**The association between atypical speech development**

**and adolescent self-harm**

Jan McAllister1, Jane Skinner2, Rosemarie Hayhow3, Jon Heron4 & Yvonne Wren3,4,5

*1 University of Essex*

*2 University of East Anglia*

*3 Bristol Speech & Language Therapy Research Unit, North Bristol NHS Trust*

*4 University of Bristol*

*5 Cardiff Metropolitan University*

Corresponding author: Dr Yvonne Wren, University of Bristol, Bristol BS8 5BN, UK. Yvonne.wren@bristol.ac.uk

**Abstract**

Background: Adolescent self-harm is a major public health issue internationally. Various factors associated with adolescent self-harm have been identified, including being bullied and experiencing mental health problems. Stuttering and speech sound disorder are associated with both of these factors. It was hypothesised that both stuttering and speech sound disorder would be associated with self-harm. This is the first study to explore the relationship between communication disorders and adolescent self-harm.

Method: Secondary analysis of a large, longitudinal, prospective, community sample, the Avon Longitudinal Study of Parents and Children, was carried out. Clinicians identified children who stuttered or exhibited speech sound disorder at age 8. When the cohort members were 16 years old, they were asked to complete a questionnaire about self-harm. Multinomial logistic regression was used to examine the associations between stuttering and speech sound disorder and the self-harm outcomes, adjusting for other relevant factors.

Results: Of 3824 participants with data for both speech status and self-harm, 94 (2.5%; 95% CI 2.0% to 3.0%) stuttered at age 8 and 127 (3.3%; 95% CI 2.8% to 3.9%) displayed speech sound disorder. Speech sound disorder at age 8 was associated with self-harm with suicidal intent in both unadjusted and adjusted models. Differences between the adjusted and unadjusted models were small, suggesting that speech sound disorder is largely an independent risk factor for self-harm with suicidal intent. Stuttering at age 8 was not associated with adolescent self-harm, and there was no association between speech sound disorder and self-harm without suicidal intent.

Conclusions: Compared with individuals without speech sound disorder, adolescents with speech sound disorder at age 8 have twice the risk of reporting self-harm with suicidal intent, even when other important predictors are taken into account.

KEYWORDS: stutter; speech sound disorder; self-harm; ALSPAC.

**Introduction**

Self-harm (deliberate self-injury via methods such as cutting, burning or poisoning) is a serious public health issue (World Health Organization, 2016). As well as being an inherently injurious act, self-harm is of particular concern because of its strong association with attempted and completed suicide. Prevalence of self-harm without suicidal intent is worryingly high across all age groups but evidence suggests it is higher in young people. A meta-analysis of 128 studies of self-harm without suicidal intent (Swannell, Martin, Page, Hasking, & St John, 2014) provided a pooled prevalence estimate of 17.2% among adolescents, compared with 13.4% in young adults and 5.5% in adults. Moreover, there is evidence that incidence in younger children is increasing with variation across the sexes. Marchant et al. (2020) found that between 2003 and 2015, there were increases in attendances at emergency departments for self-harm for young people and that females were more likely than males to be admitted.

A history of self-harm without suicidal intent has been shown to be strongly associated with an increased likelihood of attempting suicide (Mars et al., 2019) and a history of self-harm is the strongest predictor of completed suicide (Geulayov et al., 2019). Foster, Gillespie, and McClelland (1997) reported that, among those who had died by suicide, 52% had a history of self-harm. According to theoretical accounts of self-harm, individuals may use it as a means of expressing, reducing, numbing or distracting from psychological distress such as anxiety or emotional pain (e.g., Chapman, Gratz, & Brown, 2006; Linehan, 1993; Madge et al., 2011; O’Connor, 2011; Valencia-Agudo, Burcher, Ezpeleta, & Kramer, 2018). Indeed, in a study of adolescent thoughts about self-harm and suicide attempts across 17 European counties, lifetime prevalence of suicide attempts was on average 10.5% (Kokkevi, Rotsika, Arapaki, & Richardson, 2012).

Risk factors for self-harm, with and without suicidal intent, are wide ranging and include being bullied and experiencing mental health problems such as depression, anxiety, low self-esteem and poor self-concept (Madge et al., 2008; Mars et al., 2014; Monto, McRee, & Deryck, 2018; Valencia-Agudi et al., 2018). In a systematic review by Evans, Hawton, and Rodham (2006), stress factors which were identified as having strong evidence of association with self-harm in adolescents included poor peer relationships and family discord.

These are factors which have also been associated with atypical speech development. Atypical speech development in this context is used as an overarching label to cover two broad types of difficulty which can occur in children: stuttering, where speech is characterised by unintentional repetitions, prolongations and interruptions; and speech sound disorder (SSD), where the production of speech sounds is affected by substitutions, omissions, distortions and additions of phonemes as a consequence of either articulatory or phonological problems or both. Each of these types of difficulty is regarded as persistent if it continues into middle childhood. Dworzynski, Remington, Rijsdijk, Howell, and Plomin (2007) reported that just over 1% of 7-year-olds exhibited persistent stuttering while Wren, Miller, Peters, Emond and Roulstone (2016) estimated the prevalence of SSD at 8 years to be 3.6%.

