

Published in final edited form as:

*Am J Psychiatry*. 2019 March 01; 176(3): 186–195. doi:10.1176/appi.ajp.2018.18060740.

## Adolescents who self-harm and commit violent crime: Testing early-life predictors of dual harm in a longitudinal cohort study

Leah S. Richmond-Rakerd, PhD<sup>1,\*</sup>, Avshalom Caspi, PhD<sup>1,2,3,4</sup>, Louise Arseneault, PhD<sup>4</sup>, Jessie R. Baldwin, PhD<sup>4</sup>, Andrea Danese, MD, PhD<sup>4,5,6</sup>, Renate M. Houts, PhD<sup>1</sup>, Timothy Matthews, PhD<sup>4</sup>, Jasmin Wertz, PhD<sup>1</sup>, and Terrie E. Moffitt, PhD<sup>1,2,3,4</sup>

<sup>1</sup>Department of Psychology and Neuroscience, Duke University, Durham, NC, USA

<sup>2</sup>Department of Psychiatry and Behavioral Sciences, Duke University School of Medicine, Durham, NC, USA

<sup>3</sup>Center for Genomic and Computational Biology, Duke University, Durham, NC, USA

<sup>4</sup>Social, Genetic, and Developmental Psychiatry Research Centre, Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, UK

<sup>5</sup>Department of Child and Adolescent Psychiatry, Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, UK

<sup>6</sup>National and Specialist CAMHS Trauma and Anxiety Clinic, South London and Maudsley NHS Foundation Trust, London, UK

### Abstract

**Objective**—Self-harm is associated with violent offending. However, little is known about young people who engage in “dual-harm” behavior. We investigated antecedents, clinical features, and life characteristics distinguishing dual-harming adolescents from those who self-harm only.

**Method**—Participants were from the Environmental Risk (E-Risk) Longitudinal Twin Study, a nationally-representative UK cohort of 2,232 twins born in 1994-1995. Self-harm in adolescence was assessed through interviews at age 18. Violent offending was assessed using a computer questionnaire at age 18 and police records through age 22. Risk factors were assessed between ages 5-12. Adolescent mental health, victimization, personality functioning, and use of support services were measured at age 18.

**Results**—Self-harm was associated with violent crime (OR=3.50, 95% CI=2.61-4.70), even after accounting for familial risk factors. Dual-harmers had been victims of violence from childhood, and exhibited lower childhood self-control and lower childhood IQ than self-only harmers. Dual-harmers experienced higher rates of concurrent psychotic symptoms and substance dependence. They also exhibited distinct personality styles characterized by resistance to change and by

\*Corresponding author; 2020 West Main St., Durham, NC, 27708, USA; Phone: 919-613-4538, leah.richmondakerd@duke.edu. This paper was presented as a poster at the annual meeting of the American Psychopathological Association in Manhattan, NY; March 1-3, 2018.

The authors have no conflicts of interest to declare.

emotional and interpersonal lability. However, dual-harmers were not more likely than self-only harmers to have contact with mental health services.

**Conclusions**—Dual-harmers have self-control difficulties and are immersed in violence from a young age. A treatment- rather than punishment-oriented approach is indicated to meet these individuals' needs. Connecting self-harming adolescents with delinquency-reduction programs and transdiagnostic approaches that target self-regulation may reduce harmful behaviors. Preventing childhood maltreatment and implementing strategies to reduce victimization exposure could mitigate risk for both internalized and externalized violence.

---

## Introduction

Self-harm is the act of inflicting harm on oneself through the destruction of body tissue, ingestion of toxic substances, or other intentional acts (1). It can include behaviors enacted with and without suicidal intent (1). Self-harm is a leading risk factor for suicide and a major public-health problem (2–4). In the UK, where the present study is based, self-harm among adolescents is of particular concern. Between 2011–2014, the annual incidence of self-harm increased 68% among girls aged 13–16 (3). The healthcare cost associated with self-harm is estimated at £162 million yearly, with the highest costs incurred by individuals under age 18 (5). High self-harm-related costs are likewise observed in the United States (6).

Some individuals who self-harm also inflict harm on others (7–11). There may be important antecedents that increase the risk of violent crime among people who self-harm. Identifying such antecedents could guide early-years prevention strategies and the delivery of targeted interventions to reduce interpersonal violence. However, studies have primarily examined risk factors for self-harm among violent offenders, *after* they become clients of the criminal-justice system (12,13). To appropriately target assessments and treatments, clinicians need information to identify, among self-harming adolescents, who is at greatest risk for violent offending. This study aimed to characterize the risk factors that distinguish young people who engage in both self-harm and violent crime (“dual harmers”) from those who only self-harm, using data from a nationally-representative cohort of British children followed across the first two decades of life.

Our analysis capitalized on four design features. First, self-harm was assessed across adolescence and violent crime was assessed through age 22 using police records and self-reports. This allowed us to test for an association between self-harm and violent crime during the period when self-harm debuts (14) and offending peaks (15).

Second, because the cohort comprises twins, we could conduct a co-twin-control analysis among pairs discordant for self-harm, to test if the sibling who self-harmed was more likely to offend than their sibling who did not self-harm. The same unmeasured risk factors that lead individuals to self-harm may also lead them to commit violent crime (16). By comparing twins who grow up in the same family, it is possible to isolate self-harm as an indicator of violent offending, independent of familial risks.

Third, the longitudinal design enabled assessment of risk factors that antedate self-harm and violent crime. We tested whether dual harmers were distinguished by low childhood self-

control, as problems in self-regulation are theorized to underlie both self-harm (14,17) and violent offending (15,18) and may be important targets for intervention. In addition, we examined three risk factors identified as salient predictors of self-harm or violent crime and severe psychopathology: maltreatment, childhood self-harm behavior, and family history of psychiatric disorder (1,15,19). In response to external review, we also evaluated three secondary risk factors: low IQ, depression, and anxiety.

Fourth, we assessed participants' self-harm features, clinical correlates, and life characteristics. This allowed us to draw a comprehensive picture of dual harmers' psychosocial functioning. We examined self-harm method and frequency, as these are indicators of severity (4,14,20). We characterized dual harmers' mental-health difficulties, experiences of adolescent victimization, and informant-reported personality functioning. Lastly, we evaluated their use of support services.

## Methods

### Participants

Participants were members of the Environmental Risk (E-Risk) Longitudinal Twin Study, a birth cohort of 2,232 British children drawn from a larger register of twins born in England and Wales in 1994-1995 (21). Details are reported elsewhere (22). The E-Risk sample was constructed in 1999-2000, when 1,116 families (93% of those eligible) with same-sex 5-year-old twins participated in home-visit assessments. This sample comprised 56% monozygotic and 44% dizygotic twin pairs; sex was evenly distributed within zygosity (49% male). Families were recruited to represent the UK population with newborns in the 1990s on the basis of residential location throughout England and Wales and mother's age. Teenaged mothers with twins were over-selected to replace high-risk families selectively lost to the register through non-response. Older mothers having twins via assisted reproduction were under-selected to avoid an excess of well-educated older mothers. The study sample represented the full range of socioeconomic conditions in the UK, as reflected in families' distribution on a neighborhood-level socioeconomic index (23): 25.6% of E-Risk families live in "wealthy achiever" neighborhoods compared to 25.3% nationwide; 5.3% vs. 11.6% live in "urban prosperity" neighborhoods; 29.6% vs. 26.9% live in "comfortably off" neighborhoods; 13.4% vs. 13.9% live in "moderate means" neighborhoods, and 26.1% vs. 20.7% live in "hard-pressed" neighborhoods. E-Risk underrepresents "urban prosperity" households because they are likely to be childless.

