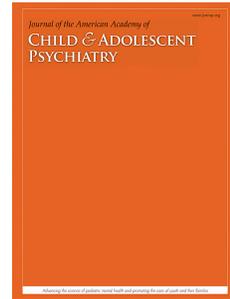


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Suicidal Thoughts and Behaviors Among First-Year College Students: Results From the WMH-ICS Project

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RH = STB Among First-Year College Students

Supplemental material

Clinical guidance

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ABSTRACT

Objective: College entrance may be a strategically well-placed “point of capture” for detecting late adolescents with suicidal thoughts and behaviors (STB). However, a clear epidemiological picture of STB among incoming college students is lacking. We present the first cross-national data on prevalence as well as socio-demographic and college-related correlates for STB among first-year college students.

Method: Web-based self-report surveys were obtained from 13,984 first-year students (response rate 45.5%) across 19 colleges in eight countries (Australia, Belgium, Germany, Mexico, Northern Ireland, South Africa, Spain, United States).

Results: Lifetime prevalence of suicidal ideation, plans, and attempts was 32.7%, 17.5%, and 4.3%, respectively. Twelve-month prevalence was 17.2%, 8.8%, and 1.0%, respectively. About 75% of STB cases had onset before the age of 16 years (Q3 = 15.8), with persistence figures in the range 41-53%. About half (53.4%) of lifetime ideators transitioned to a suicide plan; 22.1% of lifetime planners transitioned to an attempt. Attempts among lifetime ideators without plan were less frequent (3.1%). Significant correlates of lifetime STB were cross-nationally consistent and generally modest in effect size (median adjusted OR [aOR] = 1.7). Non-heterosexual orientation (aOR range 3.3-7.9) and heterosexual orientation with some same-sex attraction (aOR range 1.9-2.3) were the strongest correlates of STB, and of transitioning from ideation to plans and/or attempts (aOR range 1.6-6.1).

Conclusion: The distribution of STB in first-year students is widespread, and relatively independent of socio-demographic risk profile. Multivariate risk algorithms based on a high number of risk factors are indicated to efficiently link high-risk status with effective preventive interventions.

INTRODUCTION

Adolescence is a high-risk period for the onset of suicidal thoughts and behaviors (STB),¹ and about 21-50% of those with adolescent-onset STB continue to experience STB when transitioning into young adulthood.^{2,3} This transition includes college entrance for approximately two-thirds of young people in developed countries.⁴ Evidence suggests that there is high persistence of adolescent-onset STB into the college years,^{5,6} and rates of STB among college students do not differ substantially from those among same-aged peers.⁷ College entrance may therefore function as a strategically well-placed “point of capture” for detecting STB within the social geography of society.⁸ Due to the availability of centralized student services, the college environment also may be particularly well suited to implement interventions for preventing the progression of STB.⁹

To efficiently allocate resources for these interventions, and to adequately plan health care needs on campus, it is crucial to provide policy makers and mental health professionals with a clear epidemiological picture of STB among first-year students. A recent systematic review of the literature¹⁰ documented a substantial lack of representative data on college student STB worldwide, especially outside of North America and Asia. In addition, while college student samples are often used to test specific theory-driven hypotheses on STB (e.g.,^{11,12}), there is a lack of understanding of how STB is concentrated in student populations according to basic correlates. Previous studies have suggested that basic correlates may include socio-demographic (e.g., gender¹³, age¹⁴, socio-economic status¹⁵, religion¹⁶, sexual orientation¹⁷) as well as college-related variables (e.g., living situation¹³, student job¹⁴).

We address these shortcomings by presenting data on STB prevalence among first-year students from 19 colleges located in eight countries worldwide. These data come from the initial round of surveys in the WHO World Mental Health Surveys International College Student Project (WMH-ICS)¹⁸, a coordinated series on ongoing epidemiological needs

assessment surveys designed to provide accurate information about adverse mental health outcomes among college students and to lay the groundwork for implementing and evaluating cost-effective preventive and clinical internet and mobile-based interventions. In contrast to the vast majority of previous college STB surveys,¹⁰ the data presented here were obtained using census of the entering class and the sample size is sufficiently large to investigate the full range of STB outcomes (i.e., ideation, plans, and attempts) and transitions (i.e., plans among ideators, attempts among ideators with and without plans) as well as socio-demographic and college-related correlates of STB.

