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Received: 18 January 2022 | Accepted: 20 September 2022

DOI: 10.1002/jad.12102

RESEARCH ARTICLE

Foundation for PSA WILEY

Self-harm, in-person bullying and cyberbullying in secondary school-aged children: A data linkage study in Wales

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Funding information

Centre for the Development and Evaluation of Complex Interventions for Public Health Improvement; MQ Mental Health Research Charity (Grant Reference MQBF/3 ADP); Medical Research Council (MC/PC/17212 and MC/PC/17211); Wolfson Centre for Young People's Mental Health (Grant number 517483)

Abstract

Introduction: Although the evidence base on bullying victimization and self-harm in young people has been growing, most studies were cross-sectional, relied on self-reported non-validated measures of self-harm, and did not separate effects of in-person and cyberbullying. This study aimed to assess associations of self-harm following in-person bullying at school and cyberbullying victimization controlling for covariates.

Methods: School survey data from 11 to 16 years pupils collected in 2017 from 39 Welsh secondary schools were linked to routinely collected data. Inverse probability weighting was performed to circumvent selection bias. Survival analyses for recurrent events were conducted to evaluate relative risks (adjusted hazard ratios [AHR]) of self-harm among bullying groups within 2 years following survey completion.

Results: A total of 35.0% (weighted $N = 6813$) of pupils reported being bullied, with 18.1%, 6.4% and 10.5% being victims of in-person bullying at school only, cyberbullying only and both in-person bullying at school and cyberbullying respectively. Adjusting for covariates, effect sizes for self-harm were significant after being in-person bullied at school only (AHR = 2.2 [1.1–4.3]) and being both in-person bullied at school and cyberbullied (AHR = 2.2 [1.0–4.7]) but not being cyberbullied only (AHR = 1.2 [0.4–3.3]). Feeling lonely during recent summer holidays was also a robust predictor (AHR = 2.2 [1.2–4.0]).

Conclusions: We reaffirm the role of in-person bullying victimization on self-harm. Pupils were twice as likely to self-harm following in-person bullying as their nonvictimised peers. Interventions for young people that minimize the potential impacts of bullying on self-harm should also include strategies to prevent loneliness.

KEYWORDS

bullying, cyberbullying, data linkage, loneliness, school-based survey, self-harm

1 | INTRODUCTION

Self-harm is intentional self-injury or poisoning regardless of suicidal intent or motivation (Hawton et al., 2012; NICE, 2004). It is a major public health concern partly because of its association with future suicide but also due to the associated physical harm and psychological distress and the impact of often unscheduled care on health services (Hawton & Van Heeringen, 2000). With a median age of onset of approximately 13 years (Morey et al., 2017), incidence of self-harm

Abbreviations: AHR, adjusted hazard ratio; CI, confidence interval; CMDs, common mental disorders; ED, emergency department; EDDS, emergency department dataset; FAS, family affluence scale; GPD, general practice database; HR, hazard ratio; IPW, inverse probability weighting; MCF, mean cumulative function; PEDW, Patient Episode Database for Wales; PS, propensity score; PWP-GT model, Prentice, Williams and Peterson Gap-Time model; SAIL, secure anonymised information linkage; SHRN, school health research network; SHW, student health and wellbeing; SWEMWBS, Short Warwick-Edinburgh Mental Wellbeing Scale; WIMD, Welsh Index of Multiple Deprivation.

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increases, especially in girls, during early teenage years (Hawton et al., 2003). Self-harm is common among adolescents (13–18 years) with a lifetime prevalence ranging from 12% to 19% based on reports from schools and community samples from England (Kidger et al., 2012; Morey et al., 2017) and Ireland (Doyle et al., 2015).

Bullying is broadly defined as an aggressive, intentional, and repeated act carried out by an individual or a group against individuals who cannot easily defend themselves (Rigby, 2005). Despite the unanimity in its conceptual delimitation, bullying acts involve intentionality, reiteration and imbalance of power (Olweus, 1993). Bullying has also been suggested as a group phenomenon where perpetrators and victims, as well as defenders, supporters and bystanders are either actively or passively involved (Olweus & Limber, 2010). In-person bullying can be carried out directly, e.g., physical and verbal, psychological or relational) or indirectly, e.g., rumor spreading (Furlong et al., 2005; Olweus, 1993; Rigby, 2005; Zych et al., 2020). Approximately 17% of young people aged 10 to 15 years reported being bullied during 2017–2018 in England and Wales (Long et al., 2020).

With the increasing use of electronic communication, cyberbullying has emerged and it is typically viewed as an extension of in person bullying where bullying behavior is specifically carried out via electronic means like text/instant messages and social media posts (Smith et al., 2008). The use of the criteria on defining in-person bullying has also been applied to cyberbullying in earlier studies although aspects of anonymity and publicity for cyberbullying has been discussed (Nocentini et al., 2010). While the anonymity of the perpetrators of cyberbullying increases the potential exposure and embarrassment of the victims (John et al., 2018), anonymity may reduce the necessity of power imbalance as a criterion because victims can be more easily to stop the communication with the people they do not know (Nocentini et al., 2010). Publicity characterizes the involvement of larger audience (even in public domain) in cyberbullying. Prevalence of cyberbullying varies across countries but increases with age among secondary school pupils with their increased use of electronic technology (Suzuki et al., 2012). Overlap between being both a victim and perpetrator of bullying, as well as between using in-person and cyberbullying, have been reported (Estévez et al., 2020; Hinduja & Patchin, 2010; Juvonen & Gross, 2008).

The harmful effects of bullying victimization, including cyberbullying victimization, on young people have been well documented. They include an elevated risk of suicidal thoughts and behaviors including suicide attempts and self-harm (Heerde & Hemphill, 2019; John et al., 2018). Recent meta-analyses reported that victims of in-person bullying were 2.34 times (95% confidence interval [CI]: 1.89–2.89) as likely to have also self-harmed (Heerde & Hemphill, 2019) and this effect size ranged from 2.35 to 3.55 for cyberbullying victimization (Heerde & Hemphill, 2019; John et al., 2018). However, few studies addressed victimization of both types of bullying or reported effects for each type separately (John et al., 2018). With few exceptions (Bannink et al., 2014; Heikkilä et al., 2013; Sourander et al., 2000, 2009), the majority of studies were cross-sectional, thus temporal associations between bullying victimization and self-harm could not be established, limiting causal interpretations. Measures of self-harm behaviors predominately relied on self-reported and non-validated questionnaires reducing both validity and reliability (John et al., 2018).

Loneliness has also been identified as an important factor associated with suicidal thoughts and behaviors (McClelland et al., 2020; Stickley & Koyanagi, 2016; Stravynski & Boyer, 2001), particularly for young people (16–20 years) who are transitioning through a period in their lives of huge social, cognitive and developmental change (McClelland et al., 2020). Similarly poor mental wellbeing and life satisfaction during adolescence, aged 13–18 years, are often associated with self-harm thoughts and behaviors (13–18 years) (Morey et al., 2017; Rönkä et al., 2013; Russell et al., 2020). To our knowledge, however, control for the effects of loneliness is not common in studies of bullying and self-harm.

Data linkage between self-reported surveys and population-based routinely collected data allows for longitudinal follow-up of individuals, with wide range of variables available and the use of validated measures of self-harm and mental illnesses from contacts to health services (Holman et al., 2008; Marchant et al., 2020; Morgan et al., 2020). To address the research gaps of the current literature, this study aimed to investigate the risk of self-harm following bullying victimization using clinically recorded measures of self-harm by linking a self-reported national school survey to routinely collected data. We explored the associations of in-person bullying victimization at school and cyberbullying victimization on future self-harm. We disentangled these associations between in-person bullying at school and cyberbullying using mutually exclusive measures of bullying types as exposure. To evaluate the risk of self-harm, we first compared the crude prevalence of self-harm events between bullying groups during the 2-year period following the bullying experience and then ran time to recurrent event regression model to adjust for socio-demographic and known modifiable risk factors (Lereya et al., 2013), including loneliness. We also performed inverse probability weighting procedure to the to circumvent the known potential selection bias of our study cohort (Morgan et al., 2020).