Follow-up home visits took place when study participants were aged 7 (98% participation), 10 (96%), 12 (96%), and 18 years (93% participation). Home visits at ages 5-12 assessed twin participants and their mothers; only twins were assessed at age 18. There were no differences between those who did and did not take part at age 18 on socioeconomic status assessed when the cohort was initially defined ( $\chi^2=0.86$ ,  $p=0.65$ ), age-5 IQ scores ( $t=0.98$ ,  $p=0.33$ ), or age-5 internalizing or externalizing behavior problems ( $t=0.40$ ,  $p=0.69$  and  $t=0.41$ ,  $p=0.68$ , respectively).

Each twin was assessed by a different interviewer. Data are supplemented by searches of official records and questionnaires that are mailed, as developmentally appropriate, to

teachers, and co-informants nominated by participants. The Joint South London and Maudsley and the Institute of Psychiatry Research Ethics Committee approved each study phase. Parents gave informed consent and twins gave assent between 5-12 years and then informed consent at age 18.

### Self-harm

At age 18, participants were asked about self-harm behavior since age 12, using a life-history calendar to aid recall. Age 12-to-18 equals secondary school in the UK, a meaningful developmental period for self-harm. Participants were asked, "Have you ever tried to hurt yourself, to cope with stress or emotional pain?" Individuals who endorsed self-harm were queried about methods. 10 behaviors were probed (e.g., cutting, burning, overdose), plus the option to describe any other way they had hurt themselves. Of 2,064 participants who provided self-harm data, 280 (13.6%) were positive. To assess self-harm frequency, we summed participants' responses concerning the number of times they had performed each behavior (median reported number of self-harm incidents=6.5).

### Violent crime

Official records of participants' criminal offending were obtained through UK Police National Computer record searches conducted in cooperation with the UK Ministry of Justice. Records include complete histories of cautions and convictions beginning at age 10, the age of criminal responsibility. Our data are complete through age 22. Violent offending was coded as a binary variable to reflect whether participants had been cautioned or convicted for a violent offense. 2,060 twins consented to search of their offending histories, of whom 106 (5.2%) had a record of a violent offense (Supplementary Table S1).

Violent offending was also assessed via computer questionnaire at age 18. Participants reported on past-year offending behaviors. Violent offenses were defined to include behaviors that involved the use of force or threat of force upon a victim (e.g., robbery, assault; Supplementary Table S2). Of 2,053 respondents with self-report data, 677 (33.0%) endorsed one or more violent behaviors and 338 (16.5%) endorsed two or more.

Respondents were coded as positive for violent crime if they had an official record of a violent crime and/or self-reported two or more violent offenses. A total of 398/2,051 (19.4%) participants met these criteria (Supplementary Text).

### Self- and other-harm typology

We categorized participants into three groups for analyses: individuals coded as negative for both self-harm and violent crime ("neither harmers";  $n=1,475$  [72.0%]), coded as positive for self-harm and negative for violent crime ("self-only harmers";  $n=177$  [8.6%]), and coded as positive for both self-harm and violent crime ("dual harmers";  $n=97$  [4.7%]).

We aimed to identify which adolescents, *among those who self-harm*, are most likely to commit violent crime. Therefore, self-only harmers were the comparison group of interest. However, we also conducted comparisons with adolescents who only commit violent crime ("other-only harmers";  $n=300$  [14.6%]).

### Childhood risk factors

We analyzed four prespecified and theory-driven childhood risk factors: low self-control, maltreatment by an adult, childhood self-harm behavior, and family history of psychiatric disorder (1,15,19,24) (Supplementary Table S3). We also collected information on caregiver- and teacher-reported self-regulation difficulties at age 12 (Supplementary Table S3). In response to suggestions from external reviewers, we analyzed three secondary childhood risk factors at age 12: low IQ, depression, and anxiety (Supplementary Table S3).

### Correlates of clinical importance

We collected information on correlates of dual-harm behavior at age 18. We analyzed correlates in three categories with relevance for clinical practice: *mental-health difficulties* (DSM-IV-based symptoms or diagnoses of PTSD, depression, psychosis, and substance-dependence); experiences of *adolescent victimization* (crime victimization, maltreatment, neglect, sexual victimization, family violence, internet/mobile-phone victimization, and peer/sibling victimization); and informant-reported *personality functioning* (Supplementary Table S3).

### Service use

At age 18, participants were queried regarding past-year treatment for emotional problems. Participants were asked whether they had used a range of services, including mental-health professionals, other supports (e.g., medical doctor, social services), and medication (Supplementary Table S3).

### Statistical Analysis

We used logistic regression to test for an association between self-harm and violent crime. We included an interaction term to test whether the association differed by sex. We used conditional logistic regression to test whether twins from discordant pairs who self-harmed were at excess risk for violent crime, relative to their co-twins who did not self-harm.

We used multinomial and binomial logistic regression to predict group membership from childhood risk factors. The binomial tests were of greatest interest, as we aimed to identify the antecedents that distinguished dual from self-only harmers.

We used chi-square tests to determine whether the dual and self-only harm groups differed in the proportion of individuals reporting high-frequency self-harm (greater than 50 incidents [75<sup>th</sup> percentile of the distribution]). We used regression to test whether dual harmers were distinguished by mental-health difficulties, victimization experiences, and personality functioning; and to compare dual and self-only harmers on service use. Groups were included as predictors, first as a set of binary dummy codes (with the neither-harm group specified as the reference category), and then as a two-level nominal variable (to compare risk between the dual-harm and self-only harm groups). We analyzed continuously-distributed outcomes using ordinary least squares. We analyzed binary outcomes using logistic regression.

Analyses were conducted using SAS version 9.4 (SAS Institute Inc., Cary, NC). We corrected all analyses (except the twin-discordance analysis) for the non-independence of twin observations using survey analysis procedures. Data were treated as clustered, with the family number for each twin pair specified as the clustering variable. Analyses in which men and women were combined were adjusted for sex. Analyses were limited to individuals with complete data for self-harm and violent crime ( $n=2,049$ ); no data were imputed.

## Results

Of the 2,232 participants in the original cohort, 2,066 (92.6%) were interviewed at age 18, of whom 2,049 (99.2%) had data for both self-harm and violent crime (970 [47.3%] male). Of the 2,049 participants included in analyses, 274 (13.4%) reported self-harm and 397 (19.4%) met criteria for violent crime.

