

# Age and Gender Effects on Non-Suicidal Self-Injury, and their Interplay with Psychological Distress

Running title: Age, gender, distress and NSSI

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## **Acknowledgements**

This research was supported by a Wellcome Trust Strategic Award (reference: 095844) for the Neuroscience in Psychiatry Network (NSPN.org.uk). Additional support was provided by the National Institute for Health (NIHR) Research Cambridge Biomedical Research Center, the NIHR Collaboration for Leadership in Applied Health Research & Care East of England, and the Medical Research Council (MRC)/Wellcome Trust Behavioral and Clinical Neuroscience Institute.

## **Author Contributions**

IMG and PBJ led data collection. PW, TQ, CJ and SASN planned and conducted data analysis. All authors co-wrote the paper and approved the final manuscript.

## **Word Count**

Main text: 3837

Abstract: 199

# Abstract

**Introduction:** NSSI (non-suicidal self-injury) is an important public health issue, with high prevalence and associations with future mental illness and suicide. To date, no large single study has tested age and gender effects on NSSI and their interplay with psychological distress.

**Method:** NSSI and psychological distress were ascertained by questionnaire in a community study of 2368 young people aged 14-25; proportions at each age and of each gender were approximately equal.

**Results:** There was a significant quadratic interaction between age and gender on last month NSSI prevalence ( $p = 0.025$ ): NSSI was more common in females ages 16-19, but there were no significant gender differences at younger/older ages. General distress partially mediated the effects of age and gender on NSSI. The association between general distress and NSSI was not significantly moderated by age, gender nor their interactions.

**Conclusions:** Gender difference in NSSI is not a static gap, but evolves across time, widening in mid-adolescence and disappearing by early adulthood. Part of the reason for that gender gap being present at those ages is the increase levels of distress in young women at those ages. There was no evidence that the effects of general distress on NSSI differed by age/gender.

**Keywords:** Non-suicidal self-injury; age; gender; distress

## INTRODUCTION

Non-suicidal self-injury (NSSI) refers to the act of ‘direct, deliberate destruction of one’s own body tissue in the absence of the intent to die’ (Nock et al., 2006). Lifetime prevalence of NSSI in international adolescent community-based populations is between 18-25% (Muehlenkamp et al., 2012; Swannell et al., 2014). The most commonly reported reasons for NSSI are: reducing negative affect, self-punishment, communicating distress and trying to change the behaviour of others (Klonsky, 2007; Scoliers, 2009). While NSSI can cause short-term relief, it can lead to longer-term scarring and infection, guilt and shame, and bullying from others (Wilkinson & Goodyer, 2011). In addition, it is associated with future completed and attempted suicide and mental illness (Cooper et al 2005; Wilkinson et al, 2011; Wilkinson et al., 2018). Hence it is seen as an important public health issue, for which we need greater understanding. [LATEX]

NSSI is commonly perceived to be more common in females (Barrocas et al., 2012; Sornberger et al., 2012). However some studies show an equal prevalence of NSSI across males and females (Klonsky et al., 2003; Nock et al., 2006). Meta-analyses have also varied in findings, concluding both no gender effects (Swannell et al., 2014) and a small increase in risk for females (Bresin & Schoenleber, 2015). This ambiguity may be because studies differ in their samples, methods of assessment and in particular definition of NSSI (Bresin & Schoenleber, 2015). Females are more likely to engage in cutting and scratching in comparison to males, who are more likely to self-injure through hitting and burning (Sornberger et al., 2012). These differences in methods of NSSI between genders may underlie the gender difference seen with studies where only ‘female’ behaviours such as cutting are considered as NSSI. In addition, males are often underrepresented in the primary studies, making it harder to conclude male NSSI prevalence.

A systematic review of the current literature on the longitudinal age effects on NSSI suggested that it increases from ages 12.5 to 15 years, where it peaks and then declines (Plener et al., 2015). It is difficult to draw robust conclusions from this review as none of the studies span the whole time period across adolescence, each providing only a small snapshot of 2 or 3 years. Two cohort studies have followed the same groups of young people over time: Moran et al.

