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# **Precursors of Sibling Bullying in Middle Childhood: Evidence from a UK-Based Longitudinal Cohort Study**

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**Key Words:** Sibling, Bullying, Family, Parenting, Emotion Regulation, Ethnicity

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## Abstract

**Background:** There is increasing evidence that sibling bullying is associated with various social, emotional, and mental health difficulties. It is, however, unclear which factors predict sibling bullying in middle childhood and whether child-level individual differences make some children more susceptible to sibling bullying involvement. **Objective:** To investigate the precursors of sibling bullying in middle childhood in a UK based population sample. **Participants and Setting:** Existing data from the prospective Millennium Cohort Study (N=16,987) was used. Primary caregivers reported on precursors (child age 7 years or earlier) whilst children self-reported on sibling bullying (child age 11 years). **Analysis:** A series of multinomial logistic regression models were fitted. First, testing for crude associations between sibling bullying and the precursors individually. Culminating in a final model with the significant predictors from all of the previous models. **Results:** Structural family-level characteristics (e.g. birth order, ethnicity, and number of siblings) were found to be the strongest predictors of sibling bullying involvement followed by child-level individual differences (e.g. emotional dysregulation and sex). Parenting and parental characteristics (e.g. primary caregiver self-esteem and harsh parenting) predicted sibling bullying, but to a lesser extent. **Conclusions:** These findings suggest that structural family characteristics and child-level individual differences are the most important risk factors for sibling bullying. If causality can be established in future research, they highlight the need for interventions to be two-pronged: aimed at parents, focusing on how to distribute their time and resources appropriately to all children, and the children themselves, targeting specific sibling bullying behaviors.

**Key Words:** Sibling, Bullying, Family, Parenting, Emotion Regulation, Ethnicity

## Precursors of Sibling Bullying in Middle Childhood – Evidence from a UK-Based Longitudinal Cohort Study

Siblings are an important part of most children's lives. Approximately 85% of children have at least one sibling (Tippett & Wolke, 2015). Good relationships with siblings are associated with a number of positive social, emotional, and mental health (SEMH) outcomes (Brown, Donelan-McCall, & Dunn, 1996; Buist & Vermande, 2014; Downey & Condon, 2004). However, sibling relationships are not always positive and can include frequent conflict and aggression, such as sibling bullying, which is “any unwanted aggressive behavior(s) by a sibling that involves an observed or perceived power imbalance and is repeated multiple times or is highly likely to be repeated; bullying may inflict harm or distress on the targeted sibling, including physical, psychological, or social harm” (Wolke, Tippett, & Dantchev, 2015 p.918). Nearly half of children report being bullied by their siblings and around 40% report bullying their siblings (Wolke, Tippett, et al., 2015).

Whilst peer bullying is recognized as a public health concern (Srabstein & Leventhal, 2010), sibling bullying has been somewhat neglected in research. This is despite it often happening in front of parents (Skinner & Kowalski, 2013). Sibling bullying is perceived as less severe (Khan & Rogers, 2015) and it is often normalised by family members, health professionals, and even victims themselves (Caffaro & Conn-Caffaro, 2005; Kettrey & Emery, 2006; Omer, Schorr-Sapir, & Weinblatt, 2008). Such normalisation may be rooted in common misconceptions that sibling bullying is typical of sibling relationships (Caspi, 2012) and is good for character building (Dunn & Kendrick, 1982). Parents may not intervene and the cycle of acceptability and normalisation continues (Kiselica & Morrill-Richards, 2007).

### **Sibling Bullying and SEMH Difficulties**

There is now increasing evidence suggesting that sibling bullying is associated with various SEMH difficulties (Toseeb, McChesney, & Wolke, 2018; Tucker, Finkelhor,

Shattuck, & Turner, 2013; Tucker, Finkelhor, Turner, & Shattuck, 2014a, 2014b; van Berkel, Tucker, & Finkelhor, 2018). Furthermore, prospective longitudinal studies show that sibling bullying in childhood is associated with SEMH difficulties later in adolescence (Bowes, Wolke, Joinson, Lereya, & Lewis, 2014; Dantchev & Wolke, 2018; Dantchev, Zammit, & Wolke, 2018; Toseeb, McChesney, Oldfield, & Wolke, 2019), which suggests that sibling bullying may have lasting adverse effects for both the victims and the perpetrators.

For these reasons, it is pertinent to consider the precursors of sibling bullying in an effort to inform interventions aimed at reducing bullying behaviours within families. Given that children's development is influenced by a multitude of factors, in the present study a combination of structural family characteristics, parenting and parental characteristics, and child-level individual differences were considered.

### **Structural Family-Level Characteristics**

Structural family-level characteristics are important from an evolutionary perspective where siblings are considered as natural born rivals for limited parental resources such as attention, affection, or material goods (Tanskanen, Danielsbacka, Jokela, & Rotkirch, 2017). Hawley, in their resource control theory (Hawley, 1999), suggested that social group asymmetries foster resource-agonistic behavior and social dominance for resource acquisition. Siblings, with few exceptions (e.g. twins), differ in age, size, abilities, or strength and thus there is a power asymmetry. Therefore, access to resources is likely to vary and conflictual competitive behavior may develop such as sibling aggression (Felson, 1983). First-born children face a particularly drastic loss of resources, once a sibling enters the family system, placing these children at an especially high risk for perpetrating sibling bullying in order to regain a social standing. In households with more children and brothers, aggression is indeed higher, particularly by first-born or older siblings (Bowes et al., 2014; Menesini, Camodeca, & Nocentini, 2010; Tucker et al., 2013).

## **Parenting and Parental Characteristics**

A second important factor may be the role of parenting and parental characteristics. Reciprocal interactions between children, their primary caregivers, and their environment are vital in the socialization of behavior (Bronfenbrenner, 1979). To this end, a number of psychological theories emphasize the importance of parental behavior in children's development. For example, social learning theory (Bandura, 1977) suggests that children model parental behavior therefore, parent-child interactions may be modelled as templates for child-sibling interactions. Specifically, good quality early parent-child interactions are important as they act as scaffolding to develop internal working models for future social relationships (Bowlby, 1969). Therefore, the development of social behaviors in children, both positive and negative, are not independent of parenting and parental characteristics.

Parenting is perhaps the most well-established as a correlate of sibling aggression and bullying. Insecure parent-child attachments have previously been reported more frequently in children involved in sibling bullying (Bar-Zomer & Brunstein Klomek, 2018). Moreover, specific parenting styles including greater psychological control by mothers (Campione-Barr, Lindell, Greer, & Rose, 2014), non-involved (Bouchard, Plamondon, & Lachance-Grzela, 2018), harsh parenting (Dantchev & Wolke, 2019; Eriksen & Jensen, 2009; Tippet & Wolke, 2015) and interparental conflict (Tucker et al., 2014a) have similarly been linked to sibling aggression and bullying involvement. Although there is a large body of evidence linking negative parenting practices to sibling bullying, such practices may not be independent of parental mental health. For example, depressed mothers have poorer interactions with their young children (Dib, Padovani, & Perosa, 2019), which may have a knock on effect on parenting practices. Similarly, parenting and parental characteristics are not independent of their child's individual characteristics.

## **Child-Level Individual Differences**

Children are not passive consumers of their environment. Their innate propensities may evoke a response from their environment or they may seek out environments that are in line with their innate propensities (Plomin, 2018). For example, children with difficult temperaments may evoke a negative response from their siblings as a form of reactive aggression in response to their difficult temperament. Conversely, children with easier temperaments might be more likely to be victims of sibling bullying because they evoke a negative behavioral response from their siblings as a form of proactive aggression (i.e. they may be seen as an easy target). There is some evidence for this in the literature. Children's sex (Tucker et al., 2013), early aggressive tendencies and temperament (Dantchev & Wolke, 2019), pre-existing social and emotional difficulties (Phillips, Bowie, Wan, & Yukevich, 2016), and the presence of a neurodevelopmental condition (Toseeb et al., 2018; Tucker, Finkelhor, & Turner, 2017) are all associated with a heightened risk for aggression or bullying amongst siblings.