### Is self-harm associated with violent crime in adolescence?

Self-harm was more prevalent among women than men ( $\chi^2_{(1)}=14.93$ ,  $p<0.001$ ) and violent crime was more prevalent among men than women ( $\chi^2_{(1)}=78.08$ ,  $p<0.0001$ ), but the relation between self-harm and violent offending was similar in both sexes: the odds of committing violent crime were over three times greater for adolescents who self-harmed than for those who did not (men: OR=3.77, 95% CI=2.46-5.78; women: OR=3.27, 95% CI=2.17-4.94; Supplementary Figure S1). Therefore, men and women were combined in analyses (but we controlled for sex; OR=3.50, 95% CI=2.61-4.70). The association remained significant when only police records for violent crime were used (OR=3.26, 95% CI=2.08-5.12) and only self-reports were used (OR=3.50, 95% CI=2.57-4.76), indicating that findings do not simply reflect common method variance.

### Is the association between self-harm and violent crime explained by familial risk factors?

Twins who self-harmed were more likely to commit violent crime than their co-twins who did not self-harm (dizygotic twins: OR=2.57, 95% CI=1.07-6.16; genetically-identical monozygotic twins: OR=4.00, 95% CI=1.34-11.97; Supplementary Figure S2), indicating that the relation between self-harm and violent offending could not be entirely explained by familial risk factors (genetics or rearing environment).

### Do childhood risk factors distinguish dual from self-only harmers?

Analyses of primary risk factors showed that low childhood self-control and maltreatment predicted increased odds of being a dual versus a self-only harmer (self-control: OR=1.82, 95% CI=1.35-2.45; maltreatment: OR=2.46, 95% CI=1.10-5.51; Table 1). Together, the four primary risk factors predicted membership in the dual-harm relative to the self-only harm group with high accuracy (AUC=0.75, 95% CI=0.69-0.82, indicating a large effect (25) that requires out-of-sample replication (Supplementary Text)).

Analyses of secondary risk factors indicated that higher childhood IQ predicted decreased odds of being a dual versus a self-only harmer (OR=0.98, 95% CI=0.96-0.996; Table 1). Dual harmers did not differ from self-only harmers in their rates of childhood depression or anxiety.

### Are dual harmers' self-regulation difficulties observable across settings?

Dual harmers' self-regulation difficulties were observable across settings. Children rated by caregivers and teachers as having more self-regulation difficulties were more likely to be in the dual-harm than the self-only harm group as adolescents (caregiver's scale-score: OR=1.41, 95% CI=1.14-1.74; teacher's scale-score: OR=1.56, 95% CI=1.15-2.13; Figure 1).

### Do clinical features and life characteristics distinguish dual from self-only harmers?

Dual and self-only harmers reported similar rates of high-frequency self-harm (greater than 50 incidents: dual-harm=26.6%, self-only harm=24.6%;  $\chi^2_{(1)}=0.13, p=0.72$ ). Given the small sample sizes for some self-harm methods, we did not conduct tests of group differences for each method. However, inspection of Figure 2a suggests dual harmers exhibited higher-lethality behaviors (hanging, drowning) and aggressive acts (hitting oneself/an object, banging one's head against a wall), while self-only harmers tended to engage in lower-lethality methods (cutting, scratching).

Dual harmers did not differ from self-only harmers in their risk of developing PTSD or depression. However, they were distinguished by a higher prevalence of psychotic symptoms (OR=2.35, 95% CI=1.11-4.95). They were also more likely to meet criteria for alcohol dependence (OR=3.29, 95% CI=1.65-6.57) and cannabis dependence (OR=4.31, 95% CI=1.91-9.76; Table 2).

Dual harmers were more likely than self-only harmers to have experienced multiple types of victimization during adolescence (poly-victimization; OR=2.40, 95% CI=1.30-4.42; Supplementary Figure S3) as well as crime, maltreatment, neglect, and family violence (Table 2).

Dual harmers' personality styles were different from those of self-only harmers. Dual harmers were distinguished by greater resistance to change (lower Openness; Cohen's  $d=-0.41$ ), poorer impulse-control (lower Conscientiousness;  $d=-0.63$ ), and more aggressive/rude behavior (lower Agreeableness;  $d=-0.46$ ). They were more outgoing (higher in Extraversion); however, the effect size was modest ( $d=0.15$ ; Figure 2b; Supplementary Table S4). Both dual and self-only harmers were more easily distressed (higher in Neuroticism) and were lower in Conscientiousness and Agreeableness than neither harmers.

Despite their elevated rates of psychiatric comorbidity and difficult life experiences, dual harmers were not more likely than self-only harmers to be in contact with mental-health professionals (psychiatrists or psychologists/counsellors/psychotherapists) or other support services (Figure 3).

### Comparisons with other-only harmers

Compared to participants who committed violent crime only, dual harmers exhibited higher rates of childhood self-harm and childhood depression; had higher rates of all adolescent mental-health difficulties; were more likely to have experienced poly-victimization and nearly all types of victimization; and were lower in Conscientiousness and higher in Neuroticism (Supplementary Tables S5-S7).

## Discussion

This study shows that self-harm and violent crime co-occur in a longitudinal, population-representative contemporary cohort of British twins. The association is evident for police records and self-reports of offending. This finding is consistent with research employing population-based samples from other countries (7–10).

This study advances knowledge in five ways. First, using a co-twin-control design, we showed that the relation between self-harm and violent crime is not solely attributable to shared genetic risk or family background; self-harm itself may be an indicator of violence against others.

Second, we demonstrated that dual harmers are distinguished from self-only harmers by poor childhood self-control, including deficits in executive functioning as indicated by lower childhood IQ. Prospective assessment enabled measurement of self-control, cognitive ability, and other antecedents prior to the onset of self-harm and offending and ensured there were no ascertainment or recall biases. Moreover, dual harmers' self-regulation difficulties were reported by multiple informants, suggesting this early-emerging risk factor is observable across settings. In addition to their experiences of childhood dysregulation, dual harmers were characterized in adolescence by a triad of personality features that typifies emotional and interpersonal lability: low Conscientiousness, low Agreeableness, and high Neuroticism (26). (Dual and self-only harmers did not differ on Neuroticism, but both groups were elevated on this trait). Apparently, dual harmers' self-control difficulties are a stable core feature of their personalities.

Third, we showed that dual harmers are differentiated from self-only harmers by a history of childhood maltreatment. Further, dual harmers were more likely to be exposed to adolescent victimization. More than 80% of dual harmers had experienced at least one type of victimization, and one-third had experienced poly-victimization. These findings signal a need for primary and secondary preventive strategies to reduce continuity in victimization among individuals at risk for dual-harm behavior.

Fourth, we found that dual harmers are distinguished from self-only harmers by higher rates of psychotic symptoms, alcohol dependence, and cannabis dependence. A prior analysis (7) did not observe differences in risk for cannabis-related problems between dual and self-only harmers. However, their study employed a retrospective survey of adults and DSM-5-based lifetime diagnoses. Ours is the first study, to our knowledge, to test these associations within a prospective sample and demonstrate the role of psychosis in the self/other harm typology. Dual harmers suffer significant psychiatric comorbidity; comprehensive diagnostic assessment is needed to appropriately target interventions within this population.