2 | METHODS

2.1 | Study design

This was a cohort data linkage study. We collected data from the School Health Research Network (SHRN) Student Health and Wellbeing (SHW) Survey in Wales (Hewitt et al., 2019). Detailed descriptions of the aim, scope and survey methodology were described elsewhere (Hewitt et al., 2019; Morgan et al., 2020).

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2.2 | Participants

SHW was administered electronically in the classroom to pupils from 193 secondary schools ($N = 103{,}971$) from September to December 2017 and contained questions on school life, mental health and well-being and lifestyle behaviors. Pupils from 39 participating schools were included for pilot data linkage (approximately 18% of Welsh secondary schools) and the present study included pupils aged between 11 and 16 years at the date the survey was administered, typically school years 7–11 (Figure 1). As a pilot study for data linkage (Morgan et al., 2020), 10,014 pupils from 39 randomly selected secondary schools participated in the SHRN SHW survey between 09 and 12/2017, consented for data linkage and provided identifiable data (Figure 1).

2.3 | Measures

2.3.1 | Outcome

We identified self-harm contacts from general practice database (GPD), Patient Episode Database for Wales (PEDW), and emergency department dataset (EDDS) in secure anonymised information linkage (SAIL) based on validated code lists (Marchant et al., 2020). We extracted self-harm contacts within 2-year follow-up after survey completion (i.e., between 15/09/2017–15/12/2017 and 15/09/2019–15/12/2019). To avoid double counting of events through contacts that potentially originated from a single event (e.g., hospitalization or follow-up contact to general practice on the next day after an emergency department [ED]

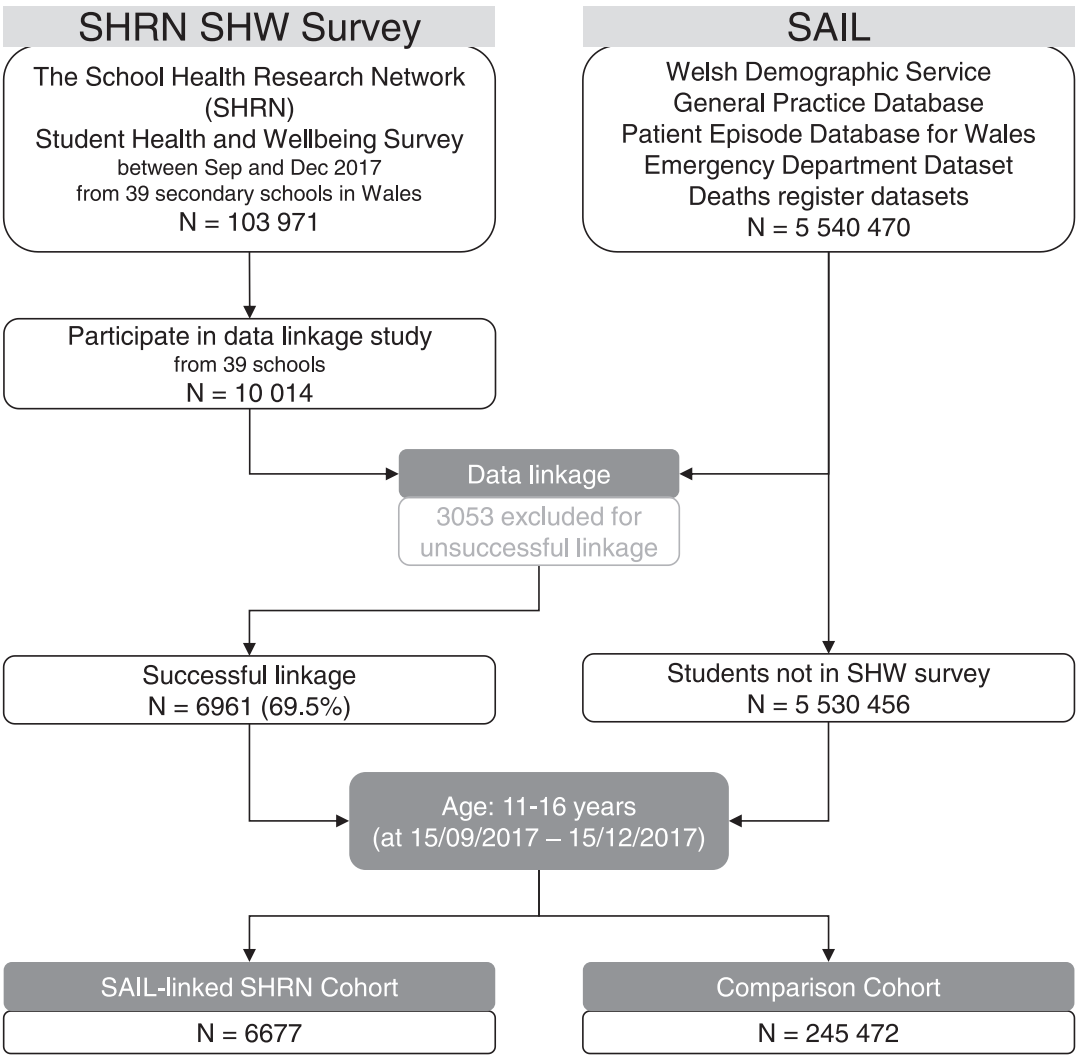

FIGURE 1 Study flow diagram.

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attendance), we grouped self-harm contacts that occurred on adjacent days as a single event. We then restricted our analysis to the first two self-harm events of an individual to circumvent small sample size with number of recurrent events >2.

2.3.2 | Exposures and other covariates

Bullying

Bullying was assessed by questionnaire described in the Health Behavior in School-aged Children survey (Inchley et al., 2018). In brief, it began with a child-friendly definition of bullying followed by questions on the frequency of being cyberbullied, as well as, being bullied and bullying others in person at school during the last couple of months. Examples of cyberbullying, such as writing mean messages, emails, text messages or posts, were provided in the relevant question. Frequency of bullying was categorized using a five-level scale (no bullying, once or twice during the past couple of months, two to three times a month, about once per week, several times per week). Further details of the survey are summarized in Supporting Information Methods. We derived three separate binary variables to identify pupils who had been cyberbullied, bullied, and bullied others at school if they indicated "at least once or twice" during the past couple of months to the respective questions. The adopted threshold for dichotomizing bullying is in keeping with definitions used in existing literature, ranging from at least once in the past 12 months (Duong & Bradshaw, 2014; Messias et al., 2014; Schneider et al., 2011) to at least once a week (Heikkilä et al., 2013). As previously described (Duong & Bradshaw, 2014; Messias et al., 2014; Schneider et al., 2011), we further combined the two binary variables for in-person school bullying and cyberbullying victimization as a mutually exclusive four-category variable: (1) neither bullied at school nor cyberbullied, (2) bullied at school only, (3) cyberbullied only and (4) bullied at school and cyberbullied (Table S2).

Feeling lonely during the most recent summer holidays

We measured loneliness by asking pupils "During the most recent summer holidays, how often did you feel lonely?". Pupils were given options "None of the time," "Rarely," "Some of the time," "Often" and "All of the time" to respond. We created a binary variable to identify pupil feeling lonely during the most recent summer holidays if they responded "Some of the time," "Often" or "All of the time" (Table S2).

Mental wellbeing and life satisfaction

We used the seven-item short Warwick-Edinburgh Mental Wellbeing Scale (SWEMWBS) to assess pupils' mental wellbeing over the last 2 weeks before the date of survey (Melendez-Torres et al., 2019; Morgan et al., 2020; Stewart-Brown et al., 2009). As described previously (Ng Fat et al., 2017), we first summed up the item scores and then created an ordinal variable containing three levels of summed scores (7–20: low; 21–26: moderate; >26: high, Table S2), with the higher level representing more positive mental wellbeing.