(2012) found that self-harm decreases from age 15.9 to 29.0 years, with the reduction being particularly rapid over the first year and a half. Daukantaitė et al (2020) found levels of NSSI to be similar at 13.7 and 14.8 years, and then to be much lower at 25.3 years. These results seem to capture the decrease in NSSI with age suggested by Plener et al. (2015). However, all primary studies have a narrow age range within adolescence (up to 3 years). The longer-terms studies either started relatively late (15.9 years) or had a gap of greater than 10 years between early adolescence and adulthood. There is no single study which measures NSSI levels at all ages from early adolescence to adulthood; and all studies vary in methodology and sampling frame. This makes it difficult to establish reliably how NSSI varies with age throughout this important age range. Any increase in NSSI over early adolescence may reflect the increase in psychological distress over this age range, hormonal changes associated with puberty (pubertal stage rather than age is associated with increased risk of self-harm: Patton et al., 2007) and the increase in exposure to a behaviour that is significantly contagious (O'Connor et al., 2009). The reduction in NSSI in later adolescence/early adulthood may come as the prefrontal cortex develops, improving emotional control (Moran et al., 2012).

It is possible that gender effects differ across age, and both cohort studies detailed above found a greater gender difference at younger ages (Moran et al, 2012; Daukantaitė et al, 2020). This was tested in a meta-analysis, wherein mean age of participants in a study had no significant effects on size of gender difference (Bresin & Schoenleber, 2015). However, such an analysis is confounded by methodological differences between studies, and averages gender differences at all ages within each study. To date, no large single study (with high numbers of participants at all age/gender combinations) has tested whether age moderates gender effects across the timespan from early adolescence to adulthood.

In keeping with the most common purpose of NSSI being to reduce distressing affect, NSSI is more common in people with high levels of psychological distress (Plener et al., 2015; Baetens et al., 2014). It is possible that the interplay with psychological distress may help to explain gender and age effects on NSSI. Firstly, age and gender differences in NSSI could reflect age/gender effects on distress: distress levels are higher in mid/late-adolescence (Rickwood and D'Espaignet, 1996; Wight et al., 2004), and in young women (Rickwood and D'Espaignet, 1996;

Rai et al., 2013); and this higher distress could be what makes NSSI more likely – *mediation model*. Secondly, both gender and age influence the methods people use to regulate emotion (Bresin, K. and Schoenleber, M., 2015). Therefore the likelihood of individuals engaging in NSSI when distressed may vary by age/gender – *moderation model*.

This study set out to test the interplay between gender, age and psychological distress on a community sample designed to recruit large numbers of people across its age range (14-25) and with equal numbers of males and females. We tested the following hypotheses:

- (1) NSSI is more common in females and peaks in mid-adolescence
- (2) Psychological distress is associated with engagement in NSSI
- (3) The age and gender patterns in NSSI would be partly explained by (i) different levels of psychological distress (mediation), and/or (ii) differential effects on whether people choose to engage in NSSI when distressed (moderation).

## **METHODS**

### **Participants and Procedure**

This study was conducted within the Neuroscience in Psychiatry Network (NSPN) 2400 cohort (Kiddle et al, 2018). Participants were sent a questionnaire pack, including a wide range of questionnaires about mental health and relationships, which was self-completed at home. The main sampling frame was age-sex-registers of patients registered in general medical practices in two British regions (Cambridgeshire & Peterborough and North London). Recruitment took place from 2012-2014. The Primary Care Research Network arranged for invitation letters to be sent by GPs to eligible individuals on the study's behalf. Further recruitment involved direct visits to secondary schools and colleges by our recruitment team. A minority were recruited directly through our website ([www.nspn.org.uk](http://www.nspn.org.uk)). The aim was to have 200 participants in each of the ten gender-age bins (14/15, 16/17, 18/19, 20/21, 22/23/24), a target that was exceeded for all bins.

