



Childhood adversities and suicidal thoughts and behaviors among first-year college students: results from the WMH-ICS initiative

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Abstract

Purpose To investigate the associations of childhood adversities (CAs) with lifetime onset and transitions across suicidal thoughts and behaviors (STB) among incoming college students.

Methods Web-based self-report surveys administered to 20,842 incoming college students from nine countries (response rate 45.6%) assessed lifetime suicidal ideation, plans and attempts along with seven CAs: parental psychopathology, three types of abuse (emotional, physical, sexual), neglect, bully victimization, and dating violence. Logistic regression estimated individual- and population-level associations using CA operationalizations for type, number, severity, and frequency.

Results Associations of CAs with lifetime ideation and the transition from ideation to plan were best explained by the exact number of CA types (OR range 1.32–52.30 for exactly two to seven CAs). Associations of CAs with a transition to attempts were best explained by the frequency of specific CA types (scaled 0–4). Attempts among ideators with a plan were significantly associated with all seven CAs (OR range 1.16–1.59) and associations remained significant in adjusted analyses with the frequency of sexual abuse (OR = 1.42), dating violence (OR = 1.29), physical abuse (OR = 1.17) and bully victimization (OR = 1.17). Attempts among ideators without plan were significantly associated with frequency of emotional abuse (OR = 1.29) and bully victimization (OR = 1.36), in both unadjusted and adjusted analyses. Population attributable risk simulations found 63% of ideation and 30–47% of STB transitions associated with CAs.

Conclusion Early-life adversities represent a potentially important driver in explaining lifetime STB among incoming college students. Comprehensive intervention strategies that prevent or reduce the negative effects of CAs may reduce subsequent onset of STB.

Keywords Childhood adversity · Suicidal ideation · Suicide attempt · College students · Multivariate models · Population-attributable risk

Introduction

The proportion of young people entering postsecondary education increased three to fivefold over the 1970–2014 period [1], now reaching approximately 65% in developed countries

[2]. Up to one-third (32.7%) of these young people experience suicidal thoughts or behaviors (STB) before entering college [3, 4]. STB are conceptualized as a severity spectrum with increasing suicidal intent, ranging from suicidal ideation (i.e., thoughts of engaging in behavior intended to end one's life) to suicide plan (i.e., formulation of a specific method through which one intends to die), and ultimately a suicide attempt (i.e., engagement in potentially self-injurious behavior with at least some intent to die) [5]. Early-life STB are associated with reduced academic performance [6], college drop-out [7], and a wide range of adverse outcomes in later life, such as persistent physical and mental health

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problems, unemployment, interpersonal difficulties, and low quality of life [8]. To inform efforts at preventive intervention, more insight is needed into risk factors for youth STB and transitions between STB. One well-established risk domain consists of childhood adversities (CAs) such as neglect, emotional abuse, physical abuse, and sexual abuse. Recent meta-analyses showed that odds of suicidal ideation and suicide attempts are 2.7 and 2.1 times higher, respectively, among people who experienced child abuse, with odds of suicide attempts especially elevated among those who experienced sexual abuse (OR = 3.2) and complex abuse (OR = 5.2) [9, 10]. Out of 23 health outcomes, suicide attempts were most strongly related to adverse childhood experiences [11], and across the lifespan, these associations are strongest before age nineteen [12].

Four important shortcomings limit our understanding of the association between CAs and adolescent STB [13]. First, recent meta-analyses [9, 10] showed that CA research to date focused mainly on suicidal ideation and suicide attempt as the outcomes, with very few studies considering suicide plan and fewer yet considering the predictors of transitions. While a few previous studies found that specific family victimization experiences, such as sexual, physical and emotional abuse are potentially important in differentiating between ideation and planned or unplanned attempts [14–16], much less research has examined the role of CAs in predicting specific transitions between STB along the severity spectrum, i.e., the transition from ideation to plans and from ideation or plans to attempts. Second, CA exposure is most often operationalized as either a simple count of CA types or as including a (limited) number of CAs in multivariate models [17, 18]. While this approach offers a simple approach in dealing with the effect of cumulative CA exposures, research on the possibility of more complex associations linking CAs with STB is underdeveloped [13]. No previous study considered a wider range of CA operationalizations to determine which is best in predicting STB. Third, CA studies traditionally focus on family victimization experiences, such as child abuse and neglect, and especially sexual abuse [19, 20]. Fewer studies have considered peer victimization, such as bullying and dating violence [21–23], despite evidence that including such experiences in CA assessment can improve the prediction of mental health outcomes [24]. Fourth, few previous studies provided insights into the extent to which STB might be reduced by targeting CAs for preventive or ameliorative interventions, although the few studies that estimated population-level associations suggest that more than half of suicide attempts among adults [25] and up to 80% [26, 27] among late adolescents are associated with childhood maltreatment.