Lastly, we found that dual harmers were not more likely than self-only harmers to encounter mental-health services. Recent UK-based data (3,27) suggest long waiting lists and high thresholds in accessing treatment, and similar challenges exist in the United States (28). Research on hospital- and community-based youth violence-prevention services identifies mistrust of authorities as a barrier to treatment engagement (29). Dual harmers' psychosocial



difficulties and prior experiences with the juvenile-justice system may impede service uptake.

This study has limitations. First, the sample comprised twins, and results may not generalize to singletons. However, the prevalences of antisocial behavior and mental-health problems are similar for twins and singletons (30,31), and the association between self-harm and violent crime has been documented in non-twin samples (7–10). Second, participants were followed only to the beginning of young adulthood. Future research will determine whether findings pertain to older age groups. Third, results may vary with historical and cross-national differences in crime-control policy. Fourth, findings concerning risk factors require replication. However, primary antecedents were selected based on prior theoretical and empirical evidence, increasing likelihood of replication. Fifth, our co-twin-control analyses included a rather small number of “informative cases” (pairs discordant for violent offending). Results will need to be replicated in samples with a higher prevalence of discordant pairs. Sixth, we designed our assessments of self-harm and violent offending consistent with recommendations for best practice. However, differences in the types of assessment methods used across constructs may have impacted our results. Finally, we are limited in our ability to infer causality. Assessment of self-harm and crime spanned much of the same period. Further, within-twin-pair associations between self-harm and violent offending may be confounded by twin-specific environmental differences. Additionally, our research can only support low childhood self-control, low IQ, and maltreatment as indicators of risk for dual-harm behavior, not necessarily indicators of causation. Establishing whether associations are causal, however, is secondary to this study’s primary aim of informing mental-health treatment.

This study has a number of implications. First, given the robust link between self-harm and harm toward others, research about self-harm—even when conducted within community samples, not only clinical or forensic settings—should collect data on interpersonal violence. Second, theoretical models of self-harm can generate testable hypotheses for research on dual-harm behavior. Many theories propose that self-harm serves an emotion-regulatory function (14,17). Recently-developed models hold that several proximal risk factors lower perceived barriers to initiating self-harm; however, its affective benefits are its primary maintaining factor (32,33). These benefits may lower barriers to engagement in other harmful behaviors, including violent crime. Although our study did not directly test this question, our findings support further investigation of self-regulation as a mediating factor. The interpersonal theory of suicide (34) posits that self-harm increases risk for suicide by habituating individuals to the fear and pain associated with harming oneself. Such habituation may also increase risk for harming others, or occur through repeated aggression toward others. Future research concerning the mechanisms underlying dual harm presents opportunities for interdisciplinary collaboration. Self-harm and offending have largely been studied separately within the fields of psychology, psychiatry, and criminology; collaborative cross-talk can inform more effective preventions and treatments.

Third, clinical guidelines recommend evaluation of risk for suicide following self-harm (35,36). The present results also recommend assessment of risk for violence toward others, particularly when the clinical picture comprises relevant antecedents and correlates. Further,

dual-harming prisoners should be closely monitored for suicidal behavior. Fourth, improving self-control among self-harmers could help prevent violent crime. Self-control training has been shown to reduce delinquency (37) and could be delivered to patients who self-harm. In addition, dual harmers often experience psychiatric comorbidity. Transdiagnostic approaches that target self-regulation (e.g., mindfulness-based approaches for emotion-regulation) may reduce harmful behaviors and co-occurring psychopathology (38). Lastly, our findings recommend application of available interventions to prevent childhood maltreatment (39) as well as implementation of exposure-reduction strategies (e.g., education on self-protective measures) and evidence-based programs (40,41) to prevent revictimization in adolescence. Dual harmers have been immersed in violence from a young age; a treatment- rather than punishment-oriented approach is indicated to meet these individuals' needs. Such an approach could also yield substantial reductions in violent offending: one in four other-harming adolescents was a dual harmer in this population-representative study.

There exists a pressing demand for improvements in adolescent mental-health services (42) and psychological treatment research (43,44). Our analysis responds to this demand by identifying several opportunities for early-years prevention and intervention science (43,44). Connecting vulnerable adolescents with delinquency-reduction programs that target self-control, preventing maltreatment and victimization, and improving children's self-regulation abilities could significantly reduce the health and social burden attributable to internalized and externalized violence.

## Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

## Acknowledgments

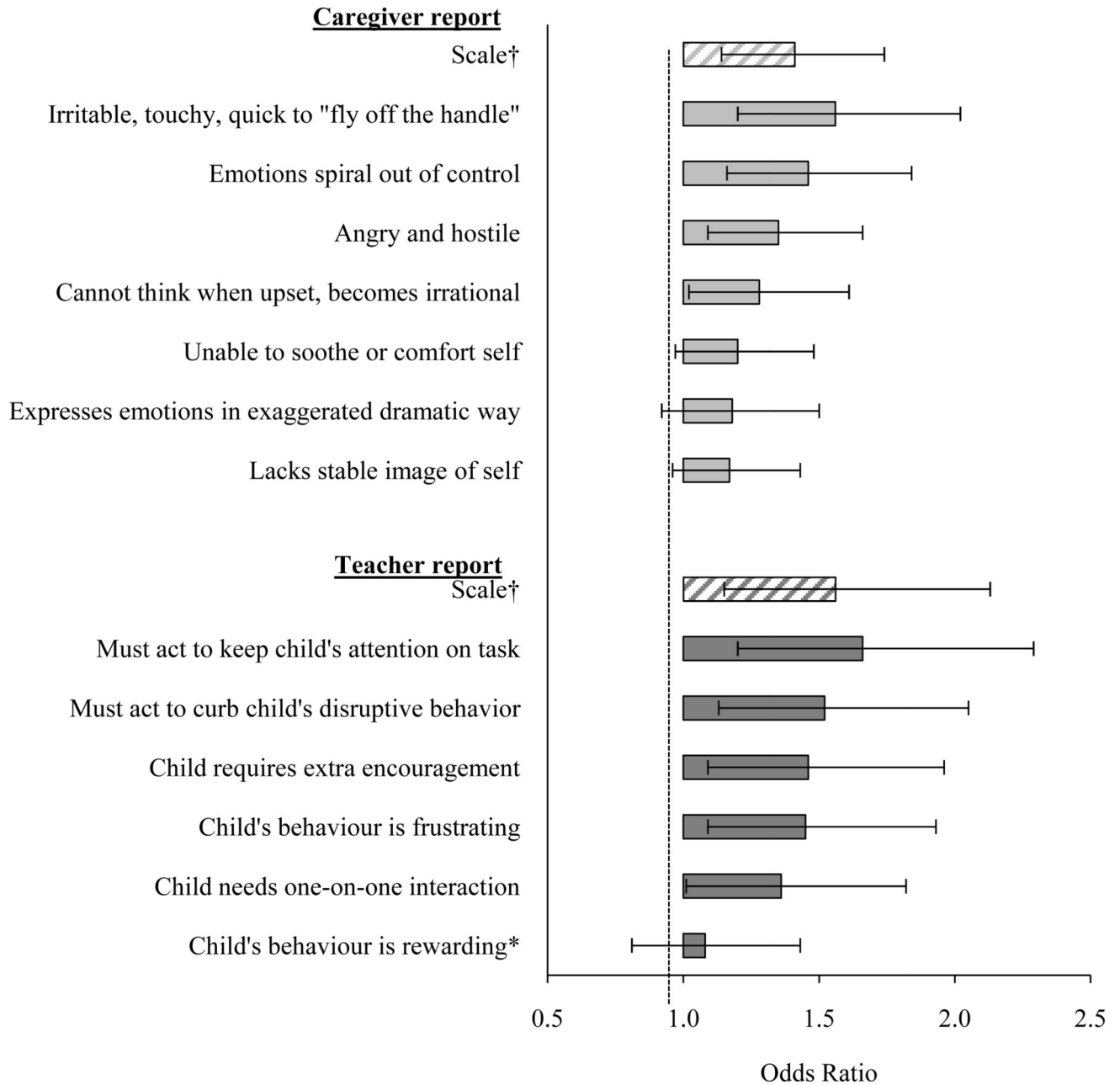
The E-Risk Study is funded by the Medical Research Council (grant G1002190). Additional support was provided by National Institute on Child Health and Development (NICHD) grant HD077482, the Jacobs Foundation and the Avielle Foundation. Dr. Richmond-Rakerd was supported by a postdoctoral fellowship provided by the NICHD (T32-HD007376) through the Center for Developmental Science at the University of North Carolina-Chapel Hill. We are grateful to the study mothers and fathers, the twins and the twins' teachers for their participation. Our thanks to members of the E-Risk team for their dedication, hard work and insights.