Atypical speech development impacts a child’s ability to make themselves understood. It is widely known that this can influence educational attainment (Anthony et al., 2011; Wren et al., 2021) with social and economic consequences which can continue into adulthood. It has also been associated with psychosocial factors such as negative peer reactions (Langevin, Packman, & Onslow, 2009; Overby, Carrell, & Bernthal et al., 2007) and bullying (Blood & Blood, 2004, 2007; Daniel & McLeod, 2017; Davis, Howell, & Cook, 2002; Langevin et al., 2009; McCormack, Harrison, McLeod, & McAllister, 2011; McCormack, McAllister, McLeod & Harrison, 2012; McLeod, Daniel, & Barr, 2013; Reilly, McKean, Morgan, & Wake, 2015; Sweeting & West, 2001).

*Stuttering and self-harm*

Among adults who stutter, evidence suggests anxiety disorders (especially social anxiety disorder) may be more prevalent than in the general population, at least among those seeking treatment for stuttering (Blumgart, Tran, & Craig, 2010; Iverach, Jones, et al., 2009; Iverach, O’Brian, et al., 2009; Iverach & Rapee, 2014; Menzies, O'Brian, Onslow, Packman, St Clare, & Block, 2008). There is some evidence that social anxiety disorder emerges during childhood in people who stutter: Iverach et al. (2016) reported a 6-fold increase in the prevalence of social anxiety disorder among 7-12 year olds who stuttered compared with controls who did not stutter. By contrast, Messenger, Packman, Onslow, Menzies, and O’Brian (2015) found that social anxiety scores for children and adolescents who stuttered were within normal limits on the Revised Children’s Manifest Anxiety Scale (RCMAS). However, they also found that boys who stuttered had high scores on the RCMAS Lie Scale, suggesting that they might have answered questions elsewhere on the RCMAS in such a way as to present themselves in a more positive light, for example, by concealing their anxieties about their speech.

Using data from a large national longitudinal study, Briley, Gerlach and Jacobs (2021) reported higher levels of depression in young people who stutter. They also found that boys who stuttered were more likely to experience suicidal ideation than their fluent peers but the same finding was not observed in girls. Further supporting evidence comes from a large population study that found that behavioural, emotional and social difficulties may be more common among children who stutter than typically developing children (McAllister, 2016).

Reports of self-harm in this population are rarer. A review of anxiety, social phobia, depression and suicide among people who stutter by Rezaeian et al. (2020) found no adequate research on suicide and stuttering. More recently however, Al-Ghamdi et al. (2022), in their study of 59 males who stuttered, found a higher risk of developing negative thoughts leading to suicidal attempts and reported that 33.9% of their participants had attempted suicide at least once. Similarly, Boyle (2015) reported unpublished research by Kuster (2012, 2013) which provided evidence from the writings of people who stutter that suicidal thoughts occur in this population, and described two who took their own lives. This devastating outcome may be related to factors other than stuttering but nevertheless, Rezaeian et al. (2020) concede that there is a known association between anxiety and suicide. Their review found a consistent reporting of an association between stuttering and anxiety.

A weakness of many of these studies was the age of the populations observed. Rezaeian et al. (2020) in their review noted that most of the 34 papers reported on adults. While the more recent Al-Ghamdi et al. (2022) study included males from age 11 up, 94% of the sample were aged over 16 and 49% over 21. There is a lack of knowledge therefore in the relationship between stuttering and self-harm in younger populations and whether the findings so far are incidental or suggestive of a pattern.

A variety of explanations have been provided in the literature for why children who stutter also experience problems with bullying and mental health which could, potentially, lead to self-harming behaviour. McAllister (2016) considers that Boyle’s (2015) model of self-stigmatisation may offer a partial explanation for the emergence of psychological difficulties in some children who stutter. Boyle’s model hypothesizes that once a child becomes aware that they are stigmatised by others, they start to apply the same negative attitudes to themselves, leading to problems with well-being.

Blood et al. (2011) compared 54 students who stuttered with 54 who did not stutter and found significantly greater rates of victimization in those who stuttered compared to those who did not. This was combined with lower self-esteem and a less optimistic life orientation in the group who stuttered. They concluded that increased vigilance and early intervention are vital for this population.

*SSD and self-harm*

Children with SSD may have higher levels of stress, which may be linked to increased levels of self-harm. Evans et al. (2004) identifies stress, in a variety of forms including poor peer relationships and family discord, as associated with an increased likelihood of self-harm in adolescents who show vulnerabilities such as a family history of suicidal behaviour and poor communication with family. Children with SSD are known to have poor peer relationships compared to their non-affected friends (McCormack et al., 2011; McCormack et al., 2012; Wren et al., 2023) while difficulties in making themselves understood could contribute to poor communication and discord within the family. This may be exacerbated by evidence that suggests children with SSD have problems handling stress, as reported by speech language pathologists and parents of children with SSD (McCormack, McLeod, Harrison, & McAllister, 2010).

