol Assess 1992;4:399–401. https://doi.org/10.1037/1040-3590.4.3.399.
[45] McCarthy DM, Simmons JR, Smith GT, Tomlinson KL, Hill KK. Reliability, stability, and factor structure of the bulimia test-revised and eating disorder Inventory-2 scales in adolescence. Assessment 2002;9:382–9.
[46] Thelen MH, Mintz LB, Vander Wal JS. The bulimia test-revised: validation with DSM-IV criteria for bulimia nervosa. Psychol Assess 1996;8:219–21. https://doi.org/10.1037/1040-3590.8.2.219.
[47] Welch G, Thompson L, Hall A. The BULIT-R: its reliability and clinical validity as a screening tool for DSM-III-R bulimia nervosa in a female tertiary education population. Int J Eat Disord 1993;14:95–105. https://doi.org/10.1002/1098-108X(199307)14:1<95::AID-EAT2260140113>3.0.CO;2-Z.
[48] Fernandez S, Malcarne VL, Wilfley DE, McQuaid J. Factor structure of the bulimia test-revised in college women from four ethnic groups. Cultur Divers Ethnic Minor Psychol 2006;12(3):403–19. https://doi.org/10.1037/1099-9809.12.3.403.
[49] Kelly NR, Mitchell KS, Gow RW, Trace SE, Lydecker JA, Bair CE, et al. An evaluation of the reliability and construct validity of eating disorder measures in white and Black women. Psychol Assess 2012;24:608–17. https://doi.org/10.1037/a0026457.
[50] Hair JF, Black WC, Babin BJ, Anderson RE, Tatham RL. Multivariate data analysis. Upper Saddle River, NJ: Pearson Prentice Hall; 2006.
[51] Fox KR, Franklin JC, Ribeiro JD, Kleiman EM, Bentley KH, Nock MK. Meta-analysis of risk factors for nonsuicidal self-injury. Clin Psychol Rev 2015;42:156–67. https://doi.org/10.1016/j.cpr.2015.09.002.
[52] Faul F, Erdfelder E, Buchner A, Lang AG. Statistical power analysis using G*Power 3.1: test for correlation and regression analyses. Behav Res Methods 2009;41:1149–60. https://doi.org/10.3758/BRM.41.4.1149.
[53] Zielinski MJ, Hill MA, Veilleux JC. Is the first cut really the deepest? Frequency and recency of nonsuicidal self-injury in relation to psychopathology and dysregulation. Psychiatry Res 2018;259:392–7. https://doi.org/10.1016/j.psychres.2017.10.030.
[54] Armey MF, Crowther JH, Miller IW. Changes in ecological momentary assessment reported affect associated with episodes of nonsuicidal self-injury. Behav Ther 2011;42(4):579–88. https://doi.org/10.1016/j.beth.2011.01.002.
[55] Mills J, Fuller-Tyszkiewicz M. Fat talk and its relationship with body image disturbance. Body Image 2016;18:61–4. https://doi.org/10.1016/j.bodyim.2016.05.001.
[56] Turner BJ, Dixon-Gordon KL, Austin SB, Rodriguez MA, Zachary Rosenthal M, Chapman AL. Non-suicidal self-injury with and without borderline personality disorder: differences in self-injury and diagnostic comorbidity. Psychiatry Res 2015;230(1):28–35. https://doi.org/10.1016/j.psychres.2015.07.058.
[57] Turner BJ, Yiu A, Layden BK, Claes L, Zaitsoff S, Chapman AL. Temporal associations between disordered eating and nonsuicidal self-injury: examining symptom overlap over 1 year. Behav Ther 2015;46(1):125–38. https://doi.org/10.1016/j.beth.2014.09.002.
[58] Dyer A, Borgmann E, Feldmann Jr RE, Kleindienst N, Priebe K, Bohus M, et al. Body image disturbance in patients with borderline personality disorder: impact of eating disorders and perceived childhood sexual abuse. Body Image 2013;10(2):220–5. https://doi.org/10.1016/j.bodyim.2012.12.007.
[59] Sansone RA, Chu JW, Wiederman MW. Body image and borderline personality disorder among psychiatric inpatients. Compr Psychiatry 2010;51(6):579. https://doi.org/10.1016/j.comppsych.2010.04.001.
[60] Moore M, Masuda A, Hill ML, Goodnight BL. Body image flexibility moderates the association between disordered eating cognition and disordered eating behavior in a non-clinical sample of women: a cross-sectional investigation. Eat Behav 2014;15(4):664–9. https://doi.org/10.1016/j.eatbeh.2014.08.021.
[61] Wedig MM, Nock MK. The functional assessment of maladaptive behaviors: a preliminary evaluation of binge eating and purging among women. Psychiatry Res 2010;178(3):518–24. https://doi.org/10.1016/j.psychres.2009.05.010.
[62] Andover MS. Non-suicidal self-injury disorder in a community sample of adults. Psychiatry Res 2014;219(2):305–10. https://doi.org/10.1016/j.psychres.2014.06.001.
[63] Gollust SE, Eisenberg D, Golberstein E. Prevalence and correlates of self-injury among university students. J Am Coll Health 2008;56(5):491–8. https://doi.org/10.3200/JACH.56.5.491-498.
[64] Pumpa M, Martin G. The impact of attitudes as a mediator between sense of autonomy and help-seeking intentions for self-injury. Child Adolesc Psychiatry Ment Health 2015;9(1). https://doi.org/10.1186/s13034-015-0058-3.
[65] Kim J, Dubowitz H, Hudson-Martin E, Lane W. Comparison of 3 Data Collection Methods for Gathering Sensitive and Less Sensitive Information. Ambul Pediatr 2008;8(4):255–60. https://doi.org/10.1016/j.ambp.2008.03.033.
[66] Turner CF, Al-Tayyib A, Rogers SM, Eggleston E, Villarroel MA, ... Roman AMCooley. Improving epidemiological surveys of sexual behaviour conducted by telephone. Int J Epidemiol 2009;38:1118–27. https://doi.org/10.1093/ije/dyp210.
[67] Armiento JS, Hamza C, Willoughby T. An examination of disclosure of nonsuicidal self-injury among university students. J Community Appl Soc Psychol 2014;24(6). https://doi.org/10.1002/casp.2190.
[68] O'Brien KS, Latner JD, Puhl RM, Vartanian LR, Giles C, Griva K, et al. The relationship between weight stigma and eating behavior is explained by weight bias internalization and psychological distress. Appetite 2016;102:70–6. https://doi.org/10.1016/j.appet.2016.02.032.
[69] Lewis PS, Bryant AL, Schaefer MB, Grunberg HP. In their own words: perspectives on nonsuicidal self-injury disorder among those with lived experience. J Nerv Ment Dis 2017;205(10):771–9. https://doi.org/10.1097/NMD.0000000000000733.
[70] Hanna KM, Scott LL, Schmidt KK. Retention strategies in longitudinal studies with emerging adults. Clin Nurse Spec 2014;28(1):41–5. https://doi.org/10.1097/nur.0000000000000020.