## References

1. Hawton K, Saunders KE, O'Connor RC. Self-harm and suicide in adolescents. *Lancet*. 2012; 379:2373–2382. [PubMed: 22726518]
2. Hawton K, Harriss L. Deliberate self-harm in young people: characteristics and subsequent mortality in a 20-year cohort of patients presenting to hospital. *J Clin Psychiatry*. 2007; 68:1574–1583. [PubMed: 17960975]
3. Morgan C, Webb RT, Carr MJ, et al. Incidence, clinical management, and mortality risk following self harm among children and adolescents: cohort study in primary care. *BMJ*. 2017; 359:j4351. [PubMed: 29046278]
4. Olfson M, Wall M, Wang S, Crystal S, Gerhard T, Blanco C. Suicide following deliberate self-harm. *Am J Psychiatry*. 2017; 174:765–774. [PubMed: 28320225]
5. Tsiachristas A, McDaid D, Casey D, et al. General hospital costs in England of medical and psychiatric care for patients who self harm: a retrospective analysis. *Lancet Psychiatry*. 2017; 4:759–767. [PubMed: 28890321]

6. Shepard DS, Gurewich D, Lwin AK, Reed GA, Silverman MM. Suicide and suicidal attempts in the United States: costs and policy implications. *Suicide Life-Threat*. 2016; 46:352–362.
7. Harford TC, Chen CM, Kerridge BT, Grant BF. Self- and other-directed forms of violence and their relationship with lifetime *DSM-5* psychiatric disorders: results from the National Epidemiologic Survey on Alcohol and Related Conditions-III (NESARC-III). *Psychiatry Res*. 2018; 262:384–392. [PubMed: 28939392]
8. Vaughn MG, Salas-Wright CP, DeLisi M, Larson M. Deliberate self-harm and the nexus of violence, victimization, and mental health problems in the United States. *Psychiatry Res*. 2015; 225:588–595. [PubMed: 25500323]
9. Sahlin H, Kuja-Halkola R, Bjureberg J, et al. Association between deliberate self-harm and violent criminality. *JAMA Psychiatry*. 2017; 74:615–621. [PubMed: 28384711]
10. Webb RT, Antonsen S, Carr MJ, Appleby L, Pedersen CB, Mok PLH. Self-harm and violent criminality among young people who experienced trauma-related hospital admission during childhood: a Danish national cohort study. *Lancet Public Health*. 2017; 2:e314–e322. [PubMed: 28736760]
11. O'Donnell O, House A, Waterman M. The co-occurrence of aggression and self-harm: systematic literature review. *J Affect Disorders*. 2015:325–350. [PubMed: 25665494]
12. Laporte N, Ozolins A, Westling S, et al. Deliberate self-harm behavior among young violent offenders. *PLoS One*. 2017; 12:e0182258. [PubMed: 28817578]
13. Hawton K, Linsell L, Adeniji T, Sariaslan A, Fazel S. Self-harm in prisons in England and Wales: an epidemiological study of prevalence, risk factors, clustering, and subsequent suicide. *Lancet*. 2014; 383:1147–1154. [PubMed: 24351319]
14. Nock MK. Self-injury. *Annu Rev Clin Psychol*. 2010; 6:339–363. [PubMed: 20192787]
15. Farrington, DP. Origins of violent behavior over the life span *The Cambridge Handbook of Violent Behavior and Aggression*. 2nd Ed. Vazsonyi, AT, Flannery, DJ, DeLisi, M, editors. Cambridge, UK: Cambridge University Press; 2018.
16. Mok PL, Pedersen CB, Springate D, et al. Parental psychiatric disease and risks of attempted suicide and violent criminal offending in offspring: a population-based cohort study. *JAMA Psychiatry*. 2016; 73:1015–1022. [PubMed: 27580483]
17. Nock MK, Prinstein MJ. A functional approach to the assessment of self-mutilative behavior. *J Consult Clin Psych*. 2004; 72:885–890.
18. Sitnick SL, Shaw DS, Weaver CM, et al. Early childhood predictors of severe youth violence in low-income males. *Child Dev*. 2017; 88:27–40. [PubMed: 28042897]
19. Keyes KM, Eaton NR, Krueger RF, et al. Childhood maltreatment and the structure of common psychiatric disorders. *Br J Psychiatry*. 2012; 200:107–115. [PubMed: 22157798]
20. Anestis MD, Khazem LR, Law KC. How many times and how many ways: the impact of number of nonsuicidal self-injury methods on the relationship between nonsuicidal self-injury frequency and suicidal behavior. *Suicide Life-Threat*. 2015; 45:164–177.
21. Trouton A, Spinath F, Plomin R. Twins Early Development Study (TEDS): a multivariate, longitudinal genetic investigation of language, cognition and behavior problems in childhood. *Twin Res*. 2002; 5:444–448. [PubMed: 12537874]
22. Moffitt TE. E-Risk Study Team: Teen-aged mothers in contemporary Britain. *J Child Adolesc Psychiatry*. 2002; 43:727–742.
23. Odgers C, Caspi A, Russell M, Sampson R, Arseneault L, Moffitt TE. Supportive parenting mediates neighborhood socioeconomic disparities in children's antisocial behavior from ages 5 to 12. *Dev Psychopathol*. 2012; 24:705–721. [PubMed: 22781850]
24. Moffitt Arseneault L, Belsky D, et al. A gradient of childhood self-control predicts health, wealth, and public safety. *Proc Natl Acad Sci USA*. 2011; 108:2693–2698. [PubMed: 21262822]
25. Rice ME, Harris GT. Comparing effect sizes in follow-up studies: ROC area, Cohen's d, and r. *Law Hum Behav*. 2005; 29:615–620. [PubMed: 16254746]
26. DeYoung CG, Peterson JB, Higgins DM. Higher-order factors of the Big Five predict conformity: are there neuroses of health? *Pers Individ Dif*. 2002; 33:533–552.