We used the adapted version of Cantril's Self-Anchoring Ladder of Life Satisfaction to measure pupils' life satisfaction (Mazur et al., 2018; Moore et al., 2018). Pupils were asked to respond on a scale from 0 to 10 on how satisfied they were with their life at the time of the survey. In keeping with others (Mazur et al., 2018; Moore et al., 2018), we derived an ordinal variable with three levels to reflect low (0–6), average (7–8) and high (9–10) level of life satisfaction (Table S2).

Other covariates

Besides categorical variables of sex (male and female) and age (11–16 years) extracted from SAIL, we also included covariates that measured pupil's socio-demographic characteristics and use of health services. We used the Family Affluence Scale assessed in the survey to measure material affluence of pupils' families (Currie et al., 2008; Hartley et al., 2016; Morgan et al., 2020). In keeping with other research on self-harm (Harriss & Hawton, 2011), we assessed deprivation level and urban/rural status of the areas pupils resided at the date of survey by extracting the Welsh Index of Multiple Deprivation (WIMD) 2011 and urban/rural indicator respectively from SAIL (Barham & Begum, 2006; Welsh Government, 2017). We extracted use of health services related to history of self-harm, history of common mental disorders (CMDs) and history of smoking status extracted from the earliest date of available data to the date before the survey being taken from SAIL (Table S2) based on previously validated code lists (Atkinson et al., 2017; John et al., 2020; Marchant et al., 2020). Detailed descriptions of these variables are summarized in Table S2.

2.4 | Procedure

2.4.1 | Data linkage

SHW survey data were uploaded to the SAIL databank (www.saildatabank.com), a databank that contains anonymised privacy protecting person-based linkable data from healthcare and public settings (Ford et al., 2009; Lyons et al., 2009).

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Detailed data linkage procedures were outlined in a previous study (Morgan et al., 2020). All data linkage within the SAIL databank were treated in accordance with the Data Protection Act 2018 and was compliant with the General Data Protection Regulation (SHRN, 2019). Appropriate disclosure control methods were used to restrict the reporting of small numbers (i.e., categories containing less than 5 individuals) to protect vulnerable individuals. Data linkage between database were performed by identity matching and creation of unique anonymised linkage identifier (anonymised linking field) to be linked across datasets. This was conducted via the National Health Service Wales Informatics Service, a trusted organization mandated to hold personally identifiable data. Further encryption of datasets using deterministic matching was based on NHS number or probabilistic matching using available demographics (first name, surname, date of birth, gender, and Phonex and Soundex versions of names) based on the Welsh Demographic Service dataset (Ford et al., 2009; Lyons et al., 2009). For probabilistic linkage, a matching score was calculated to reflect the odds of matches of demographic variables for an individual. We included individuals whose data were either deterministically linked or probabilistically linked with matching score of ≥0.9. To create a SAIL-linked SHRN cohort, we linked the SHW survey data to the following datasets in SAIL: (1) the GPD (primary care), (2) the PEDW (inpatient hospital admissions), (3) the EDDS (EDDS accident and ED attendances), (4) Welsh Demographic Service and (5) the Office for National Statistics deaths register datasets (Figure 1). Descriptions of each dataset are summarized in Table S1. Based on the larger SHRN cohort related to this study with data collected in 2017, 48.7% of the pupils consented to data linkage and provided identifiable information (Morgan et al., 2020). The successful linkage rate was 69.5% (6961/10,014) among pupils who consented to data linkage and provided identifiable data (Figure 1).

2.4.2 | Ethical approval

Ethical approval for this study was obtained from Cardiff University's School of Social Sciences Research Ethics committee (SREC/2190) and by the Health Information Research Unit's independent Information Governance Review Panel (Project Nos: 0808 and 0667). Detailed procedures of obtaining consents from schools, parents and pupils for the SHW survey were outlined elsewhere (Morgan et al., 2020; SHRN, 2021).

2.5 | Statistical analysis

To alleviate potential biases of the SAIL-linked SHRN cohort (Griffith et al., 2020; Morgan et al., 2020), we weighted the SHRN cohort by inverse probability weighting (IPW) based on propensity scores (PS) (Seaman & White, 2013). We first identified individuals from SAIL who were not from the survey sample and aged 11–16 years at the date of survey and then combined them with the SHRN cohort to form a large cohort representing the 11–16 years olds population of Wales (Figure 1). Individual's PS (propensity of being in the SHRN cohort) and the corresponding IPW were obtained by logistic regression with studied covariates (Table S2, covariates annotated with "†"). We conducted diagnostic checks on IPW to ensure the relevant assumptions were met (Austin & Stuart, 2015). Details of the IPW procedure is described in Supporting Information. Methods and our main analyses were based on the weighted SAIL-linked SHRN cohort.

We summarized characteristics as descriptive statistics with 95% CIs. We computed the proportion of bullying victimization stratified by characteristics and tested overall group differences by Chi-square or F statistics for unweighted and weighted cohorts respectively. To compare trends in proportion of bullying over age among groups, we performed linear and quadratic contrasts following logistic regression of bullying on age. We evaluated risk of self-harm using recurrent event survival analysis. As descriptive analysis, we reported crude prevalence, expressed as number of events per 1000 person years of self-harm by bullying groups. We tested the overall group differences in self-harm rates by omnibus contrasts following Poisson regression of the number of recurrent self-harm events on bullying groups, with the person-years as offset. We also constructed mean cumulative functions (MCFs) of self-harm across bullying victimization groups (Nelson, 2003). As previously suggested (Bergen et al., 2010), we ran Prentice, Williams and Peterson gap-time (PWP-GT) model, a modified Cox model for recurrent events that are assumed ordered and correlated (Cleves, 1999). We performed both unadjusted and adjusted analyses to evaluate the effect size (hazard ratios [HRs]) of risk factors on self-harm including bullying victimization, perpetrator of bullying at school, SWEMWBS, life satisfaction, loneliness and other covariates (Table S2, covariates annotated with "*"). Robust variance was used for correlated data clustered by schools. To avoid model nonconvergence due to small sample sizes of sub-groups, inconclusive responses ("I do not want to answer" and "I don't know") were excluded from modeling analyses. The proportional hazards assumption was checked for all covariates based on visual inspection and test of Schoenfeld residuals.

We extracted data from SAIL via structured query language (SQL DB2). All statistical analyses were performed using Stata version 16.1 (StataCorp, 2019) and SAS version 9.4 (SAS Institute Inc., 2013) and the level of statistical significance was set at $p = .05$. Weights from the IPW procedure were incorporated for all analyses associated with the weighted cohort. We carried out three sensitivity analyses to examine robustness of the results. The first was performed by replicating the main

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analysis with grouping of self-harm contacts which occurred within 21 days to a single event as previously described (Hope et al., 2021). The second was conducted by replicating the main analysis from the unweighted cohort and the third by using a more restricted definition for bullying, i.e., at least two to three times a month. We also conducted a supplementary analysis to examine bullying roles associated with risk of future self-harm. We first regrouped the bullying perpetration and victimization variables into a four-category variable (neither perpetrator nor victim/pure perpetrator/pure victim/both perpetrator and victim) and then repeated the main analysis.

3 | RESULTS

3.1 | Study sample

The SAIL-linked SHRN cohort consisted of 6677 pupils who consented to data linkage, provided identifiable data and aged 11–16 years at the date of SHW survey (Figure 1). We additionally identified 245,472 young individuals from SAIL as a comparison cohort to obtain PS and conduct IPW (Figure 1). Detailed results of generating PS, weights and diagnostic checks against the underlying assumptions of IPW are summarized in Figure S1 and Tables S3–S5). Characteristics of the weighted and unweighted SHRN cohorts are summarized in Table 1. The weighted cohort was more likely to be older, from more deprived areas and areas with unknown WIMD/rural-urban status, and more likely to have history of CMDs, history of self-harm and smoking related contacts to health services compared to the unweighted cohort.