METHOD

Samples

The initial round of WMH-ICS surveys was administered in a convenience sample of 19 colleges and universities (henceforth referred to as “colleges”) in eight mostly high-income countries (Australia, Belgium, Germany, Mexico, Northern Ireland, South Africa, Spain, and the United States). Web-based self-report questionnaires were administered to representative samples (i.e., census) of first-year students in each college (7 private, 12 public) across these countries between October 2014 and February 2017. A total of 14,371 questionnaires were completed, with sample sizes ranging from 633 in Australia to 4,580 in Belgium. The weighted (by achieved sample size) mean response rate across surveys was 45.5%. An overview of the sample design in each country is provided in Table S1, available online. The sample for the analyses reported here was restricted to students identifying as male or female who were full-time students ($N = 13,984$). Students excluded from analyses included: (a) missing information on gender and full-time status ($n = 35$), (b) did not identify as male or female ($n = 50$), (c) reported part-time status ($n = 302$).

Procedures

All first-year students in the colleges were invited to participate in a web-based self-report health survey. The initial mode of contact varied across colleges, with the survey part of a health evaluation in some schools, as part of the registration process in others, and as a stand-alone survey delivered via student email addresses in still others. In all cases other than in Mexico, potential respondents were invited to participate and initial non-respondents were re-contacted through a series of personalized reminder emails containing unique electronic links to the survey. The situation was different in Mexico, where students were invited to participate in conjunction with mandatory activities, which varied from school to school (e.g., student health evaluations; tutoring sessions), with time set aside for completing the survey during the sessions. In the other countries, 10 universities implemented conditional incentives in the final stages of refusal conversion (e.g., a raffle for store credit coupons, movie passes). In addition, one site (Spain) used an “end-game strategy” in which a random sample of non-respondents at the end of the normal recruitment period was offered incentives for participation. Respondents to these end-game interviews were given a weight equal to $1/p$, where p represented the proportion of non-respondents at the end of the normal recruitment period that was included in the end-game, to adjust for the under-sampling of these hard-to-recruit respondents. Informed consent was obtained before administering the questionnaires in all countries. Procedures for obtaining informed consent and protecting human participants were approved and monitored for compliance by the institutional review boards of the organizations coordinating the surveys in each country.

Measures

Suicidal thoughts and behaviors.

A modified version of the Columbia Suicidal Severity Rating Scale¹⁹ was used to assess STB, including suicidal ideation (“*Did you ever wish you were dead or would go to sleep and never wake up?*”, “*Did you ever in your life have thoughts of killing yourself?*”),

suicide plans (“*Did you ever think about how you might kill yourself [e.g., taking pills, shooting yourself] or work out a plan of how to kill yourself?*”), and suicide attempts (“*Have you ever made a suicide attempt [i.e., purposefully hurt yourself with at least some intent to die]?*”). In addition, the time course of each STB outcome was assessed, i.e., age of onset (AOO), numbers of lifetime years with STB, and number of months in the past 12 months with STB. STB transition rates were defined as the proportion of suicide planners among lifetime ideators, suicide attempters among lifetime ideators without plans (unplanned attempts), and suicide attempters among lifetime ideators with plans (planned attempts). We calculated STB persistence in two ways: (1) The ratio of 12-month to lifetime prevalence; and (2) proportional persistence, defined as the ratio of number of lifetime years with STB divided by number of years between AOO and age-at-interview (separately for ideation and plans). Persistence of suicide attempts was defined as the number of subsequent lifetime suicide attempts among those with any attempts.

Socio-demographic correlates.

Gender was assessed by asking respondents whether they identified as male, female, transgender (male-to-female/female-to-male), or “other”. Respondent age was categorized into three categories (18 years/19 year/20 or more years old). Parental educational level was assessed for father and mother separately and was categorized into high (university graduate or more), medium (some post-secondary education), and low (secondary school or less) based on the highest-of-both parents’ educational level. Parental marital status was dichotomized into “parents not married or at least one parent deceased” versus “parents married and both alive”. Respondents were asked about the urbanicity of the place they were raised (categorized into small city/large city/town or village/suburbs/rural area), and their religious background (categorized into Christian/Other religion/No religion). Sexual orientation was classified into heterosexual, gay or lesbian, bisexual, asexual, not sure, and other. Additional

questions were asked about the extent to which respondents were attracted to men and women and the gender(s) of people they had sex with (if any) in the past 5 years. Respondents were categorized into the following categories: heterosexual with no same-sex attraction, heterosexual with some same-sex attraction, non-heterosexual without same-sex sexual intercourse, and non-heterosexual with same-sex sexual intercourse.