Children with SSD have also been shown to have higher rates of emotional problems and other mental disorders compared to their non-affected peers in a large scale national study with 12,388 participants in Australia based on parent report (Keating, Turrell, & Ozanne, 2001) though what is included within the labels of emotional problems and mental disorders in this investigation is unclear. In a small scale qualitative study, the manifestation of these emotional problems for two children with SSD is reported by mothers who commented on the distress observed in their sons at not being able to be understood and in response to bullying (McCormack et al., 2012). An extreme example is provided by Carrigg, Baker, Parry, and Ballard (2015) who reported a single case study of a young adult male aged 22 with severe SSD who had presented to emergency and mental health services four times during his adolescence as a result of self-harming and suicidal ideation.

There are conflicting findings however. Beitchman et al.’s (2001) study of 105 young people with a history of speech and language impairment at age 5 found that the 38 who had problems with speech only (i.e., SSD) were no more likely than controls to show psychiatric problems at age 19. And while Wren et al. (2023) found problems with peer relationships and emotionality as reported by teachers in their 8-year-olds with SSD, their sample did not demonstrate any greater levels of depression than non-affected peers.

Understanding why children with SSD might self-harm is important to consider in exploring whether an association exists. McCormack et al. (2010) found that parents reported that their children often withdrew from communication interactions, perhaps fearful that they would not be understood. They considered that the frustrations that children may feel as a result of communication breakdown may contribute to their difficulties in handling stress.

*Aims of the study*

Investigations into risk factors for self-harm in children and young people have, to date, focused on factors relating to demographics (sex, socio-economic status), the individual (IQ, personality, mental health, behaviour) and the environment (exposure to self-harm, early adverse experiences, stressful life events, substance use, online social media use and cyberbullying) (Carballo et al., 2020; Gillies et al., 2018; Liu, Scopelliti, Pittman, & Zamora, 2018; Mars et al., 2014, 2019; Memon, Sharma, Mohite, & Jain, 2018). The communication challenges which occur as a result of atypical speech development have not been considered in such analyses and yet we have demonstrated that there is an association with many of these risk factors.

Studies of atypical speech and self-harm have, to date, focused on older populations rather than children and young people and have tended towards small samples. Al-Ghammdi et al. (2022) recommend that future studies should be designed to establish the relationship between atypical speech and self-harm. Large sample sizes are needed to determine if the associations observed in individuals are idiosyncratic or representative of a pattern. Such studies have the advantages of increased precision of results and, in a sample of the general population, of containing a reasonable number of participants with the exposures and outcomes of interest. If children with atypical speech development are at greater risk of self-harm, those working with these children in a professional capacity in schools and health roles as well as parents should be aware of this. Moreover, the impact of interventions should be measured not only on speech production but also on risk of self-harm.

The aim of this study was therefore to determine whether children with atypical speech development were more likely to engage in self-harming behaviour, with or without suicidal intent. Few studies have sufficient data to explore this question as it is rare for longitudinal population studies to include information on children’s speech development. The Avon Longitudinal Study of Parents and Children (ALSPAC) is an exception however. Used by Mars et al. (2014, 2019) to investigate differences in aetiology and prognosis for young people who self-harm with and without suicidal intent, this study includes data collected by postal questionnaire to 4799 participants on a range of issues including self-harm and data from direct assessment of 7390 children’s speech at age 8.

The specific questions addressed in this work are:

1. Are children who stutter more likely than their non-stuttering peers to self-harm, with or without suicidal intent?
2. Are children with speech sound production difficulties more likely than their unaffected peers to self-harm, with or without suicidal intent?

**Method**

*Participants*

ALSPAC is a large, longitudinal, prospective, community-sampled study of pregnancy, child health and lifespan development based in the former county of Avon in the United Kingdom. The original sample consisted of 14,541 pregnant women with expected delivery dates between 1st April 1991 and 31st December 1992 (Boyd et al., 2013; Fraser et al., 2013). These pregnancies resulted in 14,676 live births, with 13,988 children alive at one year of age. At age 7, a further 548 children joined the study; these children were eligible from birth but their mothers had not been recruited during the initial sweep. Data collection has occurred regularly since the start of the study. Please note that the study website contains details of all the data that are available through a fully searchable data dictionary and variable search tool; see <http://www.bristol.ac.uk/alspac/researchers/our-data/>. Ethical approval for the study was obtained from the ALSPAC Ethics and Law Committee and the Local Research Ethics Committee.

Not all participants completed all aspects of data collection. A total of 7390 participants completed the speech assessment measures at age 8 and 4799 participants completed the self-harm questionnaire at 16. Only those participants who had data on both measures were included in the analysis (n= 3824). Figure 1 provides a summary of participant numbers through the study. Children with co-morbidities in the sample were not excluded from either of the case groups or the control group. This was because recruitment was from a population study in which all children were eligible for inclusion provided they were born during the recruitment period and in the location for recruitment. Removing those children with known co-morbidities would risk inclusion of those with unknown co-morbidities, potentially biasing the sample. Using a normative population sample ensured that co-morbidities would appear within the sample in the same proportions as in the population as a whole.

[Figure 1 about here]

*Variables*

Data on speech fluency and speech sound production, self-harm and known confounders were collected at various times during the ALSPAC study.