### **A Comprehensive Investigation of Precursors**

In summary, much of the previous work on the correlates of sibling bullying is cross-sectional and/or limited to a small set of predictors. This is problematic as it does not allow for a comprehensive evaluation of the relationships between precursors and sibling bullying. Examining a small subset of precursors, or correlates, without controlling for others may lead to inflated effect sizes or masking effects. Some precursors may only be significant when tested in isolation, but not when tested simultaneously with other structural family-level characteristics, parenting and parental characteristics, and child-level individual differences.

To the best of the authors' knowledge, there has only been one comprehensive longitudinal evaluation of multiple early life precursors of sibling bullying in middle childhood (Dantchev & Wolke, 2019). The researchers investigated the role of structural family characteristics, parenting and parental characteristics, early social experiences, and

child-level individual differences on sibling bullying involvement in middle childhood using data from a large UK based cohort: the Avon Longitudinal Study of Parents and Children (Boyd et al., 2013; Fraser et al., 2013). In a sample of nearly 7,000 children, they found the strongest predictors of sibling bullying were structural family characteristics (e.g. having older brothers and being the first born). Parenting variables, early social experiences, and child-level individual differences were also important, albeit to a lesser extent.

The aim of the current study was to investigate precursors of sibling bullying in a single comprehensive investigation. Specifically, the extent to which structural family characteristics (e.g. birth order and poverty), parenting and parental characteristics (e.g. harsh parenting and parental engagement), and child-level individual differences (e.g. low birth weight and language concerns), all during the first seven years of life, individually and cumulatively predict sibling bullying at age 11 years was investigated. In line with previous work (Dantchev & Wolke, 2019), it was hypothesized that structural family-level characteristics would be the strongest predictors of sibling bullying at the age of 11 years. It was also hypothesized that parenting and parental characteristics and child-level individual differences would predict sibling bullying but to a lesser extent than structural family-level characteristics.

## **Method**

### **Ethical Approval**

The data used in this study was collected as part of the Millennium Cohort Study (MCS). Ethical approval was sought for each of the waves from the National Health Service (NHS) Research Ethics Committee (REC). Full details of the ethical process for the MCS is available at <https://cls.ucl.ac.uk/wp-content/uploads/2017/07/MCS-Ethical-Approval-and-Consent-2019.pdf>. Primary caregivers provided informed consent on behalf of the child. This secondary analysis of the data was approved by the Education Ethics Committee, University of York (reference: 19/14).



## **Study Sample**

The MCS is a multi-disciplinary study, following the lives of approximately 19,000 children born between 2000 and 2001 (Connelly & Platt, 2014). The sample is representative of the UK population and was drawn from the entire live birth cohort of the UK between the years 2000-2001. Disproportionate stratification was applied to ensure that all of the UK nations (Northern Ireland, Scotland, Wales and England) were represented adequately, to include highly concentrated areas of ethnic minority families and areas of deprivation. There have been six waves of data collection starting when the children were: 9 months old (N = 18,522) follow by data collection at age 3 years (N = 15,590), 5 years (N = 15,246), 7 years (N = 13,857), 11 years (N = 13,287), and 14 years (N=11,872). MCS participants at each wave were surveyed extensively, gathering information on various aspects of life such as socioeconomic status, psychological development, parenting, friendships, and relationships. In the current analysis, data from one child per family and their primary caregiver was used. For over 97% of the sample, the primary caregiver was the birth mother. Families were visited in their home. Primary caregivers were interviewed face-to-face by trained researchers, who took part in relevant training. Both, primary caregiver and the child, also completed self-report questionnaires during the visit, where appropriate. Full details of the data collection approach can be found at the study website (<https://cls.ucl.ac.uk/cls-studies/millennium-cohort-study/>).

A number of exclusionary criteria were applied to the dataset. From the total sample of 19,244, families with multiple children in the MCS were excluded (N=263) and those with no siblings when they were 11 or 14 years old (N=1,994). Therefore, the total sample size after exclusions was 16,987 (51% male).

## **Measures**

### ***Precursors***

The onset of sibling bullying is around the age of 8 years (Dantchev & Wolke, 2019). The essential inclusion criteria for the precursors in this analysis was that they were assessed prior to the typical onset of sibling bullying. As a general rule, precursors were included from the closest time point to the onset of sibling bullying. Where possible these were selected from the data collected when the child was 7 years old. Some variables were only available at earlier time points (9 months-5 years). Deviations from this general rule are explained in the description of the relevant precursor.

### **Structural Family Characteristics.**

**Primary Caregiver Highest Academic Qualification.** When the child was 9 months old, the primary caregiver was asked to report their highest academic qualification, which was recoded as an ordered variable (0=*none*, 1=*GCSE level*, 2=*advanced level*, 3=*degree level*, 4=*higher degree*).

**Birth Order.** The primary caregiver was asked to report the number of siblings that the child had. If when the child was 9 months old, they child did not have any siblings but they did when they were 11 years old, they were categorized as being the first-born (0=*second or later*, 1 = *first born*).

**Ethnicity.** The primary caregiver selected the child's ethnicity from a list. Responses were recoded to create a dummy variable (0= *non-White* or 1= *White*).

**Poverty.** Income from all sources (government benefits, employment etc.) was also surveyed when the child was 7 years old and used to calculate overall income. The OECD-modified scale was then used to standardize this overall household income (Hagenaars, de Vos, & Zaida, 1994). Poverty was categorized as those families who were below the 60% median income level (0= *not in poverty*, 1 = *in poverty*).

**Number of Siblings.** Primary caregivers completed a household grid during which they were asked to provide information about all the people who lived in the household when

the child was 7 years old (e.g. other children, partner, grandparents etc.). This information was used to calculate the number of siblings (1,2,3,4 or more)

***Lone Parent Status.*** Using data from the household grid, described previously, a dummy variable was derived for lone parent status when the child was 7 years old (0 = *two/parents or caregivers in household*, 1 = *one parent/caregiver in household*).

**Parenting and Parental Characteristics.** A number of pre-existing psychological inventories were used to measure parenting and parental characteristics. They are described below and further details of all inventories are reported elsewhere (Johnson, Atkinson, & Rosenberg, 2015).

***Primary Caregiver Self-Esteem.*** A shortened version of the Rosenberg self-esteem scale (Rosenberg, 1965) was used to measure the primary caregiver's self-esteem when the child was 9 months old. Sample items included "I am able to do things as well as most other people" and "I take a positive attitude towards myself". Responses were coded on a four-point scale (1= *strongly disagree*, 2=*disagree*, 3=*agree*, 4=*strongly agree*). Sum scores were generated (6 items, range 1 to 24). Higher scores indicate higher levels of self-esteem. The internal reliability of the scale was excellent ( $\alpha = 0.94$ ).

***Primary Caregiver Depression.*** The Malaise Inventory (Rutter, Tizard, & Whitmore, 1970) was used to assess primary caregiver depression symptoms when the child was 9 months old. Sample items included "do you feel tired most of the time" and "are you easily upset or irritated"? Responses were coded on a two-point scale (0= *no* ,1 = *yes*). Sum scores were generated (9 items, range 0 to 9). Higher scores indicate higher levels of depression symptoms. The internal reliability of the scale was good ( $\alpha = 0.73$ ).