College-related correlates.

Respondents were asked where they ranked academically compared to other students at the time of their high school graduation (from top 5% to bottom 10%; categorized into four approximately equal-sized groups) and what their most important reason was to go to university. Based on the results of a tetrachoric factor analysis (details available on request), the most important reason to go to university was categorized into extrinsic reasons (i.e., family wanted me to go/my friends were going/teachers advised me to/did not want to get a job right away) versus intrinsic reasons (to achieve a degree/I enjoy learning and studying/to study a subject that really interests me/to improve job prospects generally/to train for specific type of job). Respondents were also asked where they were living during the first semester of the academic year (parents', other relative's, or own home/university or college hall of residence/shared house, apartment, or flat/private hall of residence/other) and if they either already worked or expected to work on a student job.

Analysis

All analyses were conducted with SAS version 9.4.²⁰ Data were weighted to adjust for differences between survey respondents and non-respondents on whatever socio-demographic information was made available about the student body by university officials using post-stratification weights.²¹ In addition, multiple imputation (MI) by chained equations²² 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. Prevalence estimates are reported as weighted within-country proportions, with associated MI-adjusted standard errors obtained through the Taylor series linearization method. Please note that STB prevalence estimates did not take into account right censoring of data points with regard to age; this was addressed by including age as a correlate in subsequent analyses. Estimates of AOO and of proportional persistence (i.e., the percentage of lifetime years with STB) are reported as median values with associated interquartile ranges. To obtain pooled estimates of prevalence, AOO, and proportional persistence across countries, each country was given an equal sum of weights. Projected AOO distributions up to age 25 for each STB outcome were analyzed using time-to-event analyses (taking into account right censoring of data with regard to age).²³ To allow for accurate estimations of STB onset timings within a given lifetime year, we used the actuarial method for all time-to-event analyses, as this method assumes a constant conditional risk of STB onset during a given year of life across age.

Logistic regression analyses were used to identify correlates of lifetime STB. Regression coefficients and their MI-based standard errors were exponentiated to create odds ratios (OR) and associated 95% confidence intervals (CI). Initial models were pooled estimates across countries to examine both main effects and all possible two-way interactions among correlates, with risk for Type I error adjusted for using the false discovery rate method ($Q = 0.05$).²⁴ We then examined between-country variation in associations by including correlate-by-country interactions in an adjusted interaction dummy coding scheme that kept the product of all country-specific ORs equal to one. The latter method allowed us to detect significant between-country variation by evaluating the statistical significance of deviation of within-country coefficients from the median 1.0 value. Statistical significance in all analyses was evaluated using two-sided MI-based tests with significance level α set at 0.05.

RESULTS

STB prevalence, age-of-onset, and persistence rates

The final sample included 13,984 students (54.4% female; $M_{age} = 19.33$, $SD_{age} = 0.59$). Lifetime prevalence of ideation, plans, and attempts were 32.7%, 17.5%, and 4.3%, respectively (Table 1). Comparable 12-month estimates were 17.2%, 8.8%, and 1.0%, respectively. More than half (53.4%) of lifetime ideators made the transition to a suicide plan, with 26.8% of lifetime ideators having a plan in the past 12 months. Additionally, 22.1% of lifetime planners made the transition to an attempt, with 5.4% doing so in the past 12 months. Attempts among lifetime ideators without plan were less frequent (3.1%; 0.3% of lifetime ideators in the past 12 months).

The median AOO of lifetime suicidal ideation was 14.2 years, with roughly 75% of cases having an onset before the age of 16 years ($Q3 = 15.8$). The median AOO was slightly higher for suicide plans (14.6 years) and suicide attempts (15.1 years). Projected STB AOO curves up to age 25 (Figure 1) show that risk for STB onset was relatively low before the age of 12 and then increased steeply up to age 17, with a moderate decline in slope across the age range 17-25 years.

Twelve-month-to-lifetime prevalence ratios for suicidal ideation and plans were 50-53% (Table 1). Proportional persistence for these outcomes was 41-42%. For attempts and planned attempts, 12-month to lifetime ratios were 23-24%, while the ratio for unplanned attempts was 10.2%. The median number of attempts (among attempters; either planned or unplanned) was one, with more than 25% of lifetime attempters with a plan ($Q3 = 2.2$) and a lower proportion of lifetime attempters without a plan ($Q3 = 1.6$) making two or more attempts.