27. O'Brien D, Harvey K, Howse J, Reardon T, Creswell C. Barriers to managing child and adolescent mental health problems: a systematic review of primary care practitioners' perceptions. *Br J Gen Pract.* 2016; 66:e693–e707. [PubMed: 27621291]
28. Institute of Medicine. *Transforming health care scheduling and access: getting to now.* Washington, DC: The National Academies Press; 2015.
29. Ilan-Clarke Y, Bunn A, DeMarco J, Bifulco A, Criddle J, Holdsworth G. Setting up a youth violence prevention project in a London hospital emergency department. *J Publ Ment Health.* 2013; 12:80–92.
30. Barnes JC, Boutwell BB. A demonstration of the generalizability of twin-based research on antisocial behavior. *Behav Genet.* 2013; 43:120–131. [PubMed: 23274656]
31. Gjone H, Nøvik TS. Parental ratings of behavior problems: a twin and general population comparison. *J Child Psychol Psychiatry.* 1995; 36:1213–1224. [PubMed: 8847381]
32. Hooley JM, Franklin JC. Why do people hurt themselves? A new conceptual model of nonsuicidal self-injury. *Clin Psychol Sci.* 2018; 6:428–451.
33. Franklin, JC, Nock, MK. Nonsuicidal self-injury and its relation to suicidal behavior. *The Oxford Handbook of Behavioral Emergencies and Crises.* Kleespies, P, editor. Oxford, UK: Oxford University Press; 2018.
34. Joiner, MT. *Why People Die by Suicide.* Boston, MA: Harvard University Press; 2005.
35. National Institute for Health Care Excellence. *Self-harm. NICE quality standard 34.* National Institute for Health Care Excellence; 2013 Jun.
36. Jacobs, DG, Baldessarini, RJ, Conwell, Y. , et al. Practice guideline for the assessment and treatment of patients with suicidal behaviors. *American Psychiatric Association Practice Guidelines for the Treatment of Psychiatric Disorders.* Arlington, VA: American Psychiatric Association; 2010.
37. Piquero AR, Jennings WG, Farrington DP, Diamond B, Gonzalez JMR. A meta-analysis update on the effectiveness of early self-control improvement programs to improve self-control and reduce delinquency. *J Exp Criminol.* 2016; 12:249–264.
38. Meier MA, Meier MH. Clinical implications of a general psychopathology factor: a cognitive-behavioral transdiagnostic group treatment for community mental health. *J Psychother Integration.* 2017; doi: 10.1037/int0000095
39. Casillas KL, Fauchier A, Derkash BT, Garrido EF. Implementation of evidence-based home visiting programs aimed at reducing child maltreatment: a meta-analytic review. *Child Abuse Negl.* 2016; 53:64–80. [PubMed: 26724823]
40. Ttofi MM, Farrington DP. Effectiveness of school-based programs to reduce bullying: a systematic and meta-analytic review. *J Exp Criminol.* 2011; 7:27–56.
41. Foshee VA, Bauman KE, Ennett ST, Linder F, Benefield T, Suchindran C. Assessing the long-term effects of the Safe Dates program and a booster in preventing and reducing adolescent dating violence victimization and perpetration. *Am J Public Health.* 2004; 94:619–624. [PubMed: 15054015]
42. Geulayov G, Casey D, McDonald KC, et al. Incidence of suicide, hospital-presenting non-fatal self-harm, and community-occurring non-fatal self-harm in adolescents in England (the iceberg model of self-harm): a retrospective study. *Lancet Psychiatry.* 2018; 5:167–174. [PubMed: 29246453]
43. Holmes EA, Ghaderi A, Harmer CJ, et al. The *Lancet Psychiatry* Commission on psychological treatments research in tomorrow's science. *Lancet Psychiatry.* 2018; 5:237–286. [PubMed: 29482764]
44. Weisz JR, Kuppens S, Ng MY, et al. What five decades of research tell us about the effects of youth psychological therapy: a multilevel meta-analysis and implications for science and practice. *Am Psychol.* 2017; 72:79–117. [PubMed: 28221063]



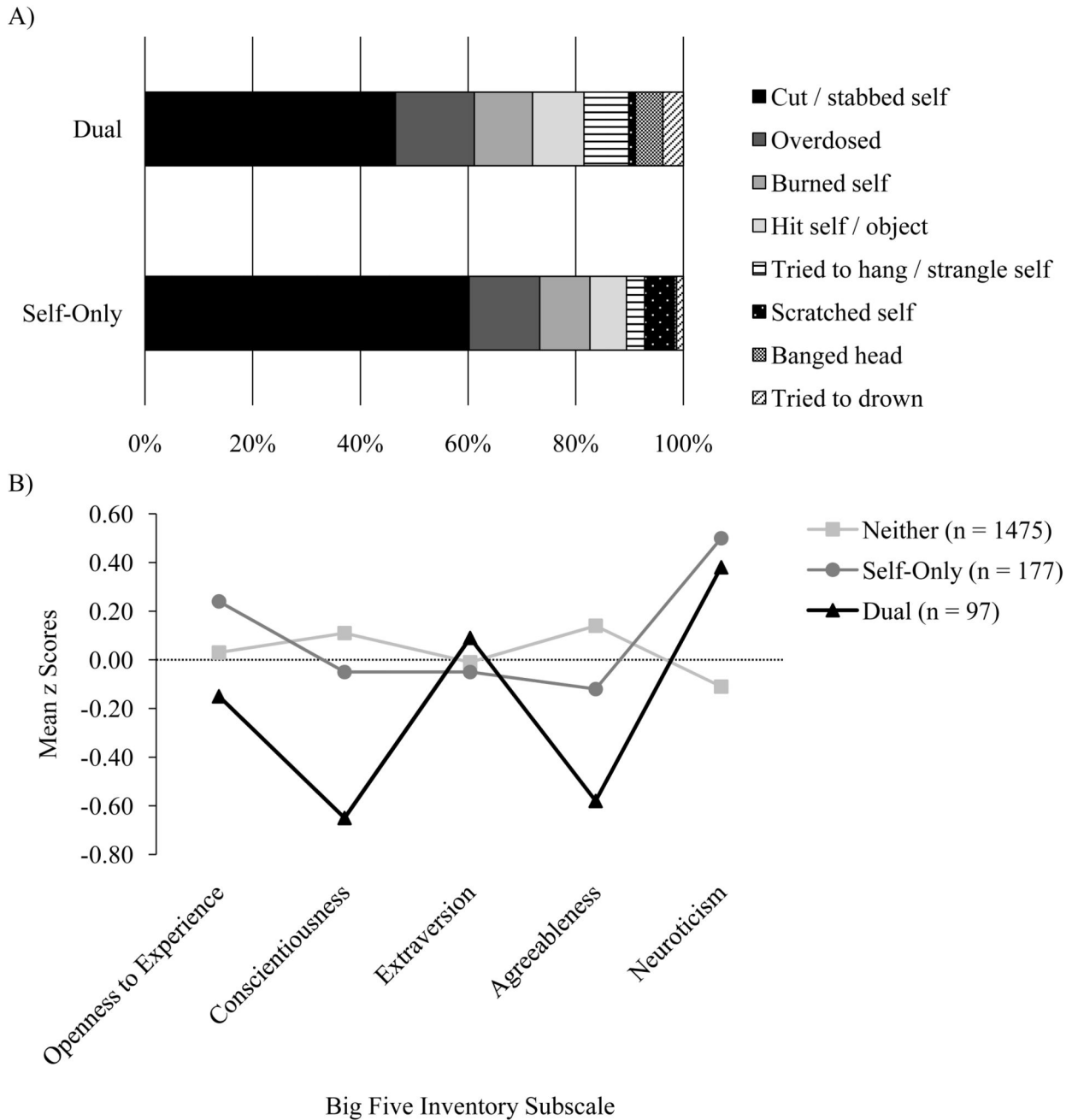
**Figure 1.** Lack of self-regulation across settings. Figure displays the odds of being in the dual-harm group versus the self-only harm group, as a function of caregiver reports of children’s self-regulation difficulties (top panel) and teacher reports of children’s self-regulation difficulties in the classroom (bottom panel).