Participants were excluded if they self-reported as being currently being treated for one

or more psychiatric disorders or for drug or alcohol dependence; if they had a current or past history of neurological disorder or trauma including epilepsy, head injury and loss of consciousness; if they had a current or past history of any medical disorder or treatment considered by the chief investigator to represent a risk for participation; if they were currently or recently (in the past 12 months) participating in a clinical trial of an investigational medical product (CTIMP); or if they had a learning disability requiring specialist education support and/or medical treatment. The primary reasons for the former criteria were: one aim of the study was to look at mind and brain development in a normative sample and we did not want to skew the sample with high numbers of people with mental illness or neurological illness; another aim was to look at risk factors for incidence of new mental illness, and so we wanted to reduce baseline levels of mental illness as such cases could not be used in an incidence study; we wanted maximum retention of participants in follow-up and so did not recruit participants if there was thought to be a high risk they would not remain in the study (in this practice this last criterion was very rarely applied). As with any community sample, we inevitably did still recruit people with mental illness, and levels of mental distress below thresholds for mental illness, that had not been recognised by the individual or diagnosed by a clinician.

Informed consent was obtained for all participants over 16. Informed assent was obtained for all participants under 16 as well as informed consent from a parent/guardian. The study was approved by the Cambridge Central NHS Local Research Ethics Committee.

## **Measures**

### NSSI

NSSI was measured using a binary self-report question ('In the last month, have you tried to hurt yourself on purpose without trying to kill yourself?') within the Drugs and Self Injury Questionnaire, a self-report questionnaire assessing an individual's risk taking behaviour. Further questions asked about frequency, methods and motivations, if participants ticked yes. These were, respectively: 'On how many days?' with a blank space to enter the number; 'What do you do? (tick the answers that apply to you)', with five options and also an option of 'Other please specify'; 'What best describes your reasons for hurting yourself? (tick the answers that

apply to you)' with 10 options. The DASI was originally developed for ROOTS (Goodyer et al., 2010), an epidemiological study of adolescent mental and physical health collected from 2005-2010 in Cambridgeshire. Reliability of the questionnaire is supported by finding similar population prevalence of NSSI in two separate community studies (Wilkinson et al., 2018) and good concurrent validity with the Self-Harm Inventory (Sansone, Wiederman, & Sansone, 1998; Cassels, 2018).

### General Distress Factor

Scales measuring psychiatric symptomatology (such as depression, anxiety and antisocial behaviour) are often correlated. This can make the most appropriate way to model the data being a bifactor analysis. This leads to a general distress factor (which accounts for the majority of the variance across the items) and multiple orthogonal specific factors which account for remaining variance. Such a bifactor analysis was conducted on self-reported NSPN questionnaire items, from six narrow band questionnaires on depression (33 item Mood and Feelings Questionnaire, MFQ; this is designed to cover the symptom areas as specified in DSM-IV for major depressive disorder; it has good test-retest reliability (Pearson's  $r = 0.78$ ); a cut off of 29 (or higher) has been found to best discriminate young people with MDD from those without MDD; Costello & Angold, 1988, Daviss, et al, 2006); anxiety (28-item Revised Manifest Anxiety Scale; Reynolds & Richmond, 1978); obsessive-compulsive symptoms (11-item Revised Leyton Obsessional Inventory; Bamber et al., 2002); anti-social behaviour (11-item Antisocial Behaviour Questionnaire); psychotic symptoms (11 items from the 74-item Schizotypal Personality Questionnaire; Raine, 1991); self-esteem (10-items Rosenberg Self-Esteem Questionnaire; Rosenberg, 1965); and mental well-being (14- items Warwick-Edinburgh Mental Well Being Scale; Tennant et al., 2007). Participants were included in the present analysis only if they completed at least 85% of the total items in the analysis (118 total items, minimum valid item count was 100) as well as 85% of each individual questionnaire to ensure adequate data on all domains.

The best solution was a bifactor model with a general distress factor, which explained a large proportion of the variance for most items, and five specific factors derived from the

residual variance after accounting for the general factor, indexing anti-social behaviour, worry, aberrant thoughts, negative self-perception and confidence (St Clair et al, 2017). For this study, we chose to look at the general distress factor alone, as this single factor accounted for the majority of the variance and represented the general distress that is common across all mental illness.