Here we use data from the WHO World Mental Health Surveys International College Student Initiative (WMH-ICS) [28], a coordinated series of epidemiological

needs-assessment surveys with first-year students from 24 colleges located in nine countries, to address the above limitations. We do this by examining associations of retrospectively reported CAs with STB (i.e., ideation, plans, and attempts) and STB transitions (i.e., from ideation to plans and from ideation or plans to attempts) using a series of multivariate models assessing the associations of seven CA types with the outcome using a range of model specifications for CA type, number, severity, and frequency. We calculate population attributable risk proportions (PARPs) to estimate the proportions of STB that might be averted by intervention to prevent or ameliorate the effects of CAs on STB. One previous report using data from eight countries part of the WMH-ICS Initiative found considerable rates of STB (32.7% lifetime ideation; 4.3% lifetime attempts). Sociodemographic correlates were cross-nationally consistent, with associations being strongest for those students with non-heterosexual orientation (OR range 3.3–7.9) [3]. We build on those earlier results as a starting point for the current investigation.

Method

Sampling procedures

An overview of the sampling procedures in each country is provided in Supplementary Table 1. The initial round of WMH-ICS surveys was administered in a convenience sample of 24 colleges and universities (henceforth referred to as “colleges”) in seven high-income countries (Australia, Belgium, Germany, Hong Kong, Northern Ireland, Spain, and the United States), and two upper middle-income countries (Mexico and South Africa). Web-based self-report questionnaires were administered to a representative sample or census of first-year students in each college. A total of 21,369 questionnaires were completed. The weighted (by achieved sample size) mean response rate across surveys was 45.6%. All colleges implemented conditional incentives (i.e., incentives received conditional on participation in the survey) in the final stages of refusal conversion to increase response among hard-to-reach students. Incentives included non-monetary incentives (e.g., movie passes or participation in a draw to win an iPad) as well as monetary incentives (e.g., HKD100 [= USD 12.8], store credit coupons, gift cards). Informed consent was obtained before administering the questionnaires in all countries, and included minimally the study or project title, the objectives of the study or project, and the opportunity to withdraw consent or data from the study. All participants were provided with coordinates of local mental health resources in case they experienced any mental distress related to survey participation. Details about ethics approval for the WHO WMH-ICS Initiative countries

is available online [29]. Compared to earlier reports (e.g., [3] on different research questions), the current sample includes five additional colleges, one additional country (Hong-Kong, China), and $n = 6998$ additional students. The sample for the analyses reported here was restricted to students identifying as male or female who were full-time students ($n = 20,842$). Part-time students were excluded because most of them came from the Australian sample and were older, full-time employed people.

Measures

Suicidal thoughts and behaviors

A modified version of the Columbia Suicidal Severity Rating Scale [30] was used to assess lifetime STB, including suicidal ideation, suicide plans, and suicide attempts. STB transition rates were defined as the proportion of students with suicide plans among those with lifetime ideation, attempts among those with lifetime ideation without plans (unplanned attempts), and attempts among those with lifetime ideation with plans (planned attempts).