*Speech fluency and speech sound production*

Data on atypical speech development were collected during the “Focus at 8” clinic. All 13,314 cohort members who were still alive, consenting and contactable were invited to the “Focus at 8” clinic which took place when they were 8 years 6 months old. The clinic, which was designed to explore the children’s physical and mental health as well as cognitive and social development, was attended by 7,488 children (mean age 103.8 months, sd 3.92; 50.1% boys). Although the original sample was diverse in terms of socio-economic status, those who attended the Focus at 8 clinic were predominantly white (96.1%), more likely to own their own homes compared to non-attendees (83.3% vs. 61.2%) and the mothers were more likely to have continued education to at least age 18 (43.3% vs. 24.9%) suggesting a bias towards a higher socio-economic status in the attendees (Wren et al, 2013). Reasons for non-attendance are not available but given the nature of the study as an inclusive longitudinal cohort study, it was anticipated that some families would cease to maintain their involvement over time. The rate of attrition is similar to other longitudinal cohort studies (Gustavson, von Soest, Karevold, & Røysamb et al. 2012). Details of the measures collected at the clinic are available at <http://www.bris.ac.uk/media-library/sites/alspac/documents/researchers/clinics/focusclinicsessions.pdf>.

The clinic included a 20-minute direct assessment of the child’s speech and language, which 7,390 children completed. No targeted speech assessments were carried out in clinic. Digital recordings were made of the children’s oral responses to the Wechsler Objective Language Dimensions (WOLD, Rust, 1996) and an adapted version of the Nonword Repetition Test ([Gathercole, Willis, Baddeley, & Emslie, 1994](https://pubs.asha.org/doi/10.1044/2019_JSLHR-L-19-0001#bib58)), and these provided the speech samples that were used to identify the child’s speech status. Three sub-samples of speech were collected: isolated words produced during a confrontation naming task (WOLD); a connected speech sample generated from three picture description tasks (WOLD); and isolated non-words that the children repeated after listening to an audio recording of each one (Nonword Repetition Test).

The collection of data from these 8 year olds was carried out using an agreed protocol. In the majority of cases (85.9%), speech data collection was carried out by UK-trained speech and language therapists (SLTs) who were native British English speakers; the remaining samples were collected by psychologists following training from the SLTs. The team carrying out data collection noted any fluency or speech features that they considered atypical in terms of fluency or speech sound production, taking into account the child’s age and accent. Children were considered to have typical speech if their speech was consistent with a regional accent and they produced only isolated errors which were not indicative of a system wide error.

The recordings of those children who were considered to have atypical fluency during the clinic session and those whose parents were concerned about their child’s fluency were listened to by members of the SLT assessment team. These recordings were then orthographically transcribed by the assessment team with disfluencies written as they were heard, for example, ‘bu, bu, bu, but’ or ‘but, but, but’. A four-point rating scale was piloted by two SLTs with considerable experience in working with children who stutter. Firstly, they independently rated 27 samples then compared and discussed their interpretations of the scale. A further 45 samples were then independently rated resulting in 98% agreement between raters. Samples rated 3 or 4 indicated stuttering. A rating scale was used for this analysis to include children who had occasional moments of severe stuttering, who would not meet the criteria for 3% stutter like disfluencies (Yairi & Grinager Ambrose, 2005). The choice of a rating scale was influenced by the relatively small speech samples which also lacked the range of speaking tasks found in more formal stuttering assessments.

These recordings and transcription were used as the basis to categorise participants into those who stuttered and those who did not. On the basis of these ratings, 173 children out of a total of 382 were identified as stuttering. There were 126 (73%) boys and 47 (27%) girls and the mean sample length was 222 syllables.

A total of 991 children were classified as having atypical speech sound production. Those whose errors were limited to what Shriberg (1993) describes as Common Clinical Distortions (N=580) were identified and excluded from further analysis. Common clinical distortions are defined by Shriberg (1993) as labialized and velarized /l/; labialized, velarized, and derhotacized /r/; and dentalized and lateralized /s/, /z/, /ʃ/, /ʒ/, /tʃ/ and /dʒ/. This is because children with these errors at this age are not typically seen for intervention in the UK as these productions are considered representative of speech difference rather than speech disorder. Of the remaining 411, five recordings were missing or corrupted and could not be transcribed; the data for these individuals were also excluded from any further analysis. The recordings of the remaining 406 participants with atypical speech sound production together with a randomly selected control group of 50 participants from the rest of the cohort were listened to, transcribed using narrow transcription and analysed in terms of error type and percentage consonants correct (PCC).

The continuous speech samples of these 456 participants contained a mean of 141.7 word tokens (standard deviation 61.4). Two of the PCC measures, PCC Late 8 and PCC Adjusted (Shriberg, 1993), were selected to be used for the purposes of identifying true cases of SSD from within the sample of children with atypical speech sound production as identified by assessors during the assessment. The PCC late 8 measure was selected as it was considered to be sensitive to later speech sound development, which was important because the sample were past the age of typical speech sound acquisition. The PCC Adjusted was selected as this measure accepts common clinical distortions as acceptable productions, which was consistent with our exclusion of children whose speech contained only these errors.

The recordings from a sample of 50 children selected at random from the total of 456 were re-transcribed by a second transcriber. Point-to-point inter-rater reliability was 92.3% for these samples. As this was carried out post hoc, it was not possible to resolve discrepancies for the 7.7% where differences were observed and the original transcriptions were used in further analyses.