The general distress factor is thus a single continuous measure, which measures a common latent construct underlying all of the above scales (ie depressive, anxiety, OCD, antisocial and psychotic symptoms; and self-esteem and wellbeing). In the sample in this analysis, this measure had mean 0.02 and standard deviation 0.96, with higher scores representing higher levels of distress.

## **Data Analytic Strategy**

The whole baseline NSPN sample available at the time of analysis was used. For descriptive purposes, age bins were used for tables/graphs; statistical analysis used exact age (decimal, to the day). To determine the effects of age and gender patterns on NSSI, logistic regression was performed, with NSSI in the past month as the outcome. To test quadratic effects of age, age<sup>2</sup>, gender, age×gender and age<sup>2</sup>×gender were the covariates. A separate regression to test linear effects included age, gender and age×gender. (Age effects are unlikely to be linear, hence us testing quadratic effects of age.)

To test whether the effects of age and gender on NSSI may be mediated by the level of general distress, two binary mediation analyses were performed (binary mediation programmed by UCLA, downloadable at: [http://www.ats.ucla.edu/stat/stata/faq/binary\\_mediation.htm](http://www.ats.ucla.edu/stat/stata/faq/binary_mediation.htm)). Outcome was NSSI; gender×age and gender×age<sup>2</sup> were the two respective predictors, and general distress was the mediator. Finally, to test whether the effects of general distress differed by age/gender, logistic regressions were performed with age, age<sup>2</sup>, gender, general distress and their two- and three-way interactions added as covariates.

All data analyses were conducted using Stata versions 13/14. P < 0.05 was the threshold for statistical significance.



## RESULTS

### Effects of Age and Gender on NSSI

2315/2368 (98%) participants had valid data on age, gender and NSSI. 1249 (54%) participants were female. There were more than 200 people in each of the 10 age/gender bins. Mean (sd) age was 19.1(3.0). Mean (sd) MFQ was 18.1 (11.9). 80% of participants self-described ethnicity as white. 226 (9.7%) participants had engaged in NSSI in the last month. Specifically, 2.0% of the whole sample had self-injured on one day in the last month, 3.4% between two to three days, 2.4% four days or more, and data on frequency was missing on the remaining 1.9%. Among those endorsing any form of NSSI, 53% reported scratching or scraping skin, 44% cutting, 42% hitting/banging, 11% burning, 7% ingesting a substance.

NSSI was more common in females (159/1249, 13%) than males (67/1066, 6%),  $\chi^2=27$ ,  $p<0.0005$ . NSSI was more common in younger participants (Mann-Whitney  $Z=2.0$ ,  $p=0.046$ ). Multiple logistic regression demonstrated a significant quadratic ( $p=0.025$ ) but not linear ( $p=0.055$ ) age x gender interaction (table 1). Therefore the regressions were repeated separately by males and females (table 1). In females, there were significant quadratic ( $p=0.033$ ) and linear ( $p=0.006$ ) effects of age. There were no significant effects of age in males ( $p>0.2$ ). Figure 1 demonstrates these different developmental trajectories in males and females: engagement in NSSI increased from early adolescence (ages 14/15), peaked at mid-adolescence (ages 16/17), and then gradually declined in females; NSSI engagement remained roughly the same across time in males. NSSI was significantly more common in females at ages 16/17 ( $\chi^2=17$ ,  $p<0.0005$ ) and 18/19 ( $\chi^2=12$ ,  $p=0.001$ ); but there were no significant gender differences at other ages ( $p>0.15$ ).

### General Distress and NSSI

There was valid data on the general distress factor for 2215 (96%) of our sample with NSSI data. Consistent with our hypothesis, higher levels of the general distress factor were significantly associated with engagement in NSSI (standardised OR=4.28,  $p < 0.0005$ )

controlling for age and gender. General distress explained about a quarter of the variance in NSSI ( $R^2 = 0.24$ ).