Childhood adversities

Childhood adversities (CAs) occurring prior to 18 years of age were assessed using 19 items adapted from the Composite International Diagnostic Interview (CIDI 3.0) Childhood Section [31], the Adverse Childhood Experience Scale [32], and the Bully Survey [33]. The 19 items assessed seven types of CAs: parental psychopathology (5 items: any serious emotional or mental health problem, serious alcohol or drug problems, attempted suicide or death by suicide, involvement in criminal activities, interparental violence), physical abuse (2 items: family member hit so hard that it left bruises or marks, physical abuse), emotional abuse (2 items: family member repeatedly said hurtful or insulting things, emotional abuse), sexual abuse (2 items: family member touched or made touch him/her in a sexual way against will, sexual abuse), neglect (2 items: had to do chores too hard or dangerous for age, seriously neglected at home), bully victimization [4 items: physical bullying (repeatedly punched, shoved or physically hurt), verbal bullying (teased, called names), indirect bullying (purposefully ignored, excluded, having spread rumors behind back), and cyberbullying (i.e., over the internet or by text messaging)], and dating violence (2 items: romantic relationship where partner repeatedly hit or hurt, romantic relationship where partner repeatedly said hurtful or insulting things). Response options consisted of 5-point Likert scales (values 0–4 representing “never”, “rarely”, “sometimes”, “often”, and “very often”).

Socio-demographic correlates

Covariates considered here included socio-demographics (gender, age, parental educational level, parental marital status, place raised, religion, sexual orientation, and current living situation) and college-related variables (expected to work on a student job, academic performance in high school, most important reason to go to university).

Analysis

Data were weighted using post-stratification weights to adjust for differences between survey respondents and non-respondents on socio-demographic information made available about the student body by university officials. Multiple imputation (MI) by chained equations was used to adjust for within-survey item non-response, random internal subsampling of survey sections, and missing data due to skip logic errors that occurred in a few surveys. Logistic regression analyses were used to identify those adverse experiences associated with lifetime STB occurrence and transitions. Regression coefficients and their MI-based standard errors were exponentiated to calculate odds ratios (OR) and associated 95% confidence intervals (CI). Statistical significance in all analyses was evaluated using two-sided MI-based tests with significance level α set at 0.05. All models adjusted for country-membership, socio-demographic and college-related variables.

In multivariate model building, four different operationalizations of CA exposure were considered (i.e., type, number, severity, and frequency of CAs) to predict the outcomes, using different transformations of the original CA items. A first series of multivariate models only considered one operationalization per model, while a second series of models included combinations of CA operationalizations. Model fit was evaluated by the Bayes Information Criterion (BIC), a well-established criterion to assess model fit that is based on the likelihood function (i.e., the goodness of fit of a regression model to the data for given values of unknown regression coefficients) and that penalizes for the number of additional parameters (regression coefficients). The latter addresses the fact that models with more complex parametrizations (e.g., combinations of CA operationalizations) tend to fit better by chance alone [34].

Due to space constraints, we present a full overview of multivariate model building in the Supplementary Methods. Here we describe the two models that provided optimal model fit (i.e., the lowest BIC value) across outcomes. The model that included the exact number of CA types provided optimal fit in predicting STB and plans among ideators. In this model, a CA type was considered present whenever at least one item assessing the corresponding CA type was reported to have occurred at least “rarely”. See “Measures” section for a

detailed description of the 19 CA items assessing the seven CA types. Number of CA types was subsequently operationalized as an 8-level categorical count variable (0–7) indicating the exact number of CAs out of the seven considered, with “none” (or zero) being the reference level. Parameterization of the 8-level categorical variable in the logistic regression analyses consisted of a dummy coding scheme [35], i.e., seven dummy variables indicating the exact number of CAs (1–7), leaving out the eight dummy indicating “none” (or zero adversities). This 8-level categorical predictor model allows for deviation from a model that includes a continuous 0–7 count variable as a predictor, as the latter would imply that the ORs associated with having exactly 2–7 adversities are equal to the 2–7th power of the OR of having exactly one adversity.