3.2 | Bullying victimization by characteristics

For the weighted SHRN cohort ($N = 6813$), 35.0% ($n = 2387$) of the pupils reported being bullied (Tables 1–2). The respective proportions of those being "in person bullied at school only," "cyberbullied only" and "both in-person bullied at school and cyberbullied" were 18.1% ($n = 1231$), 6.4% ($n = 438$) and 10.5% ($n = 718$) respectively (Table 2). 12.6% (857/6813) of pupils reported bullying others at school and 62.9% (538/857) of them indicated they were also victims of either type of bullying. Summary of statistical tests for cross-tabulations is shown in Table S6A. Distributions of types of bullying victimization were significantly different between sexes. While the proportion of being bullied at school only was higher in males (19.8% vs. 16.4%), females had a higher proportion of being "cyberbullied only" (3.8% vs. 9.0%) and "both bullied at school and cyberbullied" (7.6% vs. 13.4%). Differences in distribution was also significant by age. The proportion being bullied at school peaked at 12 years and declined at older ages (significant quadratic contrast, Table S6B). However, the proportion being "cyberbullied only" peaked at 16 years and did not show significant linear nor quadratic trend over age (Table S6B). The proportion for pupils being bullied at school and cyberbullied followed a quadratic trend over age and peaked at 13 years (Table S6B). We observed an association between bullying victimization (both types) and family affluence, which was particularly salient from bullying victimization at school (29.1% and 41.6% for the most and the least affluent quintiles, respectively). We found similar but slightly weaker associations across WIMD quintiles and between urban and rural areas. Being lonely during the most recent summer holidays, lower SEWMWBS scores, lower life satisfaction, having history of CMDs and history of self-harm were associated with higher risk of being bullied at school only and being both bullied at school and cyberbullied.

3.3 | Self-harm during follow-up and risk of self-harm following bullying victimization and other factors

Within the 2-year follow-up after survey completion, we identified 153 self-harm related contacts with health services from 71 pupils from the unweighted SAIL-linked SHRN cohort. Upon grouping of self-harm contacts occurring on adjacent days, we identified 102 events and included 92 (90.2% of 102) after restricting the first two events only from each pupil. The corresponding overall unweighted and weighted prevalence of self-harm in the SHRN cohort were 7.7 (95% CI: 5.3–11.4) and 6.9 (95% CI: 5.6–8.5) per 1000 person-years, respectively.

Over the 2-year follow-up, prevalence rates of self-harm (Table S7) were significantly different among groups of bullying victimization ($F_{(3,\ 6768)} = 12.4$; $p < .001$). Self-harm rates were the highest for the "bullied at school and cyberbullied" group (31.7 per 1000 person-years). Self-harm rates were lower for the "bullied at school only" group (7.6 per 1000 persons-years) and the "cyberbullied only" group (8.6 per 1000 person-years) but were still higher than the rates of the "neither bullied" group (2.8 per 1000 person-years). Similarly, MCFs show that bullying victimization was associated with increased risk of self-harm (Figure 2). Mean numbers of self-harm events in the "bullied at school only" group (15.3 per 1000 persons) and the "cyberbullied only" group (17.3 per 1000 persons) were comparable and were both higher than that of the "neither bullied"

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TABLE 1 Sample characteristics of the unweighted and weighted (inverse probability weighting, IPW) SAIL-linked SHRN cohort

Characteristics	Source of variable	Categories	Unweighted			Weighted[a]		
			Numbers	%	95% CI	Numbers	%	95% CI
Total	–		6677	100.0	(100.0–100.0)	6813	100.0	(100.0–100.0)
Sex	SAIL	Male	3442	51.6	(50.3–52.8)	3357	49.3	(50.4–52.7)
		Female	3235	48.4	(47.2–49.7)	3456	50.7	(46.1–55.4)
Age (years)	SAIL	11	1152	17.3	(16.4–18.2)	1023	15.0	(13.3–16.9)
		12	1590	23.8	(22.8–24.9)	1058	15.5	(13.9–17.3)
		13	1434	21.5	(20.5–22.5)	1070	15.7	(14.0–17.6)
		14	1097	16.4	(15.6–17.3)	1023	15.0	(13.3–17.0)
		15	958	14.3	(13.5–15.2)	1067	15.7	(13.5–18.0)
		16	446	6.7	(6.1–7.3)	1572	23.1	(16.9–30.6)
FAS quintile[b]	SHRN	Q1	1297	19.4	(18.5–20.4)	1273	18.7	(15.4–22.4)
(Q5: least affluent)		Q2	1297	19.4	(18.5–20.4)	1278	18.8	(16.3–21.5)
		Q3	1296	19.4	(18.5–20.4)	1453	21.3	(16.0–27.9)
		Q4	1297	19.4	(18.5–20.4)	1317	19.3	(16.5–22.6)
		Q5	1296	19.4	(18.5–20.4)	1320	19.4	(17.2–21.8)
		Unknown	194	2.9	(2.5–3.3)	171	2.5	(2.0–3.1)
WIMD quintile and	SAIL	Q1	1478	22.1	(21.1–23.2)	1040	15.3	(13.7–17.0)
Urban/Rural indicator		Q2	1308	19.6	(18.6–20.6)	984	14.4	(12.9–16.1)
(Q5: most deprived)		Q3	1425	21.3	(20.4–22.3)	1047	15.4	(13.8–17.1)
		Q4	1237	18.5	(17.6–19.5)	1108	16.3	(14.5–18.2)
		Q5	1011	15.1	(14.3–16.0)	1214	17.8	(15.9–19.9)
		Rural	2255	33.8	(32.6–34.9)	1769	26.0	(23.4–28.7)
		Urban	4204	63.0	(61.8–64.1)	3623	53.2	(48.2–58.1)
		Unknown	218	3.3	(2.9–3.7)	1421	20.9	(14.5–29.0)
Perpetrator of bullying at school	SHRN	No	5525	82.7	(81.8–83.6)	5714	83.9	(81.7–85.8)
		Yes	859	12.9	(12.1–13.7)	857	12.6	(10.9–14.5)
		Unknown	293	4.4	(3.9–4.9)	242	3.6	(3.0–4.2)
Bullied at school/Cyberbullied	SHRN	No	3871	58.0	(56.8–59.2)	4112	60.4	(56.2–64.4)
		Bullied at school only	1317	19.7	(18.8–20.7)	1231	18.1	(16.0–20.3)
		Cyberbullied only	366	5.5	(5.0–6.1)	438	6.4	(4.2–9.7)
		Bullied at school & cyberbullied	782	11.7	(11.0–12.5)	718	10.5	(9.2–12.0)
		Unknown	341	5.1	(4.6–5.7)	314	4.6	(3.7–5.7)
Feeling lonely[c]	SHRN	No	4648	69.6	(68.5–70.7)	4506	66.1	(60.6–71.3)
		Yes	1956	29.3	(28.2–30.4)	2242	32.9	(27.7–38.5)
		Unknown	73	1.1	(0.9–1.4)	65	1.0	(0.7–1.3)
SWEMWBS[d]	SHRN	Low	1132	17.0	(16.1–17.9)	1216	17.8	(15.6–20.3)
		Moderate	2745	41.1	(39.9–42.3)	2683	39.4	(35.5–43.4)

(Continues)

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TABLE 1 (Continued)

Characteristics	Source of variable	Categories	Unweighted Numbers	Unweighted %	Unweighted 95% CI	Weighted[a] Numbers	Weighted[a] %	Weighted[a] 95% CI
		High	2431	36.4	(35.3–37.6)	2602	38.2	(32.8–43.9)
		Unknown	369	5.5	(5.0–6.1)	312	4.6	(3.8–5.4)
Life satisfaction	SHRN	Low	1470	22.0	(21.0–23.0)	1512	22.2	(19.8–24.8)
		Average	2793	41.8	(40.6–43.0)	3134	46.0	(41.1–51.0)
		High	2334	35.0	(33.8–36.1)	2103	30.9	(27.2–34.8)
		Unknown	80	1.2	(1.0–1.5)	64	0.9	(0.7–1.2)
History of common mental disorders[e]	SAIL		191	2.9	(2.5–3.3)	250	3.7	(3.0–4.5)
History of self-harm[e]	SAIL		51	0.8	(0.6–1.0)	89	1.3	(0.9–1.9)
Ever smoked[e]	SAIL		203	3.0	(2.6 –3.5)	303	4.5	(3.5–5.6)

Abbreviations: CI, confidence interval; SAIL, secure anonymised information linkage; SHRN, school health research network.