The PCC scores for the control group revealed that three children had scores which were considered outliers. Therefore the means for the remaining 47 were used in analysis. The mean PCC Late 8 score for the 47 controls for both boys and girls was 96.7% with standard deviation (sd) of 4.0 (boys 95.8% sd 4.3, girls 97.6%, sd 3.6). The mean PCC Adjusted score for the 47 controls for both boys and girls was 98.1% with sd of 1.7 (boys 97.8% sd 1.6, girls 98.5%, sd 1.7).

The PCC scores for the children with atypical speech sound development were compared against these controls. Two children were shown to have 100% PCC Adjusted, suggesting that their speech errors were limited to Common Clinical Distortions. These children were excluded from any further analysis.

The criterion for identifying an individual as an SSD case was a score at least 1.2 standard deviations below the mean for the control participants. The choice for this cut off was based on Records and Tomblin (1994)’s work. They identified that clinicians’ decisions regarding diagnosis based on clinical judgment was consistent with a cut-off of -1.2 SDs on standardised tests. This process identified 263 individuals who met the diagnostic criterion for SSD; one cohort member subsequently withdrew consent, leaving 262 SSD cases potentially included in our analyses if they also had self-harm data. More details on the process of assessment and analysis of these recordings is provided in Wren et al, 2016. Six children appeared in both the children who stutter and the SSD group. They were included in all analyses.

*Self-harm* When participants were 16 years old, they were asked to complete a questionnaire about self-harm based on items from the Child and Adolescent Self-harm in Europe (CASE) study (Madge et al., 2008). Compared with non-responders (N=4528), those who returned the questionnaire (N=4799) were more likely to be female, have a higher level of education, and have a mother with a lower class of occupation (Mars et al., 2014). Presence of a history of self-harm was identified via the question, “Have you ever hurt yourself on purpose in any way (e.g., by taking an overdose of pills or by cutting yourself)?”. Those who were identified as having self-harmed with suicidal intent responded to the item, “ Do any of the following explain why you hurt yourself on [the most recent occasion]” by selecting, “I wanted to die” or responding ‘Yes’ to the item, “On any of the occasions when you have hurt yourself on purpose, have you seriously wanted to kill yourself?”. On the basis of responses to these three items, three groups were identified: those who reported that they had not deliberately self-harmed, those who reported they have self-harmed without suicidal intent, and those who reported self-harm with suicidal intent.

*Covariates*

Additional factors that were controlled for in the analyses were those that have been identified as important in previous investigations of self-harm (Mars et al., 2014). They included variables relating demographic factors (sex, income and socio-economic status); child IQ; body dissatisfaction; mental health; substance use; sensation seeking behaviour; childhood sexual abuse; cruelty to children in the household; bullying; exposure to self-harm and parental suicide attempts. Table 1 provides detail on the processes used to collect these data and information on when they were collected.

*Statistical analysis*
Self-harm was analysed as a three-level outcome: no self-harm; self-harm without suicidal intent; self-harm with suicidal intent. Multinomial logistic regression, which produces relative risk ratio (RRRs), was used to examine the associations between the exposures of stuttering and SSD and the self-harm outcome variable, adjusting for other important covariates. All of the factors that Mars et al. (2014) examined were associated with the outcome in models adjusting for sex only. All covariates were adjusted for, whether or not they were associated with stuttering or SSD. Using covariates that are not associated with the exposures of interest (stuttering and SSD), but that are good predictors of the outcome, increases the precision of the estimates. Five models were generated: one modelling stuttering and SSD alone; one adjusted for demographic factors (sex and measures of socioeconomic position); one adjusted for personal factors (IQ, body dissatisfaction, measures of mental health and of substance use); one adjusted for early adverse experiences (measures of victimisation and self-harm in friends and family); a final model including all variables mentioned. We carried out the analyses in Stata 16.

*Missing data imputation:* This analysis was based on a dataset consisting of 3824 individuals with stuttering, SSD and self-harm data. The percentage of missing values for covariates varied from 0 for sex to 27% for parental cruelty to children in the household. Values for missing covariates were imputed using Multivariable Imputation by Chained Equations (Van Buuren, 2018), and analysed via the “mi” command in Stata. The variables and imputation models employed were those used by Mars et al. (2014) who imputed missing values from the variables in the analysis plus a number of auxiliary variables (variables associated with their exposures of interest and earlier/later measures of the same exposures). Two hundred imputed datasets were generated.

**Results**Of the 3824 participants who provided data for both speech status at age 8 and self-harm at age 16, 94 (2.5%; 95% CI 2.0% to 3.0%) were assessed to be stuttering at age 8 and 127 (3.3%; 95% CI 2.8% to 3.9%) were classified as having SSD. While these figures represent a classification of the sample based on observation of behaviours that are consistent with stuttering or speech sound production problems, they should not be considered prevalence rates as cut offs based on specific metrics have not been used. There were six participants who were evaluated as having both. This was considered too few to investigate a possible interaction between the stutter and SSD variables, so these interactions were not included in the models used.