The model that included information about the frequency of the specific CA types provided optimal fit in predicting planned attempts (i.e., the transition from plan to attempt among ideators with a plan) and unplanned attempts (i.e., the transition from ideation to attempt among ideators without a plan). In this model, seven type-frequency CA scales (scaled 0–4) were created by assigning the maximum value across the items corresponding to each CA type. See “Measures” section for a detailed description of the 19 CA items assessing the seven CA types. Each type-frequency scale then corresponds to the frequency of occurrence of a specific CA type during childhood-adolescence. The seven 0–4 type-frequency CA scales were directly entered as continuous predictors in the logistic regression models, with the OR representing the change in odds with a one-unit increase along the 0–4 scale. Note that this model (compared to the model including the exact number of CA types, i.e., the best model to explain STB and plans among ideators; see the previous paragraph), also implicitly considers the cumulative risk related to having experienced multiple CA types, since the joint associations of multiple adversity exposures are captured by the product of the separate type-frequency ORs. However, this model now expands on the previous model by modeling the frequency of the seven specific adversity types during childhood adolescence.

Population-attributable risk proportions (PARPs) [36] were calculated based on respondents’ predicted probabilities estimated by the multivariate logistic regression equations [25]. In this context, PARPs provide estimates of the proportions of STB and STB transitions that could have been prevented if CAs were eliminated and the ORs represent causal pathways between CAs and STB.

Results

Variable distributions

The final sample included 20,842 students (54.7% female; mean age = 18.93, SD = 1.99). Over half of students had high parental education (55.9%), were raised in small (39.7%) or large cities (28.1%), and lived at their own home or with parent(s) or other relative(s) (64.1%). About three quarters reported Christian as religion (70.6%). See Supplementary Table 2 for a detailed overview of sample socio-demographic characteristics.

Lifetime prevalence of suicidal ideation, plans, and attempts were 27.4%, 12.7%, and 3.4%, respectively. Almost half (46.4%) of students with lifetime ideation made the transition to a plan and 23.2% of those with a plan made the transition to an attempt. Attempts among those with lifetime ideation without plan were less frequent (3.0%).

Detailed distributions of the type-frequency adverse experience scales are presented in Supplementary Table 3. Table 1 shows the prevalence of the seven types of CAs. The most prevalent CA was bully victimization (60.7%), followed by parental psychopathology (38.5%), emotional abuse (26.3%), and physical abuse (15.4%). Dating violence

Table 1 Prevalence of childhood adversities by type and number (n = 20,842)

	<i>n</i> (uw)	% (w)	SE
Type of adversity ^a			
Parental psychopathology	8066	38.5	0.4
Physical abuse	3185	15.4	0.3
Emotional abuse	5568	26.3	0.3
Sexual abuse	529	2.5	0.1
Neglect	1972	9.6	0.2
Bully victimization	12,659	60.7	0.4
Dating violence	2109	9.9	0.2
Number of adversities			
Exactly seven	72	0.4	0.0
Exactly six	229	1.1	0.1
Exactly five	691	3.3	0.1
Exactly four	1506	7.1	0.2
Exactly three	2535	12.1	0.3
Exactly two	4287	20.6	0.3
Exactly one	6548	31.4	0.4
None	4974	24.1	0.4

n (uw) unweighted numbers, % (w) weighted proportions, SE standard error

^aThe CA type is considered present whenever at least one item assessing the corresponding CA type was reported to have occurred at least “rarely”. See “Measures” section for a detailed description of the 19 CA items assessing the seven CA types

(9.9%), neglect (9.6%), and sexual abuse (2.5%) were least prevalent. Three quarters (75.9%) of students experienced at least one CA; 44.6% experienced at least two and 11.9% experienced four or more.

Multivariate associations between CA and STB

The model that best explained lifetime STB and the transition from lifetime ideation to plan included the exact number of CA types (Table 2). For all three STB outcomes, OR consistently increased between exactly two (range 1.32–2.87) and exactly six CAs (OR range 25.89–54.19) following a subadditive pattern (i.e., the increase in odds becomes increasingly smaller with increasing adversity types), and then decreased again slightly for those having exactly seven CAs (OR range 10.40–52.30). A similar OR pattern was found in predicting transition from ideation to plan (OR range 1.32–5.88).

The model that best explained lifetime planned and unplanned attempts included the frequency of CA types (Table 3). The transition from lifetime ideation to attempt (unplanned attempt) was significantly associated with frequency of emotional abuse and bully victimization (OR range 1.33–1.44), and these associations remained when adjusting for frequency of co-occurring CAs (OR range

1.29–1.36). The transition from lifetime plan to attempt (planned attempt) was significantly associated with the frequency of all seven CAs (OR range 1.16–1.59). When adjusting for frequency of co-occurring CAs, associations remained significant with the frequency of sexual abuse (OR = 1.42) and dating violence (OR = 1.29), and to a lesser extent with the frequency of physical abuse and bully victimization (OR = 1.17).