Note. For each item pertaining to self-regulation within the classroom, teachers were asked to rate how frequently they needed to intervene with the child. Sum scales and individual items were standardized to have a mean of 0 and a standard deviation of 1. N = 265 for

caregiver reports and  $N = 215-216$  for teacher reports. Error bars are 95% confidence intervals.

† Sum scale of all items.

\* Responses to this item were reverse-scored.

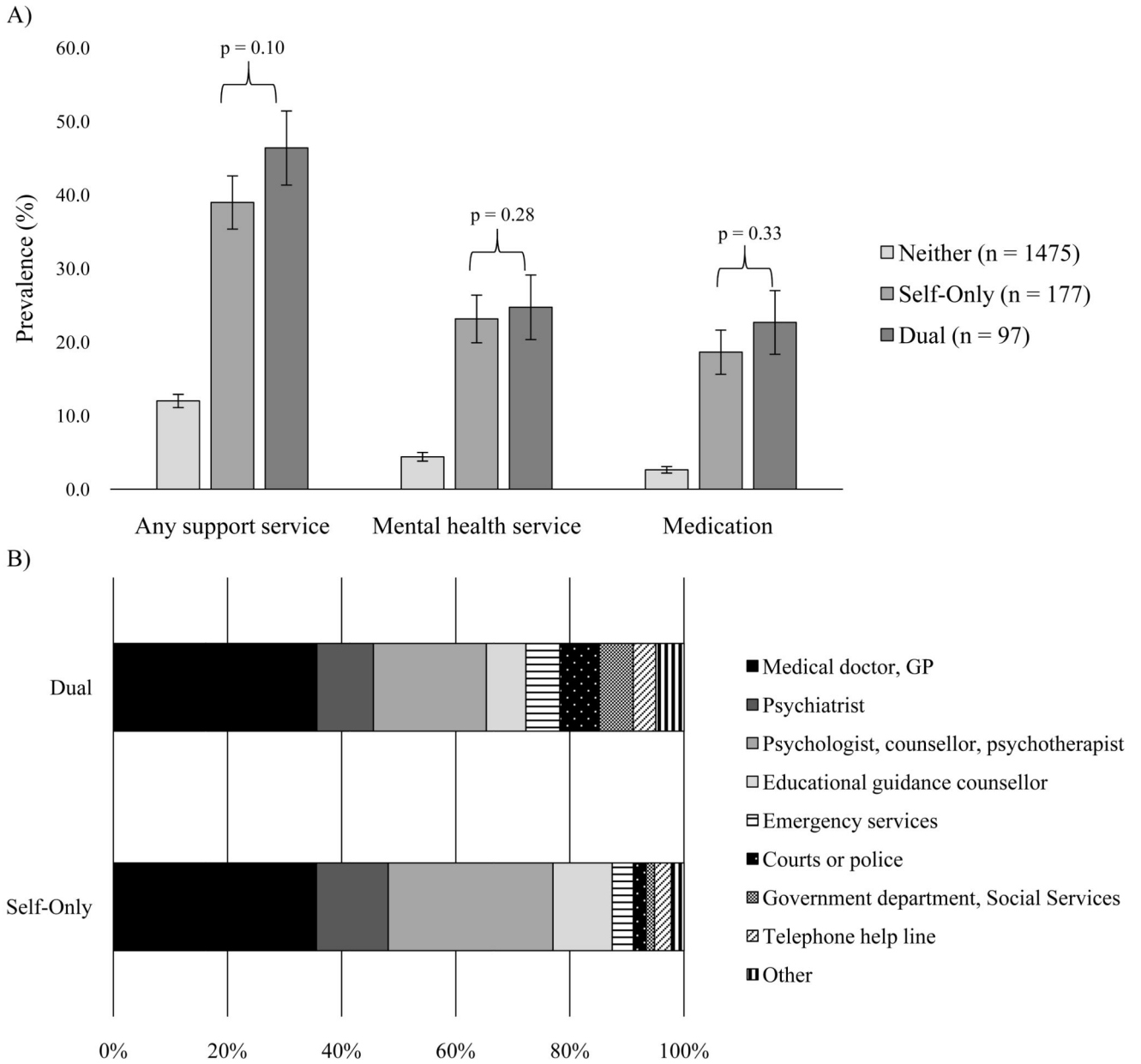


**Figure 2.** Comparing dual harmers and self-only harmers on clinical features. Panel A displays the proportion of 393 total reported self-harm behaviors attributable to different self-harm methods. Panel B displays Big Five Inventory profiles, provided by one to two informants who know the participants well, for each group.

Note. Totals in Panel A were derived by summing the number of individuals who endorsed each self-harm method. Dual harmers endorsed 157 behaviors. Self-only harmers endorsed 236 behaviors. Participants were allowed to endorse multiple behaviors and could be

included more than once within the total. Only behaviors endorsed by at least 3% of the sample are depicted. In Panel B, of the 1749 participants, 1730 (98.9%) had personality data.





**Figure 3.**  
**Comparing dual harriers and self-only harriers on past-year service use at age 18.**  
**Panel A displays the prevalence of any service use, mental health service use, and medication use across the groups. Panel B displays the proportion of 236 total reported services used attributable to different service types.**

Note. Totals in Panel B were derived by summing the number of individuals who reported using each service type in the past year. Dual harriers reported using 101 services. Self-only harriers reported using 135 services. Participants were allowed to report multiple services

and could be included more than once within the total. Only services reported by at least 3% of the sample are depicted. Error bars are robust standard errors.