***Parent-Child Conflict.*** The Pianta child-parent relationship scale (Driscoll & Pianta, 2011) was completed by the primary caregiver when the child was 3 years old. This measured the primary caregiver's feelings and beliefs towards their child and the child's

behavior towards the caregiver. The parent-child conflict subscale was used. Sample items included “[child] easily becomes angry at me” and “[child] is sneaky and manipulative with me”. Responses were coded on a five-point scale (1= *definitely does not apply*, 2= *not really*, 3= *neutral*, 4= *applies sometimes*, 5= *definitely applies*). Sum scores were generated (8 items, range 8 to 40). Higher scores indicate more parent-child conflict. The internal reliability for the scale was good ( $\alpha = 0.79$ ).

***Primary Caregiver Relationship Satisfaction.*** When the child was 5 years old, a modified version of the Golombok Rust inventory of marital state (Rust, Bennun, Crowe, & Golombok, 1990) was completed by the mother to assess relationship satisfaction with her partner. Sample items included “my husband is usually sensitive and aware of my needs” and “my husband doesn’t seem to listen to me”. Responses were coded on a five-point scale (0= *strongly agree*, 1= *agree*, 2= *neither agree or disagree*, 3= *disagree*, and 4= *strongly disagree*). Sum scores were generated (4 items, range 0 to 20). Higher scores indicate higher levels of relationship satisfaction. The internal reliability of the scale was very good ( $\alpha = 0.81$ ).

***Parental Engagement.*** When the child was 5 years old, a measure of parental engagement was used (Forrest, Gibson, Halligan, & St Clair, 2018). This consisted of questions about the frequency of primary caregiver-child activities (book reading, telling stories, musical activities, drawing/painting, physical activities, and outdoor games/activities). Sample items included “how often do you read to your child?” and “how often do you draw or paint with your child?”. Responses were coded on a five-point scale (0= *not at all*, 1= *less often*, 2= *once or twice a month*, 3= *once or twice a week*, 4= *several times a week*, 5= *everyday*). Sum scores were generated (6 items, range 0 to 30). Higher scores indicate higher levels of parental engagement. The internal reliability of the measure was good ( $\alpha = 0.70$ ).

**Primary Caregiver Global Psychological Distress.** When the child was 7 years old, the Kessler Scale (Kessler et al., 2003) was completed by the primary caregiver. The scale is commonly used as a screening tool for serious mental illness. The six-item version of the scale was used. Sample items included “during the last 30 days, how often did you feel worthless?” and “during the last 30 days, how often did you feel restless or fidgety?”. Responses were re-coded onto a five-point scale (0=*none of the time*, 1=*a little of the time*, 2=*some of the time*, 3=*most of the time*, 4=*all of the time*). Sum scores were generated (6 items, range 0 to 24). Higher scores indicate higher levels of global psychological distress. The internal reliability of the scale was good ( $\alpha = 0.88$ ).

**Harsh Parenting.** When the child was 7 years old, primary caregivers were asked to complete the Straus Conflict Tactics Scale (Straus & Hamby, 1997) to assess harsh disciplining of their child, referred to from here on as harsh parenting. Primary caregivers were asked how often they used different tactics with their child. Sample items included “ignore [child] when naughty” and “shout at [child] when naughty”. Responses were coded on a five-point scale (1= *never*, 2 = *rarely*, 3= *about once a month*, 4=*about once a week*, 5=*daily*). Sum scores were generated (6 items, range 6 to 30). Higher scores indicate harsher parenting. The internal reliability of the measure was good ( $\alpha = 0.73$ ).

**Child-Level Individual Differences.** A number of pre-existing psychological inventories were used to measure child-level individual differences. They are described below and further details of all inventories are reported elsewhere (Johnson et al., 2015)

**Sex.** During the first wave of data collection, when the child was 9 months old, sex was determined

**Low Birth Weight.** The primary caregiver was asked to report their child’s birthweight at the first wave of data collection (i.e. 9 months). This was used to create a

binary very low birth weight variable (<1,500g), which is in line with previous categorizations of low birthweight (Wolke, Baumann, Strauss, Johnson, & Marlow, 2015).

***Infant Temperament.*** When the child was 9 months old, the Carey infant temperament scale (Carey & McDevitt, 1978) was completed by the primary caregiver. Responses were coded on a five-point scale (0= *almost never*, 1=*rarely*, 2=*usually does not*, 3=*often*, 4= *almost always*). Four sum scores were generated by adding up response to the items within each of the four subscales: mood – the tone of child’s overall affect; e.g. “[child] is pleasant when first arriving in unfamiliar places” (5 items, range 0 to 20) higher scores indicate good mood, regularity– the predictability of child’s daily functions; e.g. “[child’s] naps are about the same length from day to day” (4 items, range 0 to 16) higher scores indicate high regularity, approach/withdrawal – the child’s initial response to novelty; e.g. “[child] is wary or frightened of strangers after 15 minutes” (3 items, 0 to 12) scores were reversed so that higher scores indicate higher levels of approach and adaptability – the child’s behavioral flexibility; e.g. “fretful in a new place or situation” (2 items, 0 to 8) scores were reversed so that a higher scores indicate adaptable temperament. The internal reliability for the overall scale was good ( $\alpha = 0.65$ ).

***Language Concerns.*** When the child was 5 years old, the primary caregiver was asked about speech and language concerns: “child’s speech/language developing slowly”, “child doesn’t understand others”, and “pronounces words poorly”. If respondents answered yes to any one of the three questions, their responses were recoded as “yes”, otherwise they were coded as “no”. This formed a binary variable about language concerns.

***Verbal and Non-Verbal Ability.*** The British ability scales (Elliot, Smith, & McCulloch, 1996) were used to assess verbal (naming vocabulary subscale) and non-verbal ability (picture similarities subscale). The direct assessment of the child was carried out when they were 5 years old. For the naming vocabulary subscale, which was used to assess

knowledge of item names, each child was shown a series of pictures of objects and asked to name what they saw. The verbal similarities subscale was used to assess the child's verbal reasoning and verbal knowledge. The interviewer read out three words to the child, who was asked to say how the three things were similar or go together. Ability scores were calculated using the instruction manual and used in all the analyses. Higher scores indicate better verbal and non-verbal ability. The ability scores referred to here were unstandardized.

Standardization to create z-scores was done later as part of the analyses.

***Autism Spectrum Conditions (ASC).*** When the child was 7 years old, the primary caregiver was asked "Has a doctor or health professional ever told you that [child] had Autism, Asperger's syndrome or autistic spectrum disorder?". Responses were coded on a binary scale (0=no, 1=yes).

***Affect and Behavioral Self-Regulation (Independence and Self-Regulation, Emotional Dysregulation, and Co-Operation)***. The child social behavior questionnaire (see Melhuish et al., 2004; Sammons et al., 2004) was completed by the primary caregiver and was used to measure the child's affect and behavioral self-regulation when they were 7 years old. The scale consisted of three subscales scored on a three-point scale (1=*not at all true, somewhat true*, 2=*certainly true*): independence and self-regulation e.g. likes to work things out for self (5 items: range 1 to 3) - higher scores indicate more independence and self-regulation, emotional dysregulation e.g. shows mood swings (5 items, range 1 to 3) - higher scores indicate more emotional dysregulation, and cooperation e.g. works/plays easily with others (2 items, range 1 to 3)- higher scores indicate higher levels of cooperation. The reliability of the overall scale was good ( $\alpha = 0.73$ ).

***Internalizing and Externalizing Problems.***

The parent-report strengths and difficulties questionnaire (SDQ: Goodman, 1997) was completed by the primary caregiver when the child was 7 years old. Responses were

coded on a three-point scale (0=*not true*, 1 = *somewhat true*, 2 = *certainly true*). Two subscales were created. Internalising problems (10 items, range 0 to 20), which was created by summing emotional and peer problems subscale; e.g. “[child] often complains of headaches” and “[child] is rather solitary, tends to play alone”. Externalising problems (10 items, range 0 to 20), which was created by summing the conduct problems and hyperactivity subscale; e.g. “[child] often has temper tantrums or hot tempers” and “[child] is easily distracted, concentration wavers” - higher scores indicate more internalising and externalising problems. The internal reliability of both subscales was acceptable (internalizing  $\alpha = 0.80$ , externalizing  $\alpha = 0.70$ ).