PARP estimates based on the best-fitting model for each separate outcome (Tables 2, 3) suggest that 62.6–84.7% of lifetime STB is potentially attributable to CAs (assuming a causal pathway between CAs and STB). For plans among those with lifetime ideation PARP was 29.8%, while for lifetime planned and unplanned attempts, PARPs were estimated at 42.3–46.8%.

Discussion

We investigated the associations of seven types of CA with lifetime STB and STB transitions using data from a large cross-national sample of incoming college freshmen, considering four different operationalizations of CA in multivariate model building. While a number of previous studies showed a graded relationship between the number of adversity types

Table 2 Best-fitting multivariate model to explain lifetime suicidal thoughts and behavior, and the transition from lifetime ideation to plan (n = 20,842)

	Among total sample			Among ideators
	Ideation	Plan	Attempt	Plan
	aOR (95% CI)	aOR (95% CI)	aOR (95% CI)	aOR (95% CI)
Number of adversities				
Exactly 7	10.40 (6.33–17.09)*	13.20 (7.70–22.64)*	52.30 (26.22–104.32)*	2.84 (1.44–5.59)*
Exactly 6	25.89 (18.44–36.33)*	34.38 (24.46–48.32)*	54.19 (31.86–92.18)*	5.88 (3.84–8.98)*
Exactly 5	14.45 (11.88–17.56)*	18.14 (14.20–23.17)*	24.87 (15.41–40.16)*	3.52 (2.61–4.76)*
Exactly 4	10.33 (8.89–12.01)*	12.01 (9.69–14.89)*	16.76 (10.60–26.53)*	2.60 (2.00–3.37)*
Exactly 3	7.11 (6.23–8.12)*	8.27 (6.74–10.13)*	10.58 (6.70–16.70)*	2.14 (1.66–2.74)*
Exactly 2	4.05 (3.57–4.60)*	4.53 (3.70–5.54)*	6.06 (3.84–9.57)*	1.58 (1.24–2.01)*
Exactly 1	2.63 (2.33–2.97)*	2.80 (2.29–3.43)*	2.87 (1.79–4.62)*	1.32 (1.03–1.68)*
Zero	(ref)	(ref)	(ref)	(ref)
F(ndf,ddf)[p value] ^a	237.39(7,45,067)[<0.001]*	152.53(7,10,187)[<0.001]*	65.76(7,13,622)[<0.001]*	22.75(7,3970)[<0.001]*
PARP (SE)	62.6 (1.6)	74.4 (2.7)	84.7 (6.2)	29.8 (5.5)
AUC	0.767	0.801	0.832	0.662

All models adjust for all predictors shown in the rows, country-membership, and sociodemographic and college-related variables. aOR adjusted odds ratio, AUC Area Under the Curve, CI Confidence Interval, ddf denominator degrees of freedom, ndf numerator degrees of freedom, PARP population attributable risk proportion, SE standard error

Note on the interpretation of effect sizes (OR): an OR of 2.63 as the effect size of the association between “exactly 1” adversity type and suicidal ideation, represents a Relative Risk (RR) of 1.82 [=OR/1 - (p + (p × OR))] with p being the baseline probability of suicidal ideation, i.e., 0.274], and hence, an increase in absolute risk from 27.4% to 49.8%. An OR of 52.30 as the effect size of the association between “exactly 7” adversities and suicide attempt, represents a RR of 19.06, and hence, an increase in absolute risk from 3.4% to 64.8%

*Indicates significant findings (alpha = 0.05) and are shown in bold

^aF test to evaluate joint significance of predictor variables based on multiple imputations

Table 3 Best-fitting multivariate model to explain lifetime planned and unplanned attempt (n = 20,842)