Between-country variation in suicidal ideation was considerable (lifetime range 15.2-44.6%; 12-month range 7.0-25.7%; Table 2). Twelve-month-to-lifetime prevalence ratios

were more stable (range 42.8-60.3%), as were proportional persistence (range 29.1-54.3%) and median AOO (range 13.5-14.7 years).

Socio-demographic and college-related correlates of lifetime STB

Five out of the 11 correlates we considered were consistently associated with all three STB outcomes (Table 3). The strongest correlate was sexual orientation, disaggregated into non-heterosexual orientation with same-sex sexual intercourse (aOR range 4.2-7.9), non-heterosexual orientation without same-sex sexual intercourse (aOR range 3.3-4.3), and heterosexual orientation with some same-sex attraction (aOR range 1.9-2.3). This was followed by having a religion other than Christianity (aOR range 1.5-2.0), being female (aOR range 1.3-2.2), parents not married or at least one parent deceased (aOR range 1.4-1.5), and being age 20 or older (aOR range 1.2-1.7). Sexual orientation was also the strongest correlate of transitioning from ideation to plan (aOR range 1.6-2.9), followed by having a religion other than Christianity, and being age 19 or older (aOR range 1.2-1.5). Unplanned attempts among lifetime ideators were uniquely predicted by non-heterosexual orientation with same-sex sexual intercourse (aOR = 6.1) and by being age 20 or older at matriculation (aOR = 2.5). Planned attempts among ideators, in contrast, were predicted by non-heterosexual orientation, being female, having been raised in a large city (aOR range 1.8-2.5) and by high parental education (vs. medium; aOR = 1.0/0.7 = 1.4).

Table 4 shows that the significant associations between STB and the correlates were quite consistent across countries, with only 32 of 192 correlate-by-country interactions (i.e., [24 correlates]*[8 countries]) being statistically significant.

DISCUSSION

We presented the first data from a large cross-national sample on STB among incoming college freshmen. Many of the findings are consistent with studies in more general

adolescent samples: that about one third of respondents reported lifetime STB,²⁵ with a median age of onset of 14 years,^{1,26} persistence in the range 40-50%,^{2,3,27} a substantial number of multiple attempters,²⁸ and higher rates of STB among females than males.^{25,29} An important exception, however, were STB transition rates, which differed substantially from rates in community-based samples of adolescents^{1,30} as well as adults.³¹ Specifically, the probability of transition from ideation to plan (i.e., 53.4%) was considerably higher than in general adolescent samples (generally around 33%), whereas the probability of transition from ideation to attempts was considerably lower both among planners (22.1% vs. 53-61%) and ideators without a plan (3.1% vs. 14-20%). If confirmed and not attributed to methodological differences, a lower ideation-to-action propensity in first-year students might be explained by higher levels of executive functioning, decision-making abilities³²⁻³⁴ or other factors associated both with differential selection into higher education and the propensity to make the transition to suicide attempts. This is in line with preliminary findings that more severe adolescent-onset STB, especially attempts, are related to cognitive deficits,³⁵⁻³⁷ low school performance,³⁸ and, hence, a potentially lower probability of college entrance. Further supporting these possibilities, lifetime STB, especially unplanned attempts, were independently related to having an older age at matriculation, which could have been due to adverse mental health leading to delayed college entrance.³⁹

Among the range of basic socio-demographic and college-related variables we examined, non-heterosexual orientation was found to be common (~13%) and to be the strongest correlate of lifetime STB (aOR 3.3-7.9). Possibly due to a more fine-grained disaggregation of sexual orientation, the strength of these associations is higher than found in recent meta-analyses among young people, which documented pooled odds ratios of non-heterosexual orientation with STB in the range 2.3-2.9.^{40,41} We expand on prior findings in three additional ways. First, the association of non-heterosexual orientation with STB was

consistent among entering students across eight different countries. Second, we found a higher risk of transitioning from ideation to both planned and unplanned attempts among students with non-heterosexual orientation. Third, we also found that students identifying as heterosexual but indicating some same-sex attraction are at higher risk for STB, and for transitioning from ideation to a suicide plan. These are novel findings that complement previous evidence of higher risk of suicide in later life among sexual minorities.^{42,43} As the college period is a time of increased identity exploration and consolidation,⁴⁴ these results also point to the importance of tackling developmentally relevant risk factors for STB transition on campus that include LGBT discrimination and victimization,⁴⁵ internalized homophobia,⁴⁶ and parental intolerance and rejection in response to disclosure of non-heterosexual orientation.⁴⁷