The results for the variables measured compared to the self-harm outcome were very similar to those reported in Mars et al. (2014) which is to be expected as a large subset (3824/4799; 79.6%) of their observations was used. The 975 missing participants either lacked stuttering and SSD measures or had withdrawn consent. The main difference was that parental social class was not significant in this analysis (*p* = .178), while it was for Mars et al. (*p =* .004). Parental social class was included in the multivariable analyses. Because of the ALSPAC Executive requirement noted above, a supplementary descriptive table showing the variables included in the models broken down by self-harm status was not provided, as this would be disclosive in conjunction with Table 2.

Table 2 shows the variables included in the models grouped by the stutter/no stutter (the latter including SSD participants) and SSD/no SSD measures (the latter including stuttering participants). This table has been edited so that the exact values for cells <5 are not shown and any information from which these values could be calculated has also been modified. This includes the corresponding *p* values, which are given as < .05 or ≥ .05. In this raw analysis, there was no difference between the rates of the different type of self-harm in participants with and without stuttering (*p* ≥ .05, Table 2). There was, however, a difference between the SSD and non-SSD groups, with rates of 12.3% and 11.8% for self-harm without suicidal intent and 6.3% and 11.8% for self-harm with suicidal intent respectively (*p =* .046, Table 2).

The stutter and SSD groups both had a smaller proportion of females. The stutter group were more likely to have parents from a professional/managerial class, have more educated mothers and a higher mean IQ than the non-stuttering group, whereas the SSD group were more likely to have less educated mothers and had a lower mean IQ than the non-SSD group. Participants in the stuttering group had higher mean sensation-seeking scores (both intensity and novelty) than the non-stuttering group, but no such difference was seen for the SSD group. The SSD group were more likely to have depressive symptoms and to have experienced a parental suicide attempt. Other factors (income, body dissatisfaction, anxiety disorder, substance use, measures of victimisation, and other self-harm in friends and family) did not show an association with stuttering or with SSD.

There was a great deal of consistency between the different models used to examine the relationship between stuttering and SSD and the three self-harm categories (Table 3). There was no association between stuttering and self-harm without suicidal intent (versus no self-harm) in any of the models. There was a consistent but non-significant lower risk of self-harm with suicidal intent (compared to no self-harm) and of self-harm with suicidal intent (versus self-harm without such intent) for those who stuttered in all models. There was no association between SSD and self-harm without suicidal intent, and a consistent but non-significant positive association between SSD and self-harm with suicidal intent versus without in all models. The only association that was significant was between self-harm with suicidal intent (versus no self-harm) for the SSD group compared to the non-SSD group. This was seen for all models. The fully-adjusted model produced an RRR of 2.57 [95% CI 1.31,5.03] for self-harm with suicidal intent (SHSI) and SSD. This RRR can be broken down as:

(The relative risk of SHSI compared to no self-harm in participants with SSD)/
(The relative risk of SHSI compared to no self-harm in participants without SSD), adjusted for the other variables in the model.

The RRRs did not change greatly between the variously-adjusted models. The full results for all variables included in the models are presented in the supplementary tables.

The Type I error was fixed at 5% (i.e., statistical significance of 2.5%, two tailed) in keeping with convention. The Type II error is dependent upon sample size which was fixed in this case. Given the complexity of the modelling, it was not possible to provide any *a priori* power calculations, and this therefore may have been low as indicated in the discussion. However, once parameter estimates are made, the precision of the estimates can be seen from confidence intervals.

**Discussion**

This is the first study to explore the relationship between atypical speech development (stuttering and SSD) and adolescent self-harm with or without suicidal intent. Based on results of earlier studies indicating that experiencing bullying and mental health difficulties predict the likelihood of self-harm (e.g., Madge et al., 2011; Valencia-Agudo et al., 2018) and that those with a developmental history of stuttering or SSD are more likely than typically developing peers to experience such issues (e.g., Keating et al., 2001; McCormack et al., 2012; McLeod et al., 2013; Sullivan et al., 2016; Blumgart et al., 2010; Iverach, Jones, et al., 2009; Iverach, O’Brian, et al., 2009; Iverach & Rapee, 2014; Menzies et al., 2008; McAllister, 2016), we hypothesised that participants with stuttering or SSD would be more likely than those without these speech problems to report self-harm with or without suicidal intent.

Our hypothesis was partially supported. Individuals with SSD were more than twice as likely as controls to self-harm with suicidal intent, an effect that was observed in all of our statistical models, which controlled for a wide range of factors that have previously been shown to be associated with self-harm (Mars et al., 2014). The absence of large differences between the adjusted and unadjusted models may suggest that SSD is largely an independent risk factor for self-harm with suicidal intent. The exact relationship among self-harm with suicidal intent, suicide attempts, SSD and other predictors is likely be a complex one which warrants further investigation.

*SSD and self-harm*

Despite the small absolute number of cases of self-harm with suicidal intent among those with SSD in our sample, taken together with prior findings cited in the Introduction, clinicians should take the risk seriously. First, the prevalence of SSD is relatively high, estimated at 3.6% at age 8 (Wren et al., 2016). Second, the consequences of self-harm with suicidal intent, not just for the individual but for their family and friends, are potentially devastating. A history of self-harm is the strongest predictor of completed suicide (Geulayov et al., 2019) and as many as 52% of those who die by suicide may have a history of self-harm (Foster et al., 1997).