	Among ideators (bivariate adjusted ^a)		Among ideators (final multivariate model ^b)	
	Unplanned attempt	Planned attempt	Unplanned attempt	Planned attempt
	aOR (95% CI)	aOR (95% CI)	aOR (95% CI)	aOR (95% CI)
Type-frequency scales				
Parental psychopathology	1.13 (0.95–1.35)	1.16 (1.08–1.24)*	1.04 (0.85–1.26)	1.03 (0.95–1.11)
Physical abuse	1.10 (0.83–1.44)	1.36 (1.24–1.49)*	0.82 (0.58–1.16)	1.17 (1.04–1.32)*
Emotional abuse	1.33 (1.10–1.60)*	1.25 (1.16–1.34)*	1.29 (1.01–1.64)*	1.06 (0.96–1.16)
Sexual abuse	1.28 (0.86–1.91)	1.59 (1.35–1.87)*	1.24 (0.80–1.93)	1.42 (1.20–1.69)*
Neglect	1.07 (0.77–1.48)	1.26 (1.13–1.40)*	0.91 (0.63–1.32)	1.01 (0.89–1.15)
Bully victimization	1.43 (1.20–1.71)*	1.27 (1.17–1.37)*	1.36 (1.12–1.63)*	1.17 (1.08–1.27)*
Dating violence	1.19 (0.90–1.57)	1.40 (1.27–1.54)*	1.05 (0.79–1.40)	1.29 (1.17–1.43)*
F(ndf,ddf)[p value] ^c			3.20(7,16,930)[0.002]*	15.16(7,24,949)[<0.001]*
PARP (SE)			46.8 (10.2)	42.3 (4.3)
AUC			0.682	0.699

Note on the interpretation of effect sizes: an OR of 1.16 as the effect size of the bivariate adjusted association between experiencing “very often” parental psychopathology (vs “never”) and the transition from plan to attempt among ideators, represents a RR of 1.52 [= (OR⁴)/1 - (p + (p × (OR⁴)))] with p being the baseline probability of transitioning, i.e., 0.232], and an increase in absolute risk from 23.2% to 35.4%. An OR of 1.42 as the effect size of the multivariate association between experiencing “very often” sexual abuse (vs “never”) and the transition from ideation to a suicide attempt, represents a RR of 3.72, and an increase in absolute risk from 3.0% to 11.2%

aOR adjusted odds ratio, AUC Area Under the Curve, CI Confidence Interval, ddf denominator degrees of freedom, ndf numerator degrees of freedom, PARP population attributable risk proportion, SE standard error

*Indicates significant findings (alpha=0.05) and are shown in bold

^aThe bivariate adjusted models include one type-frequency scale at a time, i.e., each cell represents a separate multivariate model including the type-frequency scale shown in the row, adjusting for country-membership, and sociodemographic and college-related variables

^bThe final multivariate models include all type-frequency scales, i.e., each column represents a multivariate model including the 7 type-frequency scales, adjusting for country-membership, and sociodemographic and college-related variables

^cF test to evaluate joint significance of predictor variables based on multiple imputations

and STB [12, 26, 37], detailed analyses from our study now show that the number of CA types (compared to alternative CA operationalizations) best explains the onset of lifetime suicidal ideation, and the subsequent transition from ideation to a suicide plan, but not the subsequent transitions from ideation to action (i.e., from ideation or plans to attempts). These findings can be seen in the light of the toxic stress response [38], i.e., the dysregulated stress response when a child or adolescent experiences adversity, which results in a disruption of brain architecture development and other organ systems, and an increased risk for the onset of physical and mental disorders. Biological mediatory pathways include epigenetic changes, changes in key brain regions (e.g., the amygdala, hippocampus), neurotransmitter changes, altered neuronal activity and connectivity, as well as altered hypothalamic pituitary adrenal axis activity [39]. Increased risk for suicidal ideation and subsequent planning with an increasing number of adversities supports the hypothesis that adapting to toxic stress becomes more difficult to negotiate when more life domains are involved, in line with Bronfenbrenner’s Ecological Systems Theory [40]. We now identified a subadditive pattern in this association, which suggests a ceiling effect of the impact of childhood adversities and

related toxic stress [12]. Of note, recent research suggests that cumulative adversities might increase the risk for ideation *indirectly* by increasing the risk of exposure to *specific* adversities during *specific* sensitive exposure periods in childhood-adolescence [41]. Further research should therefore use longitudinal designs including the exact timing of STB and adversity exposure to investigate how cumulative adversities and sensitive periods are intertwined, and provide the empirical evidence needed to develop prevention interventions and determine which aspects of childhood adversity to target.