In line with previous studies,^{31,48,49} lifetime STB prevalence varied considerably by country (15.2-44.6%), while associations between basic correlates and lifetime STB were cross-nationally more consistent. It should be stressed that with odds ratios of basic correlates with STB in the range 1.2-7.9 (median OR = 1.7), significant individual-level associations are generally modest. This points to the widespread distribution of STB in the first-year student population, relatively independent of socio-demographic risk profile. It follows that targeting the entire population of incoming students (i.e., universal prevention efforts⁵⁰) may be a feasible approach. It also follows that the accurate detection of high-risk students for STB (e.g., through risk screening projects) will depend on multivariate risk algorithms based on a high number of additional risk factors (e.g., mental disorders, childhood adversity).⁵¹ High persistence of lifetime STB, as documented here, underscores the importance of including severity markers of pre-college onset STB in such algorithms.⁵ Only then will centralized digital screening instruments at college entry allow colleges to efficiently link high-risk status with effective preventive interventions, such as internet- and mobile-based approaches.⁵² Such

approaches allow colleges to offer low-threshold interventions, which are associated with lower barriers for help seeking and at the same time allow tailoring interventions to the specific individual risk profile of students (e.g., non-heterosexual students with additional risk for adverse mental health outcomes). Recent studies suggest that such approaches can not only be effective in preventing⁵³ and treating mental health disorders,⁵⁴ but also in increasing help seeking in suicidal college students and reducing suicidal ideation.⁵⁵

Several limitations of the study deserve attention. First, the response rates were not optimal in all countries. While it has been shown that the empirical relationship between response rate and nonresponse bias is weak,⁵⁶ recent findings warn of potential overestimation of STB when response rates are low.¹⁰ Second, there is concern about non-disclosure of suicidality among young people,⁵⁷ which may have led to underestimation of STB. It should be noted, however, that computerized self-report screening measures might be related with higher rates of self-disclosure,⁵⁸⁻⁶⁰ as opposed to face-to-face interviews or telephone interviews. Third, variability in prevalence rates across counties was considerable, which may limit the generalizability of our pooled estimates towards other populations of first-year students. Possible explanations for between-country variability in STB estimates include study methodological differences,⁶¹ true differences in prevalence according to geographical location,⁶² sociodemographic differences,⁶³ differences in exposure to STB risk factors,⁶⁴ and differences in college-specific factors.⁶⁵ Future studies including a high number of colleges could use multi-level modelling approaches to better quantify and predict between-college variability in STB prevalence, and should recruit random samples of colleges (as opposed to the convenience sample of colleges in this study) to enable more robust conclusions on cross-national variability of results. Fourth, this study is limited to the use of cross-sectional data, adjusting for a limited range of basic socio-demographic and college-related correlates. Future studies should use longitudinal designs to replicate our findings, and include additional risk

domains (e.g., mental disorder, childhood adversity) to investigate STB during college. Fifth, the implementation of multiple imputation to address missing data comes at the cost of a reduced number of variable levels that can be included in both imputation and analysis models. This precluded a more fine-grained analysis of STB outcomes (e.g., passive versus active suicidal ideation) and STB correlates (e.g., parental marital status versus parental loss). Future studies on larger samples should address this issue.

In conclusion, our findings strongly support the view that college entrance may be a suitable period to detect risk for STB among young people. Campus outreach could target first-year students with non-heterosexual orientation, as this subgroup had considerable elevated risk for lifetime STB, including an increased likelihood to act on suicidal ideation and planning. But the widespread prevalence of STB among first-year students supports above all the need for developing individualized risk profiles for STB among first-year students as to obtain more effective prevention interventions. In addition, lifetime STB transition rates among the full sample of first-year students point to the fact that prevention interventions should be part of a broader policy in early life, targeting lower college entrance rates related to severe adolescent-onset STB.