***Prosocial Behaviour.*** The prosocial subscale of the parent-report SDQ was administered when the child was 7 years old. Sample items were “[child] is helpful if someone is hurt” and “[child] is considerate of other people’s feelings”. Responses were coded on a three-point scale (0=*not true*, 1 = *somewhat true*, 2 = *certainly true*). There were 5 items with a total score ranging from 0 to 10 – higher scores indicate higher levels of prosociality. The internal reliability for the prosocial subscale was good ( $\alpha = 0.67$ ).

### ***Sibling Bullying in Middle Childhood and Early Adolescence***

When they were 11 years old, the child was asked two questions and asked to respond on a six-point scale (most days, approximately once a week, approximately once a month, every few months, less often, never): “*how often do your brothers or sisters hurt you or pick on you on purpose?*” (victimization) and “*how often do you hurt or pick on your brothers or sisters on purpose?*” (perpetration). Mutually exclusive sibling bullying groups were created based on established cut-offs (Dantchev & Wolke, 2018, 2019; Wolke & Samara, 2004): victim-only: victimized at least once a week but not perpetrated; bully-only: perpetrated at least once a week but not victimized; bully-victim: both perpetrated and victimized at least once a week; uninvolved: does not meet the criteria for any of the other categories. The



correlation between a one item scale, such as the one used here, and multi-item scales was calculated in an independent sample (Avon Longitudinal Study of Parents and Children (Boyd et al., 2013; Fraser et al., 2013), and it was shown to be high (victimization:  $r = .91$ ,  $n = 6,909$ ,  $p < .01$ ; perpetration:  $r = .85$ ,  $n = 6,856$ ,  $p < .01$ ) Thus, there is good evidence for the validity of this short scale.

### **Statistical Analyses**

As with all longitudinal studies, there was some sample attrition and subsequently missing data at each of the waves. To maximize power, multiple imputation was used to deal with missing data. Guiding principles outlined by von Hippel (2018) and Madley-Dowd, Hughes, Tilling, and Heron (2019) were used for the imputation process. The proportions of missing data for each variable are shown in Table S1 (supplementary materials). All continuous variables were standardized to z-scores prior to imputation. The “mi impute” command with “chained” equations was implemented in Stata/MP 16.0 (StataCorp, 2019), which generated 50 imputed datasets. The command fills in missing values for multiple different variables with a set of possible values by using chained equations, a sequence of univariate imputation methods with fully conditional specification of prediction equations. The imputation model included all of the variables used in the subsequent analyses in a single model. To account for the application of disproportionate stratification all estimates were weighted to population level (Mostafa, 2014). Survey weights were applied according to the MCS analysis documentation (Ketende & Jones, 2011). All reported values are weighted estimates. For the regression analysis, relative risk ratios (RRR) are reported which represent the increase in relative risk per 1 standard deviation change. Given the large sample size, a more stringent statistical threshold of  $p < .01$  was used instead of the conventional  $p < .05$ .

A multi-step analysis procedure was implemented. First, to identify possible precursors of sibling bullying, a set of multinomial logistic regressions were run (see Table

S2 in the supplementary materials for an overview of selected variables). For each of the regression models the outcome variable was entered as sibling bullying involvement group (uninvolved, victim-only, bully-only, bully-victim). The independent variable was entered as one of the precursors. Only one precursor was entered in each regression model. This allowed for crude associations between sibling bullying roles and each of the precursors. Precursors belonging to the same precursor set are presented in the same table for clarity (see Tables S3-S5 in the supplementary materials). These models are not presented in the main text. If readers wish to judge and compare crude these are only available in the supplementary materials.

Once the significant predictors of sibling bullying roles had been identified using the crude associations, the precursors that were most strongly associated with sibling bullying within precursor sets were tested. To do this, further multinomial logistic regression models were fitted. Before these models were fitted, the “collin” command in STATA was used to assess collinearity. The variance inflation factor (VIF) measures the impact of collinearity among the variables used in a regression model. As a general rule, a VIF score of above 10 or a tolerance level of 0.10 indicates multicollinearity (O’Brien, 2007). Full details of the collinearity metrics are shown in Table S6. After collinearity was assessed, three models were fitted: a) structural family-level characteristics, b) parenting and parental characteristics, and c) child-level individual differences. Again, for each of the models, sibling bullying involvement group was entered as the outcome variable (uninvolved, victim-only, bully-only, bully-victim). All of the variables within the precursor set that were significant in the crude associations were entered as predictors at this stage.

Finally, a multinomial logistic regression model was run, in which all of the significant predictors from the previous set of models were entered as predictors. This

allowed for the investigation of which precursors continued to be associated with sibling bullying involvement after controlling for all of the other significant precursors.

## **Results**

### **Prevalence of Sibling Bullying**

Descriptive statistics for all variables of interest are shown in Table 1. At age 11 years old, 48% of the sample was involved in at least one type of sibling bullying (victim-only 16%; bully-only 4%; bully-victim 28%). The remaining 52% were not involved in sibling bullying.

[Table 1 Here]

### **Crude Associations and Preliminary Models.**

A number of crude associations were tested to investigate the relationship between sibling bullying and each precursor (individually). These are shown in Tables S3-S5. Significant predictors from the crude associations were then entered into one of three models: a) structural family-level characteristics (Model 1; Table 2), b) parenting and parental characteristics (Model 2; Table 2), and c) child-level individual differences (Model 3; Table 2). A number of precursors remained significant in this step and were tested in the final model. These were birth order, ethnicity, number of siblings, primary caregiver self-esteem, harsh parenting, child sex, infant temperament – approach, emotional dysregulation, and prosocial behavior.

[Table 2 Here]

### **Structural Family-Level Characteristics**

In the final model (shown in Table 3), there were a number of structural family-level characteristics that remained significant after variables from the other precursor sets were also considered. Specifically, being first-born was associated with an increased risk of being a bully-only (RRR=2.60,  $p<.001$ ) and a bully-victim (RRR=1.29,  $p<.001$ ). White ethnicity

was associated with increased risk of being a victim-only (RRR=1.61,  $p<.001$ ) and bully-victim (RRR=1.52,  $p<.001$ ). As the number of siblings increased, the risk of being involved in sibling bullying across all three bullying involvement groups also increased (victim-only RRR=1.15,  $p<.01$ ; bully-only RRR=1.31,  $p<.01$ ; bully-victim RRR=1.16,  $p<.001$ ).

[Table 3 here]

### **Parenting and Parental Characteristics**

There were only two significant predictors from the parenting and parental characteristics precursor set in the final model (shown in Table 3). Higher levels of primary caregiver self-esteem were associated with reduced risk of being a victim-only (RRR=0.89,  $p<.01$ ) and higher levels of harsh parenting were associated with increased risk of being a bully-victim (RRR=1.26,  $p<.001$ ).

### **Child-Level Individual Differences**

A number of child-level individual differences were significant in the final model (shown in Table 3). Being a boy was associated with an increased risk of being a bully-only (RRR=1.71,  $p<.001$ ) and a decreased risk of being a bully-victim (RRR=0.84,  $p<.01$ ). An approaching temperament was associated with an increased risk of being a bully-victim (RRR=1.11,  $p<.01$ ). Higher levels of emotional dysregulation were associated with increased risk of being a bully-only (RRR=1.35,  $p<.001$ ) and bully-victim (RRR=1.17,  $p<.001$ ).