[a]Weighed by inverse probability weighing from available same age population from SAIL.

[b]Family Affluence Scale.

[c]During most recent summer holidays.

[d]Short Warwick-Edinburgh Mental Wellbeing Scale.

[e]Extracted from ever to before the date of survey.

group (5.6 per 1000 persons). Pupils who had been "both bullied at school and cyberbullied" had the highest mean number of events compared to other groups (63.3 per 1000 persons).

We observed similar pattern of unadjusted HRs across bullying victimization groups from the PWP-GT model (Table 3 and Table S8) although the unadjusted HR of being cyberbullied was not statistically significant. The product of the unadjusted HRs of the "bullied at school only" and "cyberbullied only" groups (≈6.5) was comparable with that of the "bullied at school and cyberbullied" group (6.9). We also found being female, having a history of CMDs and smoking, feeing lonely during the most recent summer holiday and having low scores in SWEMWBS were significantly associated with an elevated risk of self-harm. In the adjusted analysis (Table 3 and Table S6), effect sizes remained statistically robust in "bullied at school only" (adjusted HR or AHR = 2.2; 95% CI: 1.1–4.3) and "both bullied at school and cyberbullied" (AHR = 2.2; 95% CI: 1.0–4.7) but not in the "cyberbullied only" group (AHR = 1.2; 95% CI: 0.4–3.3). AHRs were statistically significant for certain predictors including female sex (3.1; 95% CI: 1.6–6.0), history of CMDs (3.4; 95% CI: 1.4–8.6), smoking (2.8; 95% CI: 1.0–7.9) and feeing lonely (2.2; 95% CI: 1.2–4.0). Low scores in SWEMWBS (AHR = 1.8; 95% CI: 0.7–4.3) and low level of life satisfaction (AHR = 0.7; 95% CI: 0.3–1.6) were no longer significantly associated with self-harm in the adjusted analysis. Effect size of bullying others at school was neither significant in the unadjusted (AHR = 1.3; 95% CI: 0.7–2.4) nor adjusted analysis (AHR = 1.3; 95% CI: 0.6–2.6).

3.4 | Sensitivity and supplementary analysis

Results of the three sets of sensitivity analyses (Tables S8–S11 and Figures S1, S2A, and S2C) were in good agreement with the main analysis with only minor exceptions. When self-harm contacts were grouped together to those which occurred within 21 days, both having history of self-harm and history of CMDs were significant predictors of self-harm in the adjusted model for the weighted cohort (Table S8). In the adjusted models for the unweighted cohort, however, history of self-harm but not history of CMDs was a significant predictor regardless of how self-harm contacts were grouped as a single event (Table S10). Supplementary analysis on the role of bullying showed that risks of future self-harm were increasing from pure perpetrators, pure victims to both perpetrators and victims compared to those who were neither perpetrator nor victim (Tables S7 and S12 and Figure S2B and S2D). While HRs were significantly larger than one for individuals who were victimized (pure victims or being perpetrators as well), HRs for pure perpetrators were not significantly larger than one (Table S12).

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TABLE 2 Proportion of bullying victimization by characteristics from the weighted SAIL-linked SHRN cohort ($N = 6813$)

Characteristics	Category	Bullied at school or cyberbullied			Bullied at school only			Cyberbullied only			Bullied at school & cyberbullied		
		Numbers	%	95% CI	Numbers	%	95% CI	Numbers	%	95% CI	Numbers	%	95% CI
Total		2387	35.0	(31.3–38.9)	1231	18.1	(16.0–20.3)	438	6.4	(4.2–9.7)	718	10.5	(9.2–12.0)
Sex	Male	1047	31.2	(28.0–34.5)	665	19.8	(17.4–22.5)	127	3.8	(3.1–4.7)	254	7.6	(6.3–9.1)
	Female	1340	38.8	(32.0–46.0)	566	16.4	(13.3–19.9)	310	9.0	(5.0–15.7)	464	13.4	(11.0–16.3)
Age (years)	11	386	37.7	(33.5–42.1)	226	22.1	(18.2–26.7)	53	5.2	(3.7–7.3)	106	10.4	(8.2–13.1)
	12	432	40.8	(37.4–44.3)	239	22.6	(19.8–25.7)	49	4.6	(3.3–6.4)	144	13.6	(11.0–16.6)
	13	465	43.5	(39.2–47.8)	234	21.9	(18.3–26.0)	78	7.2	(4.6–11.3)	153	14.3	(11.7–17.4)
	14	388	38.0	(33.5–42.7)	206	20.1	(16.5–24.2)	47	4.6	(3.4–6.0)	136	13.3	(10.3–17.0)
	15	346	32.4	(27.4–37.9)	175	16.4	(12.8–20.8)	51	4.8	(3.5–6.6)	120	11.2	(8.7–14.4)
	16	370	23.5	(13.2–38.3)	151	9.6	(5.9–15.1)	160	10.2	(3.2–27.8)	59	3.7	(2.1–6.4)
FAS quintile[a]	Q1	370	29.1	(23.1–35.9)	205	16.1	(12.4–20.7)	58	4.6	(3.2–6.5)	107	8.4	(6.4–10.9)
(Q5: least affluent)	Q2	411	32.2	(27.2–37.5)	191	15.0	(12.4–17.9)	70	5.4	(3.3–8.8)	150	11.7	(8.8–15.4)
	Q3	457	31.5	(21.3–43.9)	265	18.3	(11.9–26.9)	61	4.2	(2.5–6.8)	131	9.0	(6.0–13.4)
	Q4	551	41.8	(33.2–51.0)	257	19.5	(15.7–23.9)	166	12.6	(4.6–30.5)	128	9.7	(7.3–12.9)
	Q5	549	41.6	(37.2–46.0)	284	21.5	(18.2–25.3)	77	5.8	(4.0–8.3)	188	14.2	(11.6–17.2)
WIMD quintile and	Q1	345	33.2	(30.4–36.2)	202	19.4	(17.1–22.0)	49	4.7	(3.6–6.1)	94	9.1	(7.5–11.0)
Urban/rural indicator	Q2	349	35.4	(32.5–38.5)	192	19.6	(17.2–22.2)	53	5.4	(4.0–7.1)	103	10.5	(8.8–12.4)
(Q5: most deprived)	Q3	380	36.4	(33.3–39.5)	200	19.1	(16.8–21.6)	57	5.5	(4.1–7.3)	123	11.8	(9.9–14.0)
	Q4	439	39.7	(36.3–43.1)	219	19.8	(17.2–22.6)	70	6.3	(4.9–8.1)	150	13.6	(11.4–16.1)
	Q5	478	39.4	(35.8–43.1)	238	19.6	(16.9–22.6)	71	5.9	(4.3–8.0)	169	13.9	(11.7–16.6)
	Rural	588	33.3	(30.9–35.8)	330	18.7	(16.8–20.8)	87	4.9	(3.8–6.2)	172	9.7	(8.4–11.1)
	Urban	1404	38.7	(37.0–40.6)	721	19.9	(18.5–21.4)	214	5.9	(5.1–6.8)	469	12.9	(11.8–14.2)
Perpetrator of bullying at school		538	62.9	(56.2–69.1)	277	32.4	(27.0–38.3)	60	7.0	(4.8–10.0)	201	23.5	(19.2–28.5)
Feeling lonely[b]		1054	47.0	(36.4–57.9)	503	22.4	(17.3–28.5)	128	5.7	(4.2–7.8)	423	18.9	(14.5–24.2)
SWEMWBS[c]	Low	644	53.0	(47.1–58.7)	271	22.3	(18.4–26.7)	74	6.1	(4.5–8.2)	299	24.6	(20.5–29.2)
	Moderate	955	35.6	(32.3–39.0)	557	20.8	(18.1–23.8)	140	5.2	(4.2–6.5)	257	9.6	(8.1–11.3)
	High	673	25.9	(18.8–34.4)	340	13.1	(10.0–16.8)	215	8.2	(3.5–18.2)	119	4.6	(3.4–6.1)
Life satisfaction	Low	776	51.3	(47.0–55.5)	374	24.7	(21.5–28.4)	93	6.1	(4.7–8.0)	309	20.4	(17.6–23.6)