McCormack et al. (2010) reported on the challenges faced by children if the impact of their SSD is such that they are unintelligible. Frustration and a tendency to become withdrawn as a response to communication breakdown and associated problems with making and sustaining friendships, as reported across other large epidemiological studies (McCormack et al., 2011), could be a contributory factor in why some children with SSD suffer with mental health and well-being issues (Keating et al., 2001; McCormack et al., 2012; McLeod et al., 2013; Wren et al., 2023) and have difficulty handling stress (McCormack et al., 2010). The evidence from this study suggests that this impact may go beyond such negative feelings and into actions, specifically self-harm with suicidal intent.

These impacts may also be experienced in those children whose SSD does not affect intelligibility but does mark them out as different. Interviews with seven adults who self-identified as having a lisp, a misarticulation primarily affecting only the sibilant consonants rarely impacting on intelligibility, by Lockenvitz, Oxley, and Tetnowski (2022) found that participants reported experiences of both internalised and public stigma. The SSD group in the study reported in this paper included children for whom low intelligibility may not have been a factor. Nevertheless, they may be vulnerable to the self-stigmatisation described by Boyle (2015) and the internalised and public stigma experienced by Lockenvitz et al.’s (2022) participants.

Stigma can be perceived by individuals if they are exposed to negative reactions from others in relation to their speech. In a study of audience response to child disordered speech, Strömbergsson, Edlund, McAllister, and Lagerberg (2021) found that listeners reacted more often to speech disrupted by acceptability (i.e., it sounded odd) than by speech disrupted by problems with intelligibility. It is not clear from the work reported in this paper whether the association between SSD and self-harm with suicidal intent is an impact of unacceptability or unintelligibility of speech. Further research is needed using a narrower definition of SSD such that only children whose intelligibility is likely to have been affected are included. This will help to determine whether it is communication breakdown as a function of low intelligibility which is the important factor or problems with acceptability of speech. Similarly, investigations into the trajectory of SSD and associations with self-harm are needed to determine if the relationship is one of severity and persistence of SSD rather than one of intelligibility and acceptability of speech.

*Stuttering and self-harm*

No relationship was observed between stuttering and self-harm with suicidal intent. The absence of this relationship was unexpected in view of the large number of studies indicating an association between stuttering and both being bullied and mental health problems, known risk factors for self-harm (Blood & Blood, 2004, 2007; Daniel & McLeod, 2017; Davis et al., 2002; Langevin et al., 2009; McCormack et al., 2011; McCormack et al., 2012; McLeod et al., 2013; Reilly et al., 2015; Sweeting & West, 2001). This is encouraging and suggests that although there is evidence that, in adulthood, this population may be more likely to suffer from anxiety (Blumgart et al., 2010; Iverach, Jones, et al., 2009; Iverach, O’Brian, et al., 2009; Iverach & Rapee, 2014; Menzies et al., 2008), depression (Briley et al., 2021) and other social, emotional and behavioural difficulties (Blood et al., 2011; Boyle, 2015; McAllister, 2016), the evidence from this study suggests that these features, when experienced in childhood, do not necessarily progress to self-harming behaviour, either with or without suicidal intent.

Nevertheless, it is important that alternative possible explanations for these findings are explored. First, the present study may be insufficiently powered to detect such a relationship, given the relatively small number of participants who stuttered and also completed the self-harm questionnaire. Moreover, this sample contained far fewer females than those in the control group, as would be expected given the higher prevalence of stuttering in males. As self-harm is more common in females (Marchant et al., 2020), it is possible that the lack of association observed is a function of the gender differences between the two samples rather than presence or absence of stuttering, although all models except model 1 were adjusted for gender. Another explanation could be that the evidence base for mental health issues among people who stutter has mainly involved participants who were seeking treatment for stuttering; there is limited evidence drawn from community samples such as the one used in the present study. Furthermore, few studies of mental health and stuttering have focused on childhood and adolescence, time windows which might be more relevant to the present study. Finally, although recovery from stuttering is most likely in the pre-school years, it is possible that some individuals may have recovered after age 8 in the current sample (Yairi & Ambrose, 2013), which might have influenced the outcome (assuming that there was a relationship between stuttering and self-harm in the first place). Further research is needed to investigate these possibilities.

A strength of this study is that it used a large, community-based sample. As Mars et al. (2014) point out, use of a community sample is important because most self-harm is not seen by specialist services. A further strength is the availability of data from direct assessment of speech, an attribute that ALSPAC shares with very few other large birth cohorts. The richness of the ALSPAC dataset also enabled us to control for a wide range of other factors associated with self-harm. Despite the large sample size in the present study, a potential weakness was the lack of statistical power, particularly for stuttering. Use of a larger community sample would have been desirable; however, it is worth pointing out that ALSPAC is the only community study of this size and breadth that contains both speech data and information about self-harm and was thus the optimal choice among currently-available resources.

*Limitations*

Large scale longitudinal population studies like ALSPAC are rare. Even more unusual is the availability of speech data which has been collected through direct assessment rather than relying solely on parent report, as is the case with other similar studies. However, there are also limitations. One of these is the data available for use are pre-determined, sometimes years in advance of when the data are used. Thus, some variables used in the analysis may represent behaviours or circumstances which can change over time, yet data are only available at a single time-point. For example, the level of maternal education recorded in pregnancy may have changed by the time the speech data were collected. Similarly, measures of personal, mental health and behaviour can change over time and participants’ responses may be different if asked about their body dissatisfaction or substance use for example, when older or younger.