### **Relative Strength of Key Precursors**

For each bullying involvement groups, the top three precursors were ranked according to relative risk ratios to provide an indication of the strongest predictors of sibling bullying (shown in Table 3). **Victim-only:** White ethnicity was the strongest predictor of being a victim-only (RRR=1.61,  $p<.001$ ) followed by higher number of siblings (RRR=1.15,  $p<.01$ ) and lower primary caregiver self-esteem (RRR=0.89,  $p<.01$ ). **Bully-only.** Being first born was the strongest predictor of being a bully-only (RRR=2.60,  $p<.001$ ) followed by being a

boy ( $RRR=1.71$ ,  $p<.001$ ) and higher levels of emotional dysregulation ( $RRR=1.35$ ,  $p<.001$ ).

***Bully-victim.*** White ethnicity was the strongest predictor of being a bully-victim ( $RRR=1.52$ ,  $p<.001$ ) followed by being first born ( $RRR=1.29$ ,  $p<.001$ ) and higher levels of emotional dysregulation ( $RRR=1.17$ ,  $p<.001$ ).

## Discussion

### Summary of Key Findings

In this large population-based study, the precursors of sibling bullying were investigated. The results showed that structural family characteristics (e.g. birth order, ethnicity, and number of siblings) are the strongest predictors of sibling bullying involvement followed by child-level individual differences (e.g. emotional dysregulation and child sex). Parenting and parental characteristics (e.g. primary caregiver self-esteem and harsh parenting) also predicted sibling bullying but to a lesser extent. These findings are summarized in Table 4 and discussed with reference to previous work in more detail in the subsequent sections.

[Table 4 here]

### Prevalence Estimates

In the current study, it was found that almost half of 11-year-old children were involved in sibling bullying, most of whom were involved in two-way sibling bullying, as a bully-victim. These findings are in line with expectations about sibling bullying involvement based previous population-based estimates (Toseeb et al., 2018; Wolke & Skew, 2012). Given the high levels of familiarity between them, siblings have bidirectional power over one another which gives rise to frequent opportunities to bully and be the victim at the same time (Tippett & Wolke, 2015).

### Structural Family-Level Characteristics

The findings on the importance of structural family characteristics are in line with previous work on the topic (Dantchev & Wolke, 2019; Tippet & Wolke, 2015; Toseeb et al., 2018). Sibling bullying across all sibling bullying groups occurred more frequently in households with more children. Furthermore, children who are first-born are more likely to be involved in sibling bullying, particularly as a perpetrator. These findings support the resource control theory (Hawley, 1999), which posits that aggression amongst siblings is a result of competition over resources. Access to parental resources such as affection, attention, and material goods become limited as the number of siblings increase. In turn, the competition over these resources increases and so siblings may resort to bullying behaviors. Specifically, for first-born children, who previously had exclusive access to resources and now have to share, resource control theory would predict that they are more likely to be involved as perpetrators, as seen in in this study.

In contrast, other structural family-level variables such as primary caregiver education and lone parent status were not associated with sibling bullying involvement, which is in line with previous work (Bowes et al., 2014; Eriksen & Jensen, 2009; Tippet & Wolke, 2015). Similarly, in line with previous research (Dantchev & Wolke, 2019), children from low income households were not more or less likely to be involved in sibling bullying compared to those from high income households. Thus, sibling bullying was found to be ubiquitous, irrespective of socioeconomic factors. Furthermore, children of White ethnicity are more likely to be involved in sibling bullying as a victim-only and bully-victim, which is in line with previous work (Tucker et al., 2013). This might be due to different cultures placing different boundaries for what is acceptable aggression amongst siblings or even due to more collectivism within ethnic minority families that may inhibit sibling bullying behavior (Killoren, Thayer, & Updegraff, 2008). In summary, in the current study, structural family-

level characteristics were found to be the strongest predictors of sibling bullying in middle childhood.

### **Parenting and Parental Characteristics**

It was also found that parenting and parental characteristics, for the most part, are not associated with sibling bullying after controlling for other factors. It may be that siblings unite and provide support to each other in situations where they are subject to poor parenting or negative parental characteristics (Gass, Jenkins, & Dunn, 2007; McHale, Updegraff, & Whiteman, 2012; Milevsky, 2005). It was, however, found that harsh parenting is associated with sibling bullying as a bully-victim, thus supporting previous work (Dantchev & Wolke, 2019; Eriksen & Jensen, 2009; Toseeb et al., 2018). These findings support attachment theory (Bowlby, 1969) and social learning theory (Bandura, 1977) as they suggest that maladaptive internal working models of social relationships may be provided through harsh parenting, where abuse becomes internalized as normal behavior. It may be that children use these maladaptive internal working models as templates for their relationships with their siblings.

### **Child-Level Individual Differences**

A number of child-level individual differences were also associated with sibling bullying involvement. Again, resource control theory (Hawley, 1999), which states that individuals with asymmetrical social groups want to acquire social dominance in order to gain access to the desired resources, helps to interpret these findings. Here, siblings use their individual differences to gain dominance over their siblings in order to gain access to parental resources. In the current study, first-borns were more likely to be perpetrators of sibling bullying, which may be because they are particularly sensitive to loss of resources when a new sibling is born and perhaps due to their relative power and strength (Dantchev & Wolke, 2019). Boys are more likely to be perpetrators of sibling bullying as a bully-only and bully-victim, which is in line with findings from Dantchev and Wolke (2019). It may, however,

also be important to explore differential outcomes according to the mode of aggression in future studies in order to better understand underlying sex differences, seeing as boys are reported to employ more physical aggression, whereas girls are found to use more indirect or relational forms of aggression (Björkqvist, 2018).

In terms of emotional dysregulation, it was found that children whose emotional responses are poorly modulated are more likely to be perpetrators of sibling bullying as a bully-only and bully-victim. This suggests that the perpetration of sibling bullying may be a maladaptive emotion regulation strategy. It is possible, however, that this type of emotional dysregulation reflects, to some degree, aspects of externalizing behavior. It is not possible within the present dataset to determine the nature of the interplay between emotional dysregulation, externalizing problems, and sibling bullying. One possibility is that emotional dysregulation mediates the relationship between sibling bullying and SEMH difficulties. Future work should consider these effects.

### **Strengths and Limitations**

A major strength of the current study was the use of a large prospective population-based sample, which was not limited by geographical location within the United Kingdom. Given that that sample was representative of the UK population, the findings are generalizable to the UK population. Furthermore, the extensiveness of data collected from the MCS families enabled the inclusion of a number of covariates in all of the statistical models. This ensured minimal risk of confounding as the observable effects were unique to the variables of interest. That said, residual confounding cannot be excluded.

There are also a number of limitations that should be borne in mind when interpreting the findings. Self-report was used to measure sibling bullying involvement. Self-report is, arguably, an accurate measure of sibling bullying, as parents are not cognizant of all conflicts happening between siblings, with much ensuing behind closed doors (Wolke, Tippet, et al.,



2015). Therefore, if parents are asked about sibling bullying it may lead to an increase in false negatives. Future work should investigate the levels of agreement between children, their siblings, and their parents on the levels of sibling bullying involvement. Moreover, while the inclusion of a large set of predictor variables strengthens the study design, allowing for multiple comparisons across the covariates similarly increases the possibility of over adjustment and hence statistical bias in the findings. This may for example, provide one possible explanation for why some child-level individual differences were no longer significant once included in the adjusted models. However, the multi-step approach adopted in this study allows readers to assess and compare these discrepancies between the crude and within-block associations.