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TABLE 2 (Continued)

Characteristics	Category	Bullied at school or cyberbullied			Bullied at school only			Cyberbullied only			Bullied at school & cyberbullied		
		Numbers	%	95% CI	Numbers	%	95% CI	Numbers	%	95% CI	Numbers	%	95% CI
	Average	998	31.8	(26.0–38.3)	553	17.6	(14.1–21.8)	166	5.3	(3.8–7.3)	279	8.9	(6.9–11.4)
	High	592	28.1	(21.7–35.6)	296	14.1	(11.8–16.7)	176	8.4	(3.1–20.7)	119	5.7	(4.6–7.0)
History of common mental disorders[d]		101	40.5	(31.4–50.4)	49	19.8	(13.1–28.8)	16	6.5	(3.1–12.8)	36	14.3	(9.3–21.5)
History of self-harm[d]		43	48.0	(30.3–66.2)	18	20.7	(9.2–40.3)	5	6.1	(2.1–16.5)	19	21.2	(10.1–39.1)
Ever smoked[d]		100	33.0	(24.4–43.0)	33	11.0	(6.7–17.4)	18	5.9	(2.8–11.8)	49	16.2	(10.4–24.2)

Abbreviations: CI, confidence interval; SAIL, secure anonymised information linkage; SHRN, school health research network.

[a]Family Affluence Scale.

[b]During most recent summer holidays.

[c]Short Warwick-Edinburgh Mental Wellbeing Scale.

[d]Extracted from ever to before the date of survey.

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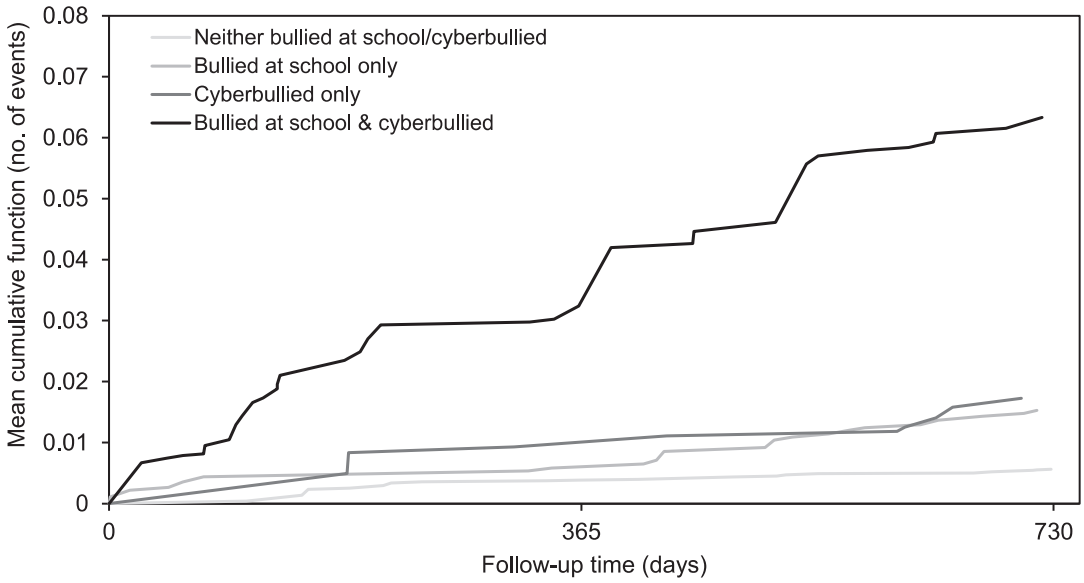

FIGURE 2 Mean cumulative function of self-harm during the 2-year follow-up period stratified by bulling victimization for the inverse probability weighted SAIL-linked SHRN cohort. SAIL, secure anonymised information linkage; SHRN, school health research network.

4 | DISCUSSION

We examined the association between bullying victimization and future self-harm behaviors by linking nationwide school survey and routinely collected data for the first time to our knowledge. This a major difference from most previous studies (see for example an earlier Finnish study (Sourander et al., 2000, for exception) using self-reported measures for both bullying and self-harm. We used IPW method based on PS to strengthen causal inference. We evaluated the risk of self-harm following victimization through in-person bullying at school and cyberbullying separately, adjusting for various factors. We found about one-third of the pupils had been victims of bullying with the majority being in-person bullied at school and about 6% of the pupils being cyberbullied only. We analysed prevalence of in-person and cyberbullying across sex, age, family affluence and levels of area deprivation. We also observed that being "bullied at school only" and being “both bullied at school in-person and cyberbullied” were associated with loneliness, low mental wellbeing, low life satisfaction, previous history of CMDs and history of self-harm. We demonstrated that, when all factors are adjusted for, being victims of “in-person bullying at school only” and victims of “both in-person school bullying and cyberbullying,” as well as being female, experiencing loneliness, having a previous history of CMDs and smoking were robust predictors of future self-harm. Interestingly, cyberbullying victimization alone is not a robust predictor of self-harm. The multiplicative effect of in-person bullying at school and cyberbullying victimization on self-harm was observed in unadjusted but not adjusted analysis. We found attenuation of effect sizes of low mental wellbeing to a level below statistical significance in the adjusted analysis. We also demonstrated the differences in risk of self-harm among pure perpetrators, pure victims and both perpetrators and victims of bullying.

Our overall prevalence of bullying victimization at school (35%) is in good agreement with that obtained from the larger Welsh samples of the SHW survey (36%) (Hewitt et al., 2019) and that from a large-scale longitudinal study of English secondary school pupils (30%–37%) (Department for Education, 2018). The distribution of victims of in-person at school and cyberbullying across sex, age and socioeconomic status are also in consistent with previous studies (Hewitt et al., 2019; Messias et al., 2014). These distributions may relate to a tendency for young people who have just transitioned to secondary school to seek to assert their dominance among a new set of peers (Pellegrini & Long, 2002). However, such tendencies apparently did not translate to cyberbullying. Its prevalence related to the increasing use of electronic devices when young people become older and gain autonomy. Our adjusted effect size of in-person bullying victimization at school on self-harm tallies with the results reported from meta-analysis (Heerde & Hemphill, 2019).