### Mediation of Age/Gender Effects by General Distress

As with NSSI, general distress was significantly higher in females than males [mean(sd): male, -0.12(0.95); female, 0.14(0.94); Mann-Whitney  $Z=6.0$ ,  $P<0.00005$ ). Figures 2 and 3 show that, as with NSSI, age significantly modified gender effects on general distress. General distress was higher in girls aged 14/15. The pattern was then similar to that for age/gender effects on NSSI, with distress being particularly higher in females from ages 16-19, then the gender gap narrowing. As described in Figure 3, mediation analyses revealed that general distress partially but significantly mediated both gender  $\times$  age and gender  $\times$  age<sup>2</sup> in their associations with NSSI. The indirect pathway containing general distress explained 35% and 29% of the total effects of the gender  $\times$  age and gender  $\times$  age<sup>2</sup> interactions, respectively. In both cases, there continued to be significant direct linear and quadratic effects of gender $\times$ age on NSSI.

### Moderation of General Distress Effects by Age/Gender

Table 2 demonstrates similar effects of general distress at all ages, in both males and females. All three-way interaction terms (distress  $\times$  gender  $\times$  age, distress  $\times$  gender  $\times$  age<sup>2</sup>) were non-significant (all  $p>0.15$ ). In a regression with three-way interactions removed, all two-way interaction terms between distress and age/ age<sup>2</sup>/gender were non-significant (all  $p>0.12$ ).

## DISCUSSION

This study examined three hypotheses: (1) NSSI is more common in females and peaks in mid-adolescence; (2) Psychological distress is associated with engagement in NSSI; (3) The age and gender patterns in NSSI are partly explained by (i) different levels of psychological distress

(mediation), and (ii) differential effects on whether people choose to engage in NSSI when distressed (moderation).

Our findings revealed a complex interplay between age, gender and NSSI. While NSSI was more common in females through the entire sample, as hypothesised, this gender effect was significantly modified by age, such that the age pattern differed greatly between genders. In females, NSSI seemed to rise from early adolescence, peak at mid-adolescence (age 16-17), and then gradually decline; in males, however, NSSI remained at similar levels at all ages. This peak in females, and the difference in age patterns across genders, were unlikely to be due to chance, in view of the significant quadratic effect of age x gender. This difference in age pattern meant that the gender difference was only statistically significant at ages 16-20.

This age pattern supports findings from a meta-analysis which found a peak at age 15 (Plener et al., 2015) and findings from two longitudinal cohort studies which found a decline from adolescence to adulthood (Moran et al, 2012; Daukantaitė et al, 2020). Of note, these cohort studies also found a significant gender difference in adolescents but not adults. However, these latter cohort studies were not able to investigate whether there is a peak in mid-adolescence, as they did not sample participants through the age range 14-19. While the Plener study found that NSSI was more common in females, it did not investigate whether age influenced gender effects. Our findings add to the literature demonstrating that NSSI is not a static gap, but seems to evolve across time, widening in mid-adolescence (16/17 years), closing in late-adolescence, and disappearing by early adulthood. These age effects on gender differences in NSSI may provide a partial explanation for why studies have differed on whether they have found gender differences in self-harm – this may depend on age of samples. It also demonstrates that rather than simply looking at gender differences, mechanistic studies need to consider mediators of both age and gender effects on self-harm.

The second hypothesis was supported by our results: elevated general distress was robustly and independently associated with increased risks for NSSI, explaining a substantial proportion of variance (24%). This fits with existing research evidence (Plener et al., 2015;

Baetens et al., 2014) and several theoretical models postulating an affect regulation function of NSSI (Linehan, 1993; Nock, 2009).