Some variables had high levels of missing data. Whilst 50 imputed datasets were generated to deal with missing data, this should be borne in mind when interpreting the findings. Furthermore, the statistical models implemented in this study do not take into account the temporal nature of the variables. Whilst longitudinal data has been used, the data have effectively been treated as cross-sectional. This means that the ability to make causal inferences is limited. Whilst it seems counterintuitive to consider the possibility that sibling bullying causes there to be more siblings in the family, it may be that both sibling bullying and number of siblings are related through a third unmeasured factor. Future work should adopt causal inference statistical frameworks to investigate the directionality of the observed effects.

### **Practical Implications**

The findings may have potential implications for the protection of children from abuse within the family as they suggest that structural family-level characteristics are important predictors of sibling bullying. Therefore, family-level interventions, in particular when a second or third child is on the way, aimed at parents focusing on how to distribute

their time and resources appropriately to all children may reduce in the incidence of sibling bullying in the general population. Furthermore, child-level interventions could target specific sibling bullying behaviors in order to bring about behavior change at the child-level. Finally, given the growing evidence that sibling bullying is associated with social, emotional, and mental health difficulties (Toseeb et al., 2018; Tucker et al., 2013; Tucker et al., 2014a, 2014b; van Berkel et al., 2018), and in order to reduce this health burden, it may be appropriate for health professionals to ask about sibling bullying, and consider intervening, where appropriate.

## **Conclusions**

In this population-based study a number of precursors to sibling bullying in middle childhood were identified. Structural family-level characteristics (e.g. birth order, ethnicity, and number of siblings) were found to be the strongest predictors of sibling bullying involvement followed by child-level individual differences (e.g. emotional dysregulation and sex). Parenting and parental characteristics (e.g. primary caregiver self-esteem and harsh parenting) explained some variance but to a lesser extent. If future work confirms causal links between these factors, these findings highlight the need for family- and child-level interventions.

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Table 1.

*Prevalence of Sibling Bullying Split by Variable of Interest*

Variable	Neither	Victim Only	Bully Only	Bully-Victim
Sibling Bullying	5566 (52%)	1680 (16%)	468 (4%)	3005 (28%)
<b>Structural Family-Level Characteristics</b>				
Primary caregiver highest education	1.44 (1.08)	1.42 (1.05)	1.41 (1.11)	1.48 (1.05)
First Born				
No	3407 (53%)	1125 (17%)	193 (3%)	1733 (27%)
Yes	1952 (50%)	493 (13%)	258 (7%)	1179 (30%)
Ethnicity				
Non-White	1153 (60%)	237 (13%)	102 (5%)	420 (22%)
White	4390 (50%)	1433 (17%)	363 (4%)	2568 (29%)
Poverty				
Not in poverty	3589 (52%)	1069 (15%)	282 (4%)	1992 (29%)
In poverty	1438 (51%)	460 (16%)	131 (5%)	781 (28%)
Number of siblings	1.66 (0.93)	1.76 (0.91)	1.67 (0.93)	1.70 (0.89)
Lone parent status				
Two parents/caregivers	4192 (52%)	1257 (15%)	333 (4%)	2341 (29%)
One parent/caregiver	841 (52%)	273 (15%)	80 (5%)	438 (27%)
<b>Parenting and Parental Characteristics</b>				
Primary caregiver self-esteem	18.28 (3.40)	17.83 (3.54)	18.21 (3.51)	18.00 (3.40)
Primary caregiver depression	1.61 (1.72)	1.79 (1.81)	1.64 (1.80)	1.75 (1.80)
Parent-child conflict	16.75 (5.80)	16.97 (5.86)	17.49 (6.14)	17.76 (6.00)
Primary caregiver relationship satisfaction	16.14 (3.13)	15.86 (3.27)	15.92 (3.17)	15.94 (3.12)
Parental engagement	19.56 (4.94)	19.37 (4.87)	19.07 (4.68)	19.36 (4.70)
Primary caregiver psychological distress	2.86 (3.61)	3.04 (3.78)	3.38 (4.14)	3.30 (3.84)
Harsh parenting	15.42 (3.53)	15.83 (3.49)	16.71 (3.50)	16.75 (3.37)
<b>Child-Level individual differences</b>				
Sex				
Female	2800 (53%)	810 (15%)	164 (3%)	1568 (29%)
Male	2766 (51%)	870 (16%)	304 (6%)	1437 (27%)
Low birth weight				
Normal	5296 (52%)	1600 (16%)	442 (4%)	2870 (28%)
Low	54 (49%)	14 (13%)	7 (6%)	36 (32%)
Infant temperament: mood	14.18 (3.41)	14.25 (3.40)	14.26 (3.26)	14.01 (3.36)
Infant temperament: regularity	13.11 (3.07)	13.07 (3.15)	13.04 (3.04)	13.03 (3.08)
Infant temperament: approach	9.50 (2.38)	9.62 (2.35)	9.79 (2.27)	9.71 (2.27)

Infant temperament: adaptability	5.55 (1.94)	5.53 (1.91)	5.72 (1.79)	5.66 (1.90)
Language concerns				
No	4667 (52%)	1377 (16%)	394 (4%)	2495 (28%)
Yes	447 (47%)	167 (18%)	42 (4%)	294 (31%)
Verbal ability	106.66 (16.81)	106.36 (15.73)	106.85 (15.84)	108.40 (15.30)
Non-verbal ability	82.76 (11.31)	81.75 (11.54)	81.75 (12.11)	82.86 (11.34)
Autism spectrum conditions				
No	4791 (52%)	1511 (16%)	408 (4%)	2730 (28%)
Yes	50 (42%)	17 (15%)	5 (4%)	46 (39%)
Independence and self-regulation	2.53 (0.36)	2.50 (0.36)	2.50 (0.37)	2.50 (0.37)
Emotional dysregulation	1.67 (0.46)	1.71 (0.46)	1.86 (0.48)	1.78 (0.48)
Co-operation	2.63 (0.33)	2.61 (0.33)	2.54 (0.36)	2.58 (0.34)
Internalizing problems	2.55 (2.67)	2.68 (2.78)	2.88 (2.91)	2.80 (2.76)
Externalizing problems	4.28 (3.66)	4.62(3.53)	5.40 (3.86)	4.98 (3.66)
Prosocial behavior	8.72 (1.55)	8.55 (1.62)	8.25 (1.78)	8.49 (1.67)

**Note.** The values in this table are taken from the original dataset (before imputation). They represent mean (standard deviation) for continuous variables and number of observations (%) for categorical/binary variables. The % add up to 100% within rows across columns.

Table 2.

*Precursors of sibling bullying involvement at age 11 years – separate models for each precursor set*