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Table 1. Prevalence, age of onset (AOO), and persistence of suicidal thoughts and behaviors (STB) in the WMH-ICS surveys (N = 13,984).

	lifetime	12-month	age of onset	Persistence		
				12-month/lifetime	proportional persistence ^a	persistence ^b
	% (95%CI)	% (95%CI)	median [IQR]	% (95%CI)	median [IQR]	median [IQR]
STB prevalence						
ideation	32.7 (31.5-34.0)	17.2 (16.2-18.2)	14.2 [12.2-15.8]	52.5 (50.2-54.9)	41.2 [21.8-70.1]	/
plan	17.5 (16.5-18.5)	8.8 (8.0-9.5)	14.6 [12.8-16.1]	50.2 (47.0-53.4)	41.9 [21.8-70.7]	/
attempt	4.3 (3.8-4.9)	1.0 (0.7-1.2)	15.1 [13.5-16.6]	22.8 (17.5-28.2)	/	1.0 [1.0-2.1]
STB transition rates						
plan among lifetime ideators	53.4 (51.1-55.6)	26.8 (24.7-28.9)	14.6 [12.8-16.1]	50.2 (47.0-53.4)	41.9 [21.8-70.7]	/
attempt among lifetime ideators without plan	3.1 (1.9-4.3)	0.3 (0.0-0.7)	14.2 [12.3-15.8]	10.2 (0.0-21.2)	/	1.0 [1.0-1.6]
attempt among lifetime ideators with plan	22.1 (19.5-24.7)	5.4 (4.0-6.8)	15.2 [13.6-16.6]	24.4 (18.6-30.1)	/	1.0 [1.0-2.2]

Note: to obtain pooled estimates of prevalence, age of onset, and (proportional) persistence across countries, each country was given an equal sum of weights. IQR = interquartile range.

^a proportional persistence of suicidal ideation and suicide plan is defined as the percentage of lifetime years with ideation or plan, among lifetime ideators or planners, respectively.

^b persistence of suicide attempts is defined as the actual number of lifetime suicide attempts among lifetime attempters.

Table 2. Prevalence, age of onset, and proportional persistence of suicidal ideation in the WMH-ICS, by country.

	sample size	lifetime	12-month	age of onset	Persistence	
					12-month/lifetime	proportional persistence ^a
					n	% (95%CI)
All countries ^b	13,984	32.7 (31.5-34.0)	17.2 (16.2-18.2)	14.2 [12.2-15.8]	52.5 (50.2-54.9)	41.2 [21.8-70.1]
Australia	529	44.6 (40.0-49.2)	25.7 (21.7-29.7)	14.1 [8.8-16.3]	57.5 (50.6-64.5)	32.7 [14.3-67.2]
Belgium	4,490	15.2 (14.1-16.2)	7.0 (6.3-7.8)	13.8 [11.2-15.5]	46.2 (42.4-50.0)	29.1 [15.8-53.6]
Germany	652	37.1 (33.3-41.0)	18.8 (15.7-21.9)	14.2 [12.5-15.7]	50.5 (44.1-57.0)	40.8 [21.1-69.2]
Mexico	4,190	23.0 (21.7-24.3)	9.8 (8.9-10.8)	14.5 [12.5-16.0]	42.8 (39.6-46.1)	28.3 [17.6-56.1]
Northern-Ireland	711	30.6 (27.2-34.0)	18.5 (15.6-21.4)	14.7 [13.2-15.9]	60.3 (53.8-66.8)	45.2 [23.4-72.3]
South-Africa	666	42.5 (38.6-46.4)	24.3 (21.0-27.7)	14.3 [12.5-15.9]	57.2 (51.1-63.3)	46.4 [25.7-74.9]
Spain	2,046	33.0 (29.6-36.5)	14.7 (12.3-17.2)	14.5 [12.7-16.0]	44.6 (38.5-50.7)	37.1 [22.1-61.7]
USA	700	35.9 (32.2-39.6)	18.8 (15.9-21.8)	13.5 [12.0-14.9]	52.5 (46.1-58.8)	54.3 [28.6-75.4]
F(ndf,ddf)[p-value] ^c	.	69.37(7,97881)[<0.01] ^d	46.56(7,83419)[<0.01] ^d	12.11(7,405182)[<0.01] ^d		16.21(7,41571)[<0.01] ^d

Note: IQR = interquartile range.

^a proportional persistence of suicidal ideation is defined as the percentage of lifetime years with ideation.

^b to obtain pooled estimates of prevalence, age of onset, and proportional persistence across countries, each country was given an equal sum of weights.

^c F-test to evaluate significant between-country difference in estimates based on multiple imputations. ndf = numerator degrees of freedom; ddf = denominator degrees of freedom.

^dSignificant findings.