Moreover, the types of assessment and analyses which can be carried out on large population samples of over 7000 participants are different to those which can be used with smaller samples. Time and cost limitations for this study meant that all measures of speech and language had to be completed within 20 minutes. The most efficient way to collect data therefore was to use assessments which could provide data for both speech and language analysis. It was for this reason that language assessments were used as the basis for the speech sample used in the analyses reported in this paper.

However, these limitations must be balanced with the strength that comes with a large sample size and the confidence that we can have in findings. There may be fluctuations in individuals’ responses over time but these are unlikely to result in major differences to results. Moreover, given the age of the children, phonetic transcription of continuous speech samples would arguably provide richer and more naturalistic data with greater sensitivity to difference than had a single word phonemically balanced picture description task been used.

Attrition is another challenge with longitudinal research. However, use of imputation by another study using the same dataset (Mars et al., 2014) suggests that the data included in the analysis reported in this paper were robust. Reporting accuracy is also a potential source of bias. Participants may fail to report sensitive issues such as self-harm with suicidal intent accurately, for example because self-reports may be affected by current mood state; nonetheless, self-report is considered to be more reliable than interviewing, which is the method used in some other studies. Sexual abuse may be inaccurately reported, in part due to sensitivity but also due to imperfect knowledge when, as in the present study, a parent rather than the victim is the source of the data.

The self-harm data do not allow researchers to pinpoint the timing of reported incidents relative to the influence of predictors. It is therefore difficult to determine with any certainty whether some predictors pre-dated the reported self-harm and therefore whether there could be a causal relationship with the outcome. While this is particularly the case for variables collected relatively close to age 16 when the self-harm questionnaire was administered, Mars et al. (2014) have pointed out that since self-harm rarely occurs before age 12, predictors gathered before this age almost certainly pre-date the self-harm events; importantly for this study, this includes diagnosis of stuttering and SSD.

*Clinical implications*

As part of a broader self-harm prevention strategy, practitioners need to be aware of the diverse range of factors, including speech sound production difficulties, that are associated with, and may contribute causally to, self-harm with suicidal intent among adolescents (Madge et al., 2011). Speech and language therapy services need to ensure that provision is in place for older children with speech sound production difficulties as well as pre-schoolers. This provision needs to include an awareness that children with a history of speech sound production difficulties - who may not present with these currently – are at higher risk than their peers of self-harm with suicidal intent. It should also consider that severity may not be a factor in determining the likelihood of observing self-harm behaviour and that problems with acceptability of speech may be as important, or possibly even more important, than intelligibility. Other professionals who need to be aware of the findings reported here include general practitioners and other clinicians, teachers, and those in the voluntary, community and social enterprise sectors who provide counselling for children and young people, both those targeting self-harm and suicide prevention and more wide-ranging services such as Childline in the United Kingdom.

Considering that a high percentage of adolescents who attempt suicide have previously self-harmed with suicidal intent (Muehlenkamp & Gutierrez, 2007; Brausch & Gutierrez, 2010; Zetterqvist, Lundh, Dahlström, & Svedin, 2013), professionals need to be vigilant for risk factors that are particularly associated with suicide attempts, such as self-harm in family or friends or the presence of anxiety or behavioural disorders (Mars et al., 2018; Mars et al., 2019). There are differing views about the effectiveness of interventions to address self-harm in adolescents (Hawton et al., 2015; Ougrin, Tranah, Stahl, Moran, & Asarnow, 2015). Further research needs to develop the therapeutic evidence base and, in the context of the present study, explore further the relationship between atypical speech development and self-harm and develop appropriate intervention approaches.

**Conclusion**

Compared with individuals without SSD, adolescents who had persistent SSD at age 8 have twice the risk of reporting self-harm with suicidal intent versus no self-harm, and this effect may be independent of other predictors of the outcome. The relationship among these other predictors, SSD, self-harm with suicidal intent and actual suicide attempts may be a complex one which requires further investigation. This finding has important implications for service delivery for this client group.

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Data Availability Statement

Information about how to access the data used in the study reported here can be found at

<http://ww.bristol.ac.uk/alspac/researchers/access/> .

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**Description of supplementary files**

**Supplementary table 1:** Degree of ‘missingness’ in variables

**Supplementary table 2:** Associations between speech variables (model 1) and self-harm with and without suicidal intent (n=3824)

**Supplementary table 3:** Associations between speech variables and demographic factors (model 2) and self-harm with and without suicidal intent (n=3824)

**Supplementary table 4:** Associations between speech variables and personal factors (model 3) and self-harm with and without suicidal intent (n=3824)

**Supplementary table 5:** Associations between speech variables and environmental factors (model 4) and self-harm with and without suicidal intent (n=3824)

**Supplementary table 6:** Associations between speech variables and all factors (final model) and self-harm with and without suicidal intent (n=3824)

**Title for Figure 1**

Figure 1. Summary of case identification (see text for further detail).