Precursor	Child age	Uninvolved	Victim Only	Bully Only	Bully-Victim
<b>Model 1: Structural Family-Level Characteristics</b>					
First born	9 months	Reference	0.85 [0.73, 0.98]*	2.84 [2.19, 3.67]***	1.36 [1.22, 1.52]***
White ethnicity	9 months	Reference	1.69 [1.40, 2.03]***	1.04 [0.78, 1.38]	1.64 [1.40, 1.93]***
Number of siblings	7 years	Reference	1.15 [1.06, 1.25]**	1.33 [1.15, 1.54]***	1.17 [1.10, 1.24]***
<b>Model 2: Parenting and Parental Characteristics</b>					
Primary caregiver self-esteem	9 months	Reference	0.91 [0.85, 0.97]**	1.04 [0.92, 1.19]	0.96 [0.90, 1.03]
Primary caregiver depression	9 months	Reference	1.06 [0.98, 1.15]	0.92 [0.78, 1.07]	1.00 [0.93, 1.06]
Parent-child conflict	3 years	Reference	0.97 [0.90, 1.04]	1.04 [0.91, 1.19]	1.08 [1.02, 1.14]*
Primary caregiver relationship satisfaction	5 years	Reference	0.94 [0.88, 1.01]	0.96 [0.84, 1.09]	1.02 [0.97, 1.09]
Primary caregiver psychological distress	7 years	Reference	0.97 [0.90, 1.06]	1.08 [0.93, 1.25]	1.04 [0.98, 1.12]
Harsh parenting	7 years	Reference	1.15 [1.07, 1.24]***	1.38 [1.20, 1.58]***	1.32 [1.25, 1.41]***
<b>Model 3: Child-Level Individual Differences</b>					
Boy	9 months	Reference	1.03 [0.90, 1.18]	1.75 [1.38, 2.21]***	0.86 [0.77, 0.95]**
Infant temperament - approach	9 months	Reference	1.10 [1.01, 1.18]*	1.16 [1.00, 1.35]*	1.14 [1.07, 1.21]***
Non-verbal ability	5 years	Reference	0.92 [0.86, 0.98]*	0.95 [0.84, 1.07]	1.02 [0.97, 1.08]
Verbal ability	5 years	Reference	0.94 [0.88, 1.00]	0.97 [0.85, 1.11]	1.05 [0.99, 1.12]
Independence and self-regulation	7 years	Reference	0.98 [0.90, 1.06]	1.15 [1.00, 1.33]	1.02 [0.95, 1.09]
Emotional dysregulation	7 years	Reference	1.10 [1.00, 1.20]*	1.56 [1.32, 1.84]***	1.26 [1.18, 1.35]***
Cooperation	7 years	Reference	1.10 [1.00, 1.20]*	1.01 [0.87, 1.19]	1.02 [0.95, 1.10]
Internalizing problems	7 years	Reference	1.10 [1.00, 1.08]	0.94 [0.81, 1.08]	0.99 [0.93, 1.06]
Externalizing problems	7 years	Reference	1.01 [0.91, 1.13]	0.97 [0.81, 1.15]	1.06 [0.97, 1.15]
Prosocial behavior	7 years	Reference	0.91 [0.84, 0.98]*	0.83 [0.74, 0.94]**	0.92 [0.86, 0.99]*

\*p<.05, (note in the current study this level of significance is not interpreted as significant), \*\* p<.01, \*\*\*p<.001. Values are Relative Risk Ratio [95% confidence intervals]. Note. All significant precursors (at p<.01) on this table were entered into a single multinomial logistic regression model (Table 3).

Table 3.

*Final model – Precursors of sibling bullying involvement at age 11 years*

Precursors	Child age	Uninvolved	Victim Only	Bully Only	Bully-Victim
<b>Structural Family-Level Characteristics</b>					
First born	9 months	Reference	0.83 [0.72, 0.96] <sup>*</sup>	2.60 [2.00, 3.39] <sup>***</sup>	1.29 [1.14, 1.43] <sup>***</sup>
White ethnicity	9 months	Reference	1.61 [1.34, 1.94] <sup>***</sup>	0.98 [0.72, 1.32]	1.52 [1.28, 1.79] <sup>***</sup>
Number of siblings	7 years	Reference	1.15 [1.06, 1.24] <sup>**</sup>	1.31 [1.13, 1.52] <sup>**</sup>	1.16 [1.09, 1.23] <sup>***</sup>
<b>Parenting and Parental Characteristics</b>					
Primary caregiver self-esteem	9 months	Reference	0.89 [0.84, 0.95] <sup>**</sup>	1.05 [0.95, 1.18]	0.95 [0.90, 1.01]
Harsh parenting	7 years	Reference	1.10 [1.02, 1.20] <sup>*</sup>	1.15 [1.00, 1.32]	1.26 [1.18, 1.34] <sup>***</sup>
<b>Child-Level Individual Differences</b>					
Boy	9 months	Reference	1.04 [0.91, 1.19]	1.71 [1.35, 2.16] <sup>***</sup>	0.84 [0.75, 0.94] <sup>**</sup>
Infant temperament - approach	9 months	Reference	1.08 [0.99, 1.16]	1.13 [0.97, 1.32]	1.11 [1.04, 1.19] <sup>**</sup>
Emotional dysregulation	7 years	Reference	1.05 [0.97, 1.14]	1.35 [1.18, 1.54] <sup>***</sup>	1.17 [1.10, 1.24] <sup>***</sup>
Prosocial behavior	7 years	Reference	0.95 [0.88, 1.02]	0.89 [0.80, 1.00] <sup>*</sup>	0.96 [0.90, 1.01]

<sup>\*</sup>p<.05 (note in the current study this level of significance is not interpreted as significant), <sup>\*\*</sup>p<.01, <sup>\*\*\*</sup>p<.001. Values are Relative Risk Ratio [95% confidence intervals]. Note. All precursors on this table were entered into a single multinomial logistic regression model.

Table 4.

*Overview of factors that increase risk of sibling bullying in final model*

<b>Precursor Set</b>	<b>Victim-Only</b>	<b>Bully-Only</b>	<b>Bully-Victim</b>
Structural family characteristics	White ethnicity	First born	First born
	More siblings in household	More siblings in household	White ethnicity More siblings in household
Parenting and parental Characteristics	Low primary caregiver self-esteem		Harsh parenting
Child-level individual differences		Boy	Girl
		Higher emotional dysregulation	Approaching temperament Higher emotional dysregulation

Note. The factors listed in this table reached the  $p < .01$  threshold in the model presented in Table 3.

### Supplementary Materials

Table S1

*Missing data and imputed values*

Variable	Complete	Imputed N	Imputed %	Total
<b>Structural Family-Level Characteristics</b>				
Primary caregiver highest education	15,803	1,184	7%	16,987
Birth order	16,378	609	4%	16,987
Ethnicity	16,886	101	1%	16,987
Poverty	11,881	5106	43%	16,987
Number of siblings	11,899	5,088	30%	16,987
Lone parent status	11,899	5,088	30%	16,987
<b>Parenting and Parental Characteristics</b>				
Primary caregiver self-esteem	15,721	1,266	7%	16,987
Primary caregiver depression	15,259	1,728	10%	16,987
Parent-child conflict	10,947	6,040	36%	16,987
Primary caregiver relationship satisfaction	9,593	7,394	44%	16,987
Parental engagement	12,378	4,609	27%	16,987
Primary caregiver psychological distress				
Harsh parenting	10,613	6,374	38%	16,987
<b>Child-Level individual differences</b>				
Sex	16,987	0	0%	16,987
Low birth weight	16,321	666	4%	16,987
Infant temperament: mood	14,444	2,543	15%	16,987
Infant temperament: regularity	15,176	1,811	11%	16,987
Infant temperament: approach	11,400	5,587	33%	16,987
Infant temperament: adaptability	13,317	3,670	22%	16,987
Language concerns	12,378	4,609	27%	16,987
Verbal ability	12,964	4,023	24%	16,987
Non-verbal ability	12,983	4,004	24%	16,987
Autism spectrum conditions	11,874	5,113	43%	16,987
Independence and self-regulation	11,551	5,436	32%	16,987
Emotional dysregulation	11,552	5,435	32%	16,987
Co-operation	11,553	5,434	32%	16,987
Internalizing problems	11,544	5,443	32%	16,987
Externalizing problems	11,545	5,442	32%	16,987
Prosocial behavior	11,541	5,446	32%	16,987
<b>Outcome</b>				
Sibling bullying	10,719	6,268	37%	16,987



Table S2.

*Overview of selected variables*

<b>Precursor Set</b>			
<b>Child Age</b>	<b>Structural Family Characteristics</b>	<b>Parenting and Parental Characteristics</b>	<b>Child-Level Individual Differences</b>
<b>9 months</b>	Primary caregiver highest academic qualification First born Ethnicity	Primary caregiver self-esteem  Primary caregiver depression	Sex  Low birth weight Temperament -mood Temperament - regularity Temperament -approach Temperament -adaptability
<b>3 years</b>	-	Parent-child conflict	
<b>5 years</b>	-	Primary caregiver relationship satisfaction Parental engagement	Language concerns Non-verbal ability Verbal ability
<b>7 years</b>	Poverty Number of siblings in household Lone parent	Primary caregiver psychological distress Harsh parenting	Autism spectrum conditions Independence and self-regulation Emotional dysregulation Co-operation Internalizing problems Externalizing problems Prosocial behavior

Table S3.