To expand upon the extant literature on age and gender effects on prevalence, we explored *mechanisms* for the age and gender differences in NSSI. General distress partially mediated the age and gender patterns in NSSI: the greater NSSI prevalence in late adolescent girls may thus be partly attributable to elevated distress experienced by girls at that age. These results add support to Klonsky's (2011) recommendation that distress may constitute a fruitful avenue for NSSI intervention. Note, however, general distress only partially mediated the gendered age patterns in NSSI, suggesting that other age/gender-related characteristics are likely to explain differences in NSSI. For example, Prinstein et al. (2010) found that peer socialisation effect on NSSI was particularly strong among adolescent girls, which may be another reason for higher rates of what is a highly contagious behaviour in this group (O'Connor et al, 2009). It is also noticeable from figures one and two that while NSSI and general distress patterns by age/gender are similar for ages 16-24, there are very different at ages 14/15 – distress is higher in girls at this age, but NSSI rates are similar.

The association between general distress and NSSI was not moderated by age, gender nor their interactions. Thus we found no evidence to support the idea that the reason for the gender difference in late adolescence is that girls are more likely to self-harm than boys when distressed. It is possible that the study was not large enough to test all moderation effects: inspection of results suggested reduced effects of general distress on NSSI at older ages, although the age x distress interaction was not statistically significant ( $p = 0.12$ ). Inspection of results and interaction terms suggests very little differences in the effects of distress on NSSI between males and females.

## **Strengths and Limitations**

The main strength of this study is its utilisation of a large community sample, balanced for age and gender across the main ages of NSSI. The main limitation of this study is that it is cross-sectional. Firstly this means that cohort effects may account for age differences: there may be

something about the 16-19 year old females at that point in time that accounted for their higher prevalence other than their age. To truly test age effects, we would need to follow-up the same cohort over time. Secondly it means that any interpretations about directionality are tentative. While there is significant evidence that general distress is prospectively associated with future NSSI (Mars et al 2014), and that NSSI is primarily used to relieve distress (Klonsky 2007), there is also some evidence that NSSI leads to future onset of mental illness and distress (Mars et al., 2014; Wilkinson et al., 2018). Thus another alternative (albeit less likely) interpretation of these results is that some other factor causes NSSI rates to be higher in mid-late adolescent girls, and this higher level of NSSI causes higher levels of distress. Ideally mediational effects need to be tested in prospective studies; however this is difficult in practice, given that NSSI occurs at the moment of peak distress, rather than being caused by the distress measured at an earlier point in time. Another limitation is that the recruitment criteria (in particularly excluding people being treated for mental illness) were intended to create a sample representing those at risk of developing mental illness for the first time. This meant the sample was not truly representative of the general population, limiting the ability to generalise results to those with very high levels of mental distress. That said it is to be noted that there were still significant numbers of participants with high levels of mental distress and undetected mental illness.

## **Clinical implications and future directions**

Gender differences in non-suicidal self-injury are strongly influenced by age and seem particularly strong from ages 16-19, with greater prevalence in females at those ages only. This partial mediation of this gender/age effect by psychological distress provides further support for the reduction of psychological distress as an important component of treatment for NSSI. Future studies need to try to identify mechanisms (beyond general distress) for these gender/age effects. Future studies need to take into account both the age and gender of individual participants.