In contrast to some studies (Heerde & Hemphill, 2019; Schneider et al., 2011), we did not observe significantly elevated risk of self-harm for pupils who had been “cyberbullied only” or cumulative effects associated with being both bullied at in-person at school and cyberbullied. The disparity could be explained by high heterogeneity of study designs, settings, and measures of bullying and self-harm (Heerde & Hemphill, 2019; John et al., 2018). Results from a longitudinal follow-up study, similar to ours, showed that in-person but not cyberbullying victimization is associated with suicidal thoughts during the 2-year follow-up among first-year secondary school pupils when baseline level of suicidal thoughts was adjusted for

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TABLE 3 Summary of regression coefficients (hazard ratios, HRs) of the Prentice, Williams and Peterson gap time Cox models for risk of recurrent self-harm events during follow-up period for the weighted SAIL-linked SHRN cohort

			Unadjusted analysis			Adjusted analysis[a]		
Variable	**Reference**	**Categories**	**HR**	**95% CI**	***p* value**	**HR**	**95% CI**	***p* value**
Bullied at school/cyberbullied	No	Bullied at school only	2.5	(1.1–5.3)	.024	2.2	(1.1–4.3)	.024
		Cyberbullied only	2.6	(0.9–7.7)	.090	1.2	(0.4–3.3)	.760
		Bullied at school & cyberbullied	6.9	(2.7–17.6)	<.001	2.2	(1.0–4.7)	.043
Sex	Male	Female	4.3	(2.2–8.3)	<.001	3.1	(1.6–6.0)	.001
Age (years)	11–13	14–16	1.0	(0.6–1.8)	.982	1.0	(0.5–1.7)	.927
FAS quintile	Q1	Q2	3.5	(1.4–8.8)	.007	2.2	(0.8–5.8)	.125
(Q5: least affluent)		Q3	0.7	(0.2–2.0)	.485	0.7	(0.2–2.2)	.551
		Q4	1.8	(0.7–4.4)	.214	1.6	(0.6–4.5)	.395
		Q5	2.2	(0.9–5.7)	.097	1.3	(0.4–3.9)	.634
WIMD quintile	Q1	Q2	1.2	(0.6–2.6)	.607	1.2	(0.5–2.4)	.711
(Q5: most deprived)		Q3	1.9	(0.9–4.3)	.111	1.8	(0.9–3.8)	.116
		Q4	1.4	(0.6–3.6)	.459	0.9	(0.3–2.4)	.809
		Q5	1.2	(0.5–2.8)	.618	1.0	(0.4–2.6)	.948
Urban/Rural indicator	Rural	Urban	0.9	(0.5–1.7)	.846	0.7	(0.4–1.4)	.334
Perpetrator of bullying at school	No	Yes	1.3	(0.7–2.4)	.377	1.3	(0.6–2.6)	.531
History of common mental disorders	No	Yes	4.1	(1.5–11.7)	.007	3.4	(1.4–8.6)	.009
History of self-harm	No	Yes	4.5	(1.0–20.9)	.052	2.4	(0.6–8.7)	.194
Ever smoked	No	Yes	3.2	(1.3–8.0)	.012	2.8	(1.0–7.9)	.046
Feeling lonely	No	Yes	4.8	(2.2–10.5)	<.001	2.2	(1.2–4.0)	.013
SWEMWBS	High	Low	8.1	(3.8–17.4)	<.001	1.8	(0.7–4.3)	.213
		Moderate	2.2	(1.0–4.6)	.043	1.1	(0.5–2.7)	.814
Life satisfaction	High	Low	2.5	(1.0–6.2)	.052	0.7	(0.3–1.6)	.383
		Average	1.2	(0.5–3.1)	.710	0.5	(0.2–1.1)	.100

Abbreviations: CI, confidence interval; HR, hazard ratio; SAIL, secure anonymised information linkage; SHRN, school health research network.

[a]Adjusted for all covariates listed in the table.

(Bannink et al., 2014). Nevertheless, our findings on cyberbullying tally with previous cross-sectional studies from the United Kingdom (Przybylski & Bowes, 2017; Wolke et al., 2017) and the United States (Waasdorp & Bradshaw, 2015) and suggest that cyberbullying is an extension of in person bullying at school and associated with fewer new victims as demonstrated in studies where cyberbullying and direct/relational bullying were not separated.

Since reporting and help-seeking behaviors of victims of cyberbullying are not as common as in victims of in-person bullying (Agatston et al., 2007; Dooley et al., 2010), underestimation of prevalence of cybervictimisation and the corresponding risk of self-harm is plausible. Related to this, the nonsignificance of the estimates could be due to the small prevalence of cyberbullying victimization alone and self-harm. Differences in onset and duration of exposure to in-person and cyberbullying may also affect the magnitude of the effect sizes (Bannink et al., 2014). Our data and others (Messias et al., 2014; Sourander et al., 2000; Suzuki et al., 2012) suggested that in-person bullying victimization is more prevalent at an earlier age than cyberbullying victimization. This may result in less exposure time to cyberbullying and reduced effects of cyberbullying victimization on self-harm within the fixed follow-up period in our relatively young sample. Future research may use longitudinal measures of bullying to control for duration of exposures of both bullying categories.

Notably, our unadjusted relative risk of self-harm associated with victimization of "both in-person bullying at school and cyberbullying" was the largest among other bullying groups. However, in the adjusted analyses, the effect size attenuated to the level observed in the in-person bullying victimization at school only. As previously suggested (John et al., 2018), we surmise that the apparent effects of cyberbullying victimization on self-harm may be partially shared by in-person bullying

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victimization and other risks factors. Interestingly, feeling lonely during most recent holidays is a robust predictor of self-harm in this study. While the negative impacts of loneliness on young people have been recognized (Beidel et al., 2007; Mahon et al., 2001), further research is required to examine how in-person and cyber bulling interplay with other risk factors such as loneliness.

Our nonstatistically significant effect size associated with in-person bullying perpetration at school on self-harm is not consistent with a recent meta-analysis (Heerde & Hemphill, 2019) but is consistent with a longitudinal follow-up study on in-person bullying perpetration and suicidal thoughts in adolescents aged 15–17 (Heikkilä et al., 2013) as well as studies using self-reported measures of self-harm (Copeland et al., 2013; Lereya et al., 2013).

We additionally examined the role of bullying on risk of future self-harm and found that risk of self-harm for pure perpetrators were not statistically significantly larger than those who were not involved in bullying. We also observed that risk of self-harm was increasing from pure perpetrators, pure victims to both perpetrators and victims. These findings were in line with the literature suggesting that pure bullying perpetrators are associated with higher level of perceived popularity among peers and use bullying to access to resources and gain social dominance (Guy et al., 2019; Volk et al., 2012), thereby outweighing the negative effects of bullying. Those who are both perpetrators and victims of bullying, however, may be the most defeated, with unsuccessful attempts to fight back and diminishing popularity and connection (Guy et al., 2019) and thus experienced worst outcomes. The relationship between bullying victimization and perpetration is complex, with previous studies demonstrating that being a previous bullying victim is associated with higher risk of future bullying perpetration (Álvarez-García et al., 2015).

4.1 | Strength and limitations

A clear advantage of this study is the availability of data linkage between survey and routinely collected data at individual level. With data linkage, we performed longitudinal follow-up and our results could establish temporal associations between bullying victimization and self-harm behaviors. To our knowledge, similar investigations are not commonly reported (Bannink et al., 2014; Heikkilä et al., 2013; John et al., 2018). Combining routinely collected data with self-report survey data allows for the examination and control for multiple variables from both sources. We could simultaneously assess psychological factors, self-harm and other physical/mental health related conditions using validated measures or codes to ensure validity and reliability. To circumvent selection/collider biases from using nonrepresentative samples (Griffith et al., 2020; Morgan et al., 2020), we applied IPW adjustment to the SHRN cohort by nesting it within a population-based cohort (Griffith et al., 2020). We were able to analyse the associations of in-person bullying victimization at school and cyberbullying victimization on future self-harm separately and at the same time adjusted for other known risk factors.

A major limitation of this study is the lack of single agreed measures on bullying (Evans & Smokowski, 2016; John et al., 2018; Przybylski & Bowes, 2017). While we used single-item measures in keeping with others (Zaborskis et al., 2018), multiple-item measures (Felix et al., 2011; Yanagida et al., 2016) and peer nominations (Phillips & Cornell, 2012) have been advocated. This issue applies also to loneliness as multiple-item measures were also recommended (ONS, 2018). The frequency of episodes of bullying for classifying binary bullying groups are highly variable between studies, which range from at least once in the past 12 months (Duong & Bradshaw, 2014; Messias et al., 2014; Schneider et al., 2011), more than four times in the last 6 months (Wolke et al., 2017), once or twice in the past 4 weeks (Bannink et al., 2014), two or three times a month (Zaborskis et al., 2018) to at least once a week (Heikkilä et al., 2013). We nevertheless reported robust findings when an alternative, more restricted definition was used.