*Crude associations between sibling bullying involvement and structural family characteristics*

<b>Precursor</b>	<b>Child age</b>	<b>Uninvolved</b>	<b>Victim Only</b>	<b>Bully Only</b>	<b>Bully-Victim</b>
Primary caregiver highest academic qualification	9 months	Reference	0.97 [0.91, 1.03]	0.97 [0.87, 1.08]	1.03 [0.98, 1.09]
First born	9 months	Reference	0.78 [0.68, 0.89]***	2.30 [1.85, 2.86]***	1.23 [1.11, 1.37]**
White ethnicity	9 months	Reference	1.58 [1.33, 1.89]***	0.98 [0.75, 1.29]	1.57 [1.34, 1.84]***
Poverty	9 months	Reference	1.11 [0.97, 1.28]	1.15 [0.90, 1.50]	1.00 [0.87, 1.13]
Number of siblings	7 years	Reference	1.15 [1.08, 1.24]***	1.06 [0.93, 1.20]	1.07 [1.01, 1.13]*
Lone parent	7 years	Reference	1.11 [0.93, 1.31]	1.12 [0.83, 1.50]	0.90 [0.78, 1.04]

\*p<.05, \*\*p<.01, \*\*\*p<.001. Values are Relative Risk Ratio [95% confidence intervals]. Note. Each line represents a separate multinomial logistic regression model. They are presented together for ease of comprehension. P values of <.01 are interpreted as significant.

Table S4.

*Crude associations between sibling bullying involvement and parenting and parental characteristics*

<b>Precursor</b>	<b>Child age</b>	<b>Uninvolved</b>	<b>Victim Only</b>	<b>Bully Only</b>	<b>Bully-Victim</b>
Primary caregiver self-esteem	9 months	Reference	0.87 [0.82, 0.93]***	1.00 [0.89, 1.12]	0.91 [0.87, 0.96]**
Primary caregiver depression	9 months	Reference	1.13 [1.05, 1.21]**	0.99 [0.87, 1.13]	1.08 [1.03, 1.14]**
Parent-child conflict	3 years	Reference	1.06 [1.00, 1.12]	1.14 [1.01, 1.29]*	1.19 [1.13, 1.24]***
Primary caregiver relationship satisfaction	5 years	Reference	0.90 [0.84, 0.96]**	0.93 [0.82, 1.05]	0.96 [0.91, 1.01]
Parental engagement	5 years	Reference	0.99 [0.97, 1.00]	0.98 [0.96, 1.00]	0.99 [0.98, 1.00]
Primary caregiver psychological distress	7 years	Reference	1.07 [0.99, 1.15]	1.12 [0.99, 1.27]	1.12 [1.06, 1.18]***
Harsh parenting	7 years	Reference	1.16 [1.08, 1.24]**	1.40 [1.23, 1.59]***	1.37 [1.29, 1.44]***

\*p<.05, \*\*p<.01, \*\*\*p<.001. Values are Relative Risk Ratio [95% confidence intervals]. Note. Each line represents a separate multinomial logistic regression model. They are presented together for ease of comprehension. P values of <.01 are interpreted as significant.

Table S5.

*Crude associations between sibling bullying involvement and child-level individual differences*

<b>Precursor</b>	<b>Child age</b>	<b>Uninvolved</b>	<b>Victim Only</b>	<b>Bully Only</b>	<b>Bully-Victim</b>
Boy	9 months	Reference	1.10 [0.96, 1.25]	1.98 [1.57, 2.49]***	0.94 [0.85, 1.05]
Low birth weight	9 months	Reference	0.94 [0.52, 1.70]	1.60 [0.64, 3.83]	1.14 [0.72, 1.81]
Infant temperament – mood	9 months	Reference	1.02 [0.96, 1.10]	1.05 [0.94, 1.18]	0.96 [0.91, 1.01]
Infant temperament - regularity	9 months	Reference	0.96 [0.90, 1.03]	0.98 [0.88, 1.09]	0.97 [0.92, 1.03]
Infant temperament - approach	9 months	Reference	1.06 [0.98, 1.15]	1.14 [0.98, 1.32]	1.11 [1.05, 1.18]**
Infant temperament - adaptability	9 months	Reference	1.00 [0.93, 1.07]	1.12 [0.99, 1.26]	1.06 [1.00, 1.11]
Language concerns	5 years	Reference	1.31 [1.07, 1.61]*	1.14 [0.78, 1.64]	1.16 [0.98, 1.37]
Non-verbal ability	5 years	Reference	0.89 [0.83, 0.95]***	0.91 [0.81, 1.02]	1.01 [0.96, 1.07]
Verbal ability	5 years	Reference	0.90 [0.84, 0.96]**	0.92 [0.81, 1.05]	1.03 [0.97, 1.09]
Autism spectrum conditions	7 years	Reference	1.04 [0.61, 1.81]	1.37 [0.57, 3.33]	1.37 [0.88, 2.15]
Independence and self-regulation	7 years	Reference	0.93 [0.87, 0.99]*	0.93 [0.83, 1.05]	0.93 [0.88, 0.98]**
Emotional dysregulation	7 years	Reference	1.12 [1.05, 1.20]**	1.53 [1.36, 1.72]***	1.28 [1.22, 1.35]***
Co-operation	7 years	Reference	0.96 [0.90, 1.02]	0.79 [0.71, 0.89]***	0.87 [0.83, 0.92]***
Internalizing problems	7 years	Reference	1.06 [0.99, 1.14]	1.13 [1.01, 1.28]*	1.11 [1.05, 1.18]**
Externalizing problems	7 years	Reference	1.11 [1.03, 1.19]**	1.35 [1.21, 1.52]***	1.21 [1.15, 1.28]***
Prosocial behavior	7 years	Reference	0.90 [0.84, 0.96]**	0.75 [0.68, 0.83]***	0.87 [0.82, 0.92]***

\*p<.05, \*\*p<.01, \*\*\*p<.001. Values are Relative Risk Ratio [95% confidence intervals]. Note. Each line represents a separate multinomial logistic regression model. They are presented together for ease of comprehension. P values of <.01 are interpreted as significant.

Table S6.

*Collinearity metrics for multiple regression models*

	VIF	Tolerance
<b>Model 1: Structural family characteristics</b>		
First born	1.19	0.84
Ethnicity	1.04	0.97
Number of siblings in household 7 years	1.23	0.81
<b>Model 2: Parenting and Parental Characteristics</b>		
Primary caregiver self-esteem 9 months	1.36	0.74
Primary caregiver depression 9 months	1.39	0.72
Parent-child conflict 3 years	1.21	0.83
Primary caregiver relationship satisfaction 5 years	1.15	0.87
Primary caregiver psychological distress	1.29	0.77
Harsh parenting 7 years	1.12	0.90
<b>Model 3: Child-level individual differences</b>		
Sex	1.06	0.95
Infant temperament – approach 9 months	1.04	0.96
Non-verbal ability 5 years	1.17	0.86
Verbal ability 5 years	1.19	0.84
Independence and self-regulation 7 years	1.43	0.70
Emotional dysregulation 7 years	2.11	0.47
Co-operation 7 years	1.82	0.55
Internalizing problems 7 years	1.34	0.75
Externalizing problems 7 years	2.45	0.41
Prosocial behavior 7 years	1.44	0.70

**Note.** The VIF and tolerance values were calculated on the original dataset without imputations.