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# Tables and Figures

**TABLE 1.** Effects of age, gender and their interactions on past month NSSI

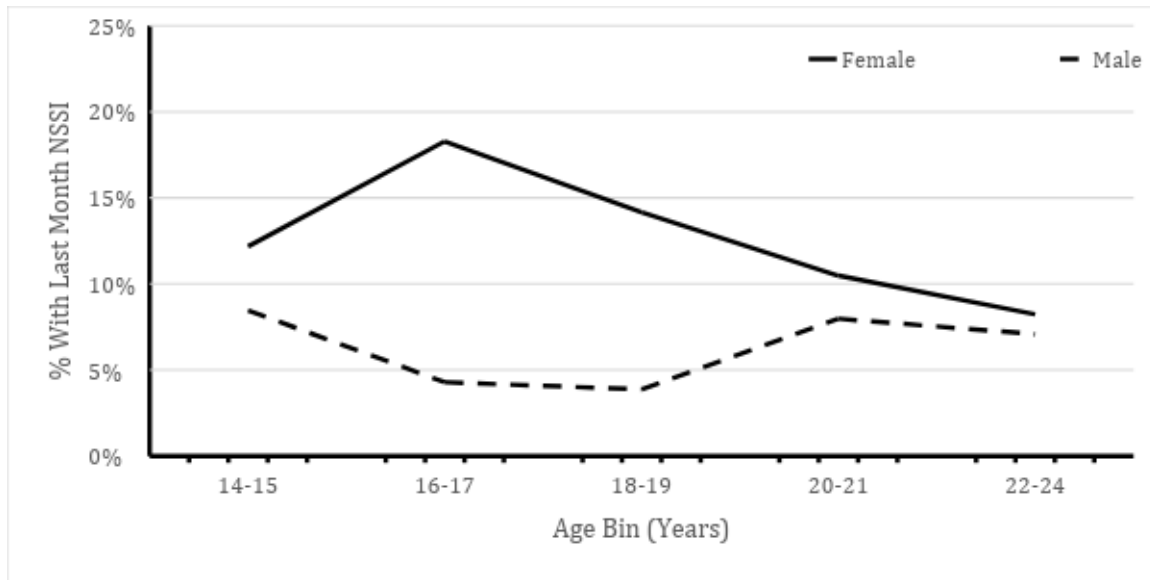
	<b>Total</b> (n = 2,315)	<b>Males</b> (n = 1,066)	<b>Females</b> (n = 1,249)
	<b>OR</b> (95% CI)	<b>OR</b> (95% CI)	<b>OR</b> (95% CI)
<b>Age</b>	9.18* (1.33-63.34)	0.54 (0.19-1.55)	0.92* (0.87-0.98)
<b>Age<sup>2</sup></b>	0.94* (0.89-0.99)	1.02 (0.94-1.05)	0.98* (0.96-0.99)
<b>Gender</b>	1.13e+5 (0.36- 3.55e+10)		
<b>Age x Gender</b>	1.10 (1.00-1.22)		
<b>Age<sup>2</sup>x Gender</b>	1.04* (1.00-1.08)		

Note. \* $p < 0.05$ ;

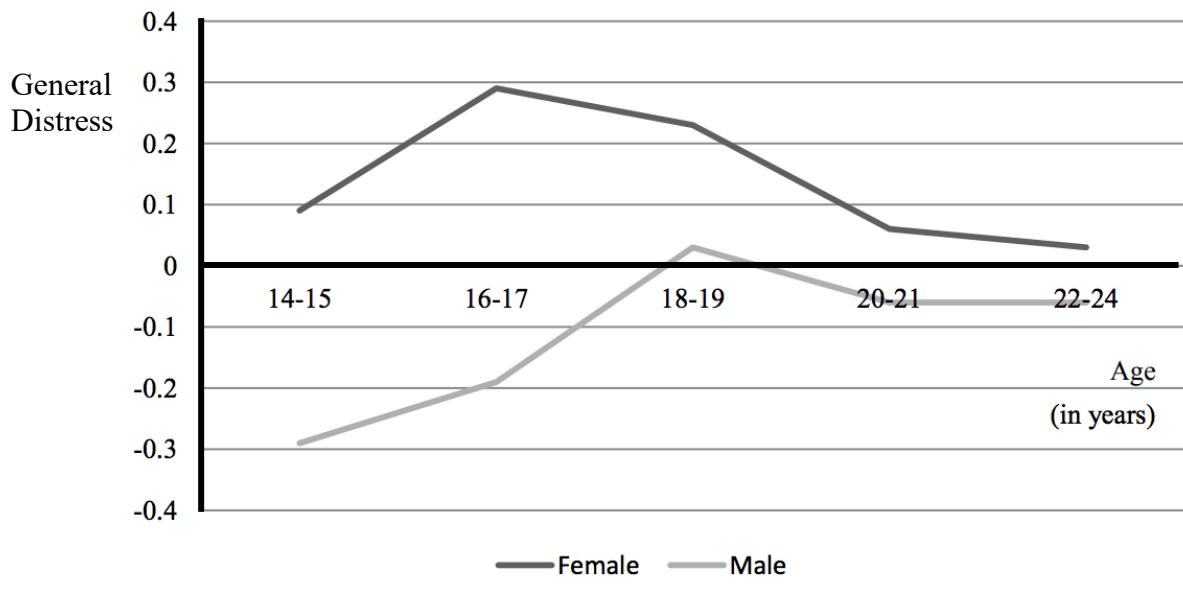
**TABLE 2.** Effects of General Distress on NSSI, Separated by Age and Gender