The temporality between bullying victimization and other baseline covariates were not known. Loneliness could be a consequence of bullying victimization or a correlate, precursor or mediator to future self-harm (Bannink et al., 2014). Victims of bullying may experience loneliness through difficulties establishing social connections and integration into school life. Other pupils may believe they can avoid being bullied by not associating with existing victims. In contrast, pupils who are lonely have poor social connections and integration into school life may experience increased bullying. We did not measure whether and how long bullying experience persisted. We suggest further longitudinal studies on the role of loneliness, other mental health exposures and the effects of the temporal dynamics of bullying on self-harm.

We did not have self-/parent-/teacher-reported measures of self-harm in this study due to the perceived sensitive nature of the topic to be asked in secondary schools. Validity of the associations between bullying and self-harm could be improved using measures from multiple sources and informants (Winsper et al., 2012). The small sample size of this survey cohort leads to reduced statistical power for rare outcomes such as self-harm, which is particularly evident for self-harm following cyberbullying victimization only. Data on cyberbullying perpetration nor previous histories of bullying were available in this study. We therefore interpret the findings associated with the role of bullying with caution as misclassification of the bullying role of pupils will bias our findings. For pupils who also bullied others at school, we could not determine the dynamics of change in the role between victimization and perpetration since the time frame of both questions was the same. Although we

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assessed various factors on bullying victimization and self-harm, we were unable to examine variables (e.g., family and friend relationship, connectedness) due to data availability.

This study used a selective sample of secondary school pupils in Wales who consented to data linkage and provided identifiable data and characteristics of this sample were different from the same-age general population (Morgan et al., 2020). These differ from studies using anonymised population-based routinely collected registries which do not require individual consent, allowing for more representative linkage. We use the IPW procedure to circumvent the selection bias. Given some key variables could not be collected/analysed, however, we cannot guarantee the validity of the assumptions of using IPW and elimination of biases (Austin & Stuart, 2015). Nonetheless, our consistent estimates between the weighted and unweighted cohorts strengthen the robustness of the findings. It has also been shown from simulation study that actual associations observed from a more representative sample remain robust in the presence of selective drop-out (Wolke et al., 2009).

We also relied on the unverified assumption of using the PWP-GT model to assess risk of recurrent self-harm. However, this approach has been shown appropriate for studies analysing recurrent self-harm events (Bergen et al., 2010). Self-harm contacts belonging to a single event cannot be easily identified and grouped in routinely collected data. Nonetheless, we showed in the sensitivity analysis that our estimates are robust regardless of change in grouping strategy. Information on individuals with a high number of recurrent self-harm events was lost due to the restriction of the maximum number of recurrent self-harm events to two. Nevertheless, we still retained more than 90% of total recurrent events based on the threshold.

Other limitations include the usual caveats of using self-reported data in surveys and using routinely collected data for research. We are likely to underestimate self-harm and other conditions for individuals who do not contact health services, have nondetectable symptoms or have their conditions misclassified. Biases due to loss of follow-up and missing data from both data sources may also reduce validity. Data coverage of the primary care database was not completed for the study period whereas data collection of emergency attendance began in 2009. Inaccurate data linkage could generate missing data and lead to biased estimation of PS and other effect sizes.

4.2 | Implications for policy and practice

This study underscores the significant impact of school bullying victimization, together with other risk factors such as loneliness and female sex, on future self-harm behaviors for secondary school pupils. These results should inform both schools and other professionals who work with adolescents to be aware of these risk factors when offering mental health and wellbeing support. Our results indicate that action to prevent self-harm in adolescents also requires efforts on preventing loneliness including times during summer holidays, which could be incorporated in a whole-school approach. Pupils should be encouraged to report and seek help, especially for cyberbullying which may be poorly recognized currently (John et al., 2018). Since the roles of being bullying victims and perpetrators can be complex and dynamic across in-person and cyberbullying (Álvarez-García et al., 2015; Estévez et al., 2020), future research is warranted to investigate any moderation effects of victimization and perpetration of both types of bullying on self-harm. Programs for preventing bullying should focus on the needs of both victims and perpetrators of bullying and restorative practices. We also demonstrated the ability of linking survey and routinely collected data. Studies using similar data linkage approaches are well-placed to explore temporal relationships between a range of demographic, wellbeing and lifestyle risk factors and different health outcomes.

5 | CONCLUSION

This study suggests that victims of in-person school bullying, loneliness, previous history of CMDs/self-harm, smoking and being female are all predictors for future self-harm behaviors but the effect of cyberbullying victimization only is not robust. While we call for unified unambiguous measures of bullying as well as larger-scale studies which warrant statistical power, we made use of data linkage between survey data and routinely collected data for longitudinal evaluations with validated measures of self-harm and other known psychological factors. We also applied procedures to circumvent the nonrepresentativeness of our cohort to improve causal inference. We believe similar research approaches could better inform policymakers, schools, parents, clinicians, and other professionals on where to focus efforts to support pupils' mental health and well-being.

AUTHOR CONTRIBUTIONS

Ann John: conceptualized this study anad supervised data analysis. **Kelly Morgan**, **Nicholas Page**, **Marcos Del Pozo-Baños**, and **Sze Chim Lee**: facilitated and performed data linkage. **Sze Chim Lee and Alice Puchades**: conducted the analysis.

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Ann John, **Sze Chim Lee**, and **Alice Puchades**: wrote the initial draft and all authors commented on the interpretation of findings and the manuscript.

ACKNOWLEDGMENTS

This work was supported by the Adolescent Mental Health Data Platform (ADP) and the Wolfson Centre for Young People's Mental Health (Grant Number 517483). The ADP is funded by MQ Mental Health Research Charity (Grant Reference MQBF/3 ADP). ADP and the author(s) would like to acknowledge the data providers who supplied the datasets enabling this research study. The views expressed are entirely those of the authors and should not be assumed to be the same as those of ADP or MQ Mental Health Research Charity.

This study was also supported by grants from the Medical Research Council (MC/PC/17212 and MC/PC/17211) and the Centre for the Development and Evaluation of Complex Interventions for Public Health Improvement (DECIPHer), a UKCRC Public Health Research Centre of Excellence. Joint funding (MR/KO232331/1) from the British Heart Foundation, Cancer Research UK, Economic and Social Research Council, Medical Research Council, the Welsh Government and the Wellcome Trust, under the auspices of the UK Clinical Research Collaboration, is gratefully acknowledged. It was also supported by its successor the DECIPHer, which is funded by Welsh Government through Health and Care Research Wales.

The funders had no role in the design of the study; in the collection, analyses or interpretation of data; in the writing of the manuscript or in the decision to publish the results.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

The survey data that support the findings of this study are available from DECIPHer but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available. Data are however available from the authors upon reasonable request and with permission of DECIPHer.

Data analysed for this study were obtained under the IGRP approval from the SAIL databank (www.saildatabank.com). Raw data are not available for sharing but can be applied for access through SAIL. Relevant data are also available in the paper and its Supplementary files.

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

ETHICS STATEMENT

Ethical approval for this study was obtained from Cardiff University's School of Social Sciences Research Ethics committee (SREC/2190) and by the Health Information Research Unit's independent Information Governance Review Panel (Project Nos: 0808 and 0667). Detailed procedures of obtaining consents from schools, parents and pupils for the SHW survey were outlined elsewhere (Morgan et al., 2020; SHRN, 2021).

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How to cite this article: John, A., Lee, S. C., Puchades, A., Del Pozo-Baños, M., Morgan, K., Page, N., Moore, G., & Murphy, S. (2023). Self-harm, in-person bullying and cyberbullying in secondary school-aged children: A data linkage study in Wales. *Journal of Adolescence*, 95, 97–114. https://doi.org/10.1002/jad.12102

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