Our study substantially expands previous knowledge by showing that the frequency of specific CAs involving family and peer victimization experiences provides the best model to explain the transition from ideation or plans to attempts. It should be noted that this model also *indirectly* considers the increasingly adverse effects of the number of CA types (cf. the best model for ideation, and transition to plan), but now stresses the potential role of the *frequency* of *specific* adversity types experienced during childhood-adolescence in explaining the transition to attempts. Specifically, we found that planned attempts among ideators were associated with the frequency of all seven CA types under study, and when

adjusting for co-occurring adversities, these associations remained significant with the frequency of physical abuse, sexual abuse, bully victimization, and dating violence. Unplanned attempts among ideators, in turn, had specific associations with the frequency of emotional abuse and bully victimization only, in both unadjusted and adjusted analyses. As a whole, these findings are in line with the concept of Acquired Capability for Suicide, part of Joiner's Interpersonal Theory of Suicide [42]. According to this theory, the capability to attempt suicide consists in an increased pain tolerance and reduced fear of death, and can be acquired through the repeated exposure to physically painful and/or fear-inducing experiences. It is noteworthy that many of the adversities considered in our study are indeed threat-based adversities (in contrast to deprivation-based), including all those with strong independent relationships with transitioning from suicide plans to attempts (i.e., physical/sexual abuse, bullying and dating violence). This may explain why more frequent exposure to these specific painful and/or fear-inducing childhood-adolescent experiences can result in an increased capability for suicide. In the presence of suicidal desire (ideation/plans), this acquired capability then facilitates the transition to suicide attempts. Further research should confirm our findings and investigate whether the associations of specific CA type-frequencies with transitioning to suicide attempts are best explained by common (e.g., the acquired capability for suicide) or separate causal pathways. Such research would ideally be longitudinal and attempt to investigate the extent to which CAs are associated with theoretically specified mediators measured prior to the onset of suicidality.

An important contribution from our study is that we calculated Population Attributable Risk Proportions (PARP), i.e. estimations of the proportions of adverse outcomes (i.e., STB, STB transitions) that are associated with potential risk factors (i.e., childhood adversity). We found that high proportions of pre-college onset STB are associated with CAs: 63% of lifetime ideation, 85% of lifetime attempts, and 30–47% of transitions from ideation or plans to attempts. To the extent that these associations are causal, these results suggest that effective interventions targeting family and peer victimization experiences could substantially reduce STB among young people. Comprehensive approaches are advocated to prevent CA, such as establishing multi-disciplinary trauma-informed care networks [43, 44] and multilayered prevention and response strategies to early-life violence [22]. Prevention of peer victimization such as bullying and dating violence requires coordinated school-based efforts between youth, parents, educators and policy makers [45, 46]. The finding that co-occurrence of adversity is common and that there exists a graded relationship between number of adversities and STB occurrence indirectly support the thinking underlying comprehensive population-based approaches in

tackling complex systems of adversity rather than targeting only one particular type of adversity.

Regarding the prevention of childhood-adolescent adversity, it is worth noting that our findings of a high prevalence and co-occurrence of CAs, on the one hand, and of the importance of cumulative/frequent adversity in explaining STB, on the other hand, may be compatible with a syndemics model of health [47]. In the current context, syndemics can be defined as the concentration of adversity within vulnerable population segments, with complex interactions between CA types explaining increasingly adverse outcomes through negative biosocial feedback loops over time (e.g., re-victimization). Using nationwide registry data from more than 1 million Danish children, a recent *Lancet* paper [48] provided evidence for the existence of CA syndemics, by showing that a small proportion of socially disadvantaged children (3%) had multiple adversities throughout childhood (continuous material deprivation, increasing loss or threat of loss experiences, and increasingly dysfunctional family dynamics), which was associated with a 4.54 times higher all-cause mortality risk between the age of 16 and 34, with suicide being a common cause of death. A syndemics model of health stresses that effective interventions would ideally target factors that determine childhood adversity from (co) occurring in the first place, by targeting psychosocial factors that give rise to adversity and its concentration in certain population segments. Current prevention approaches predominantly focus on the early detection of CAs and on reducing their psychological effects once they occur. Future research should focus on identifying the social forces or conditions that determine the co-occurrence of adversity among young people, including future college students.