Age Bin	Male		Female	
	Standardised OR	95% CI	Standardised OR	95% CI
14-15	6.8	2.8-16.4	6.5	3.3-12.8
16-17	5.3	2.3-12.5	5.5	3.1-9.5
18-19	3.5	1.5-8.4	3.2	2.0-5.1
20-21	3.7	2.0-6.8	3.5	2.1-5.8
22-24	5.7	2.6-12.4	3.2	1.9-5.5

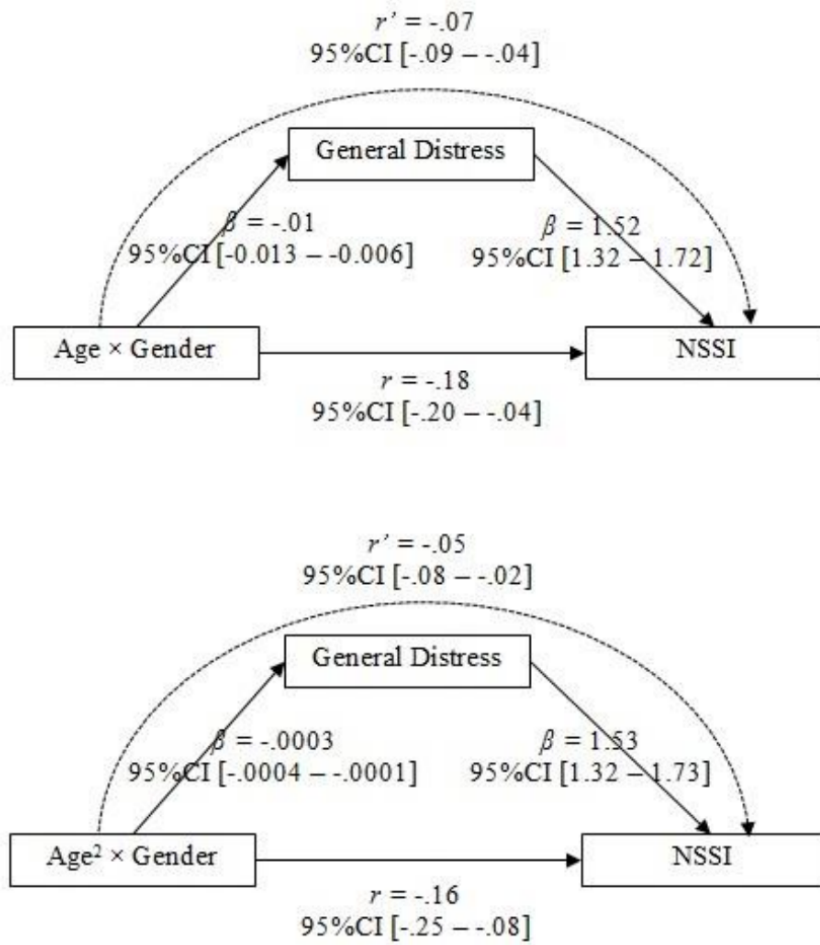
*Note: the standardised odds ratio compares participants with NSSI against participants without NSSI.*



**FIGURE 1.** Percentage of Participants with Past Month Non-Suicidal Self-Injury, by Age and Gender.



**FIGURE 2.** General distress (mean) by age and gender.



**Figure 3.** General distress as mediator of the association between age x gender and NSSI, and the association between age<sup>2</sup> x gender and NSSI ( $r$  indicates direct effect,  $r'$  indirect effect).