**Table 1**  
**Predicting dual- versus self-only harm status from childhood risk factors.**

Childhood Risk Factor	Self- and Other-Harm Status						Dual (D) n = 97	
	Neither (N) n = 1475		Self-Only (S) n = 177		Mean or No. SD or %		Mean or No. SD or %	
	Mean or No.	SD or %	Mean or No.	SD or %	Mean or No.	SD or %	Mean or No.	SD or %
<i>Primary risk factors<sup>c</sup></i>								
Low self-control (Mean, SD) <sup>d,e</sup>	-0.19	0.94	-0.03	0.89	0.70	1.08		
Maltreatment (No., %)	58	3.9%	14	7.9%	18	18.6%		
Childhood self-harm (No., %)	39 / 1419	2.8%	17 / 172	9.9%	13 / 93	14.0%		
Family psychiatric history (Mean, SD) <sup>f,g</sup>	0.35	0.26	0.45	0.31	0.45	0.26		
<i>Secondary risk factors<sup>h</sup></i>								
IQ (Mean, SD) <sup>i</sup>	100.15	15.08	98.06	15.23	91.94	16.88		
Depression (No., %)	26 / 1441	1.8%	14 / 171	8.2%	14 / 93	15.1%		
Anxiety (No., %)	74 / 1442	5.1%	19 / 171	11.1%	10 / 93	10.8%		
							<b>S vs. N<sup>a</sup></b>	<b>D vs. N<sup>a</sup></b>
							<b>Odds Ratio</b>	<b>Odds Ratio</b>
							<b>95% CI</b>	<b>95% CI</b>
							<b>1.16-1.65</b>	<b>1.90-2.95</b>
							<b>2.36</b>	<b>2.36</b>
							<b>1.09-4.76</b>	<b>2.91-9.76</b>
							<b>5.33</b>	<b>5.33</b>
							<b>2.18-7.54</b>	<b>2.90-10.72</b>
							<b>5.58</b>	<b>5.58</b>
							<b>2.06-7.81</b>	<b>1.72-7.48</b>
							<b>3.59</b>	<b>3.59</b>
							<b>0.98-1.01</b>	<b>0.95-0.98</b>
							<b>0.97</b>	<b>0.97</b>
							<b>2.52-9.99</b>	<b>4.73-18.76</b>
							<b>9.42</b>	<b>9.42</b>
							<b>1.19-3.60</b>	<b>1.21-4.99</b>
							<b>2.46</b>	<b>2.46</b>
							<b>1.82</b>	<b>1.82</b>
							<b>1.35-2.45</b>	<b>1.35-2.45</b>
							<b>2.46</b>	<b>2.46</b>
							<b>1.10-5.51</b>	<b>1.10-5.51</b>
							<b>1.37</b>	<b>1.37</b>
							<b>0.63-2.96</b>	<b>0.63-2.96</b>
							<b>0.73</b>	<b>0.73</b>
							<b>0.29-1.87</b>	<b>0.29-1.87</b>
							<b>0.98</b>	<b>0.98</b>
							<b>0.96-0.996</b>	<b>0.96-0.996</b>
							<b>1.94</b>	<b>1.94</b>
							<b>0.84-4.48</b>	<b>0.84-4.48</b>
							<b>1.07</b>	<b>1.07</b>
							<b>0.42-2.67</b>	<b>0.42-2.67</b>

Note. Measures were assessed between ages 5-12. The number of participants with data is reported when lower than the group sample size. All regression models controlled for sex. Bolded estimates indicate a significant difference between the dual-harm and self-only harm groups, which was the test of interest.

<sup>a</sup>Odds ratios are from multinomial logistic regression models.

<sup>b</sup>Odds ratios are from binomial logistic regression models.

<sup>c</sup>Primary risk factors were prespecified.

<sup>d</sup>The self-control factor score was standardized to have a mean of 0 and a standard deviation of 1.

<sup>e</sup>Higher scores indicate lower levels of self-control (more self-control difficulties).

<sup>f</sup>Indicates the proportion of a participant's relatives with a psychiatric disorder.

<sup>g</sup>N = 1441, 171, and 93 participants in the neither-harm, self-only harm, and dual-harm groups, respectively, had data on family psychiatric history.

<sup>h</sup>Secondary risk factors were added in response to peer review.

<sup>i</sup>N = 1442, 171, and 93 participants in the neither-harm, self-only harm, and dual-harm groups, respectively, had data on IQ.

**Table 2**  
**Comparing dual- and self-only harm groups on correlates of clinical importance**

Self- and Other-Harm Status												
Neither (N) n = 475 <sup>a</sup>			Self-Only (S) n = 177 <sup>b</sup>			Dual (D) n = 97 <sup>c</sup>			D vs. S			
	No.	%	No.	%	No.	%	No.	%	Odds Ratio	95% CI	Odds Ratio	95% CI
<b>Mental Health Difficulties</b>												
PTSD	26	1.8	24	13.6	13	13.5			7.67	4.10-14.34	9.90	4.86-20.14
Depression	182	12.4	95	54.0	58	59.8			7.65	5.34-10.95	11.76	7.58-18.26
Psychotic symptoms	18	1.2	16	9.0	16	16.5			7.63	3.88-15.01	16.63	7.98-34.64
Alcohol dependence	144	9.8	23	13.0	33	34.4			1.47	0.88-2.44	4.69	2.93-7.52
Cannabis dependence	19	1.3	11	6.2	25	25.8			5.93	2.55-13.76	25.11	12.56-50.19
<b>Victimization Experiences<sup>d</sup></b>												
Poly-victimization <sup>e</sup>	36	2.4	38	21.5	32	33.3			9.91	6.05-16.25	22.09	12.51-39.03
Conventional crime	179	12.1	59	33.3	54	55.7			4.08	2.82-5.91	8.77	5.72-13.44
Maltreatment	15	1.0	17	9.6	20	20.6			10.13	4.79-21.45	25.63	11.86-55.43
Neglect	12	0.8	13	7.3	14	14.6			8.95	4.05-19.80	22.05	9.97-48.75
Sexual	7	0.5	25	14.1	15	15.6			27.94	11.62-67.18	52.17	20.52-132.68
Family	118	8.0	41	23.2	33	34.4			3.39	2.24-5.13	6.12	3.79-9.89
Internet	69	4.7	24	13.6	15	15.6			2.60	1.57-4.31	4.72	2.46-9.09
Peer	152	10.3	64	36.2	36	37.5			4.54	3.17-6.50	5.65	3.54-9.02

Note. All measures were assessed at age 18. All regression models controlled for sex. Bolded estimates indicate a significant difference between the dual-harm and self-only harm groups, which was the test of interest. Prevalence estimates are derived using the number of participants with data for the measure; this was occasionally slightly lower than the group sample size.

<sup>a</sup>Number of participants with data ranged from 1473-1475.

<sup>b</sup>Number of participants with data ranged from 176-177.

<sup>c</sup>Number of participants with data ranged from 96-97.

<sup>d</sup>Prevalences for victimization experiences indicate the percentage of individuals who reported a severe level of exposure.

<sup>e</sup>Poly-victimization = 3 or more types of victimization.