Several limitations of our study should be mentioned. First, this is a cross-sectional study and no information on the timing of CA was collected. This precluded establishing temporality between CA and STB. Because of this limitation, the associations we found might partially represent associations temporally prior to STB with the subsequent occurrence of victimization. However, the median age of onset of STB in our sample is 14–15 years [3], which is substantially older than the reported age-of-onset of child abuse in the population [49]. This difference is less certain, however, for bullying, which is most prevalent in middle school (age 11–13) [50], and for dating violence, which typically has onsets in the later teen years [51]. Second, retrospective measures of CA may be subject to recall bias and have been found to identify different cases than prospective assessments. They are, however, more stable over time in terms of test–retest stability [19, 52]. Third, nondisclosure of STB among young people may lead to underestimation of STB. It should be noted that computerized self-report screening measures as used in this study result in higher rates of self-disclosure than in face-to-face interviews [53]. Fourth, the

survey response rate was suboptimal in some countries, which may reduce the external validity of our findings. However, non-response bias may predominantly affect univariate statistics, with substantially less bias in multivariate associations [54]. Fifth, lack of statistical power precluded testing whether our main findings vary by country. This will be addressed by future studies from the WMH-ICS Initiative, including more countries/colleges, and larger sample sizes.

Conclusion

We found high prevalence and co-occurrence of CAs and found that early-life suicidal ideation and transitions from ideation to plan are best explained by the exact number of adversities, while the frequency of adversity best explains the transition from ideation or plans to attempts. Taken together, these results argue for the importance of a public health perspective of intervention that focuses comprehensively on complex clusters of adversity rather than individual adversities. These results call for further efforts to disentangle the specific role of mental disorders in explaining the associations of childhood adversity with STB as well as on the relative contribution of peer and family adverse and protective experiences. In addition, the cumulative effects of adversity experiences on STB should be further investigated using prospective study designs. It is important to note that a number of recent meta-analyses on the association between core types of childhood maltreatment have been carried out among children and young adults [10], adults [9], and prisoners [55]. As large sample sizes are needed to replicate our results, future studies could use individual-level meta-analysis methods [56] in order to pool data across studies and achieve the adequate statistical power to investigate further the different specifications of CA in their associations with STB, as presented here.

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Declarations

Conflict of interest Dr. Auerbach serves on the scientific advisory board for Ksana Health. Dr. Ebert reports to have received consultancy fees/served on the scientific advisory board for Sanofi, Novartis, Mind-district, Lantern, Schoen Kliniken, and two German health insurance companies (BARMER, Techniker Krankenkasse). He is also a stakeholder in the Institute for health training online (GET.ON), which aims to implement scientific findings related to digital health interventions into routine care. Dr. Wilks receives consultation fees from Mindstrong Health and Click Therapeutics. In the past 3 years, Dr. Kessler was a consultant for Datastat, Inc., Holmusk, RallyPoint Networks, Inc., and Sage Pharmaceuticals. He has stock options in Mirah, PYM, and Roga Sciences.

Ethics approval Details about ethics approval for the WHO WMH-ICS Initiative countries is available online [29].

Consent to participate Informed consent was obtained before administering the web-based self-report questionnaires and after explaining study procedures in all countries.

Consent for publication Not applicable.

Availability of data and material The participant data and statistical analysis plan used for this study are available upon reasonable request from the corresponding author (PM) as long as the main objective of the data sharing request is replicating the analysis and findings as reported in this paper.

Code availability The statistical code (SAS) used for this study are available upon reasonable request from the corresponding author (PM) as long as the main objective of the statistical code sharing request is replicating the analysis and findings as reported in this paper.

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