Table 3. Socio-demographic and college-related correlates for lifetime suicidal thoughts and behaviors (STB) in the WMH-ICS surveys.

	predictor distribution ^a	ideation	plan	attempt	plan among ideators	attempt among ideators without plan	attempt among ideators with plan
	% (SE)	aOR (95%CI)	aOR (95%CI)	aOR (95%CI)	aOR (95%CI)	aOR (95%CI)	aOR (95%CI)
Being female	54.4 (0.7)	1.4 (1.3-1.6) ^d	1.3 (1.2-1.5) ^d	2.2 (1.7-2.9) ^d	1.0 (0.8-1.2)	1.2 (0.6-2.4)	2.0 (1.4-2.7) ^d
Age							
20 years or more	22.1 (0.6)	1.2 (1.0-1.4) ^d	1.4 (1.2-1.7) ^d	1.7 (1.3-2.3) ^d	1.3 (1.1-1.7) ^d	2.5 (1.1-5.7) ^d	1.4 (1.0-2.0)
19 years	26.2 (0.6)	1.0 (0.9-1.2)	1.2 (1.0-1.4)	1.3 (1.0-1.7)	1.2 (1.0-1.5) ^d	2.0 (1.0-4.1)	1.1 (0.8-1.5)
18 years ^b	51.7 (0.6)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)
	F(ndf,ddf)[p-value] ^c	3.03(2,135706)[0.05]	6.72(2,29880)[<0.01] ^d	7.52(2,46744)[<0.01] ^d	3.85(2,42841)[0.02] ^d	3.40(2,8749)[0.03] ^d	1.59(2,28505)[0.20]
Parental education							
Low	18.4 (0.5)	1.0 (0.8-1.1)	0.9 (0.7-1.1)	0.9 (0.6-1.2)	0.9 (0.7-1.1)	1.9 (0.8-4.5)	0.8 (0.5-1.2)
Medium	24.3 (0.6)	0.9 (0.8-1.0)	0.9 (0.7-1.0)	0.7 (0.5-1.0) ^d	1.0 (0.8-1.2)	1.6 (0.7-3.8)	0.7 (0.5-1.0) ^d
High	57.3 (0.7)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)
	F(ndf,ddf)[p-value] ^c	1.68(2,465)[0.19]	1.27(2,691)[0.28]	2.45(2,1030)[0.09]	0.35(2,446)[0.70]	1.26(2,903)[0.28]	2.40(2,681)[0.09]
Parents not married or at least one parent deceased	25.8 (0.6)	1.5 (1.3-1.6) ^d	1.4 (1.2-1.7) ^d	1.5 (1.2-2.0) ^d	1.1 (0.9-1.3)	1.0 (0.5-2.0)	1.2 (0.9-1.7)
Place raised							
Rural area	7.6 (0.4)	1.0 (0.8-1.2)	0.8 (0.6-1.2)	1.2 (0.7-2.0)	0.8 (0.5-1.1)	0.7 (0.1-4.0)	1.8 (0.9-3.7)
Suburbs	17.1 (0.6)	1.1 (0.9-1.4)	1.1 (0.8-1.4)	1.3 (0.8-2.0)	1.0 (0.7-1.4)	0.5 (0.1-2.1)	1.6 (0.9-2.8)
Town/village	20.5 (0.6)	1.1 (1.0-1.3)	1.0 (0.8-1.2)	1.1 (0.8-1.7)	0.9 (0.7-1.2)	1.2 (0.4-3.4)	1.1 (0.7-1.8)
Large city	26.8 (0.6)	1.0 (0.8-1.1)	0.9 (0.7-1.1)	1.4 (1.0-2.0) ^d	0.9 (0.7-1.2)	2.1 (0.9-4.7)	1.8 (1.2-2.8) ^d
Small city	28.0 (0.6)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)
	F(ndf,ddf)[p-value] ^c	1.14(4,359)[0.34]	1.02(4,482)[0.40]	1.09(4,483)[0.36]	0.50(4,264)[0.73]	1.58(4,4624)[0.18]	2.35(4,345)[0.05]
Religion							
Another religion	7.3 (0.4)	1.5 (1.1-1.9) ^d	1.7 (1.3-2.2) ^d	2.0 (1.2-3.3) ^d	1.5 (1.0-2.1) ^d	1.6 (0.3-7.7)	1.3 (0.7-2.4)
No religion	30.8 (0.7)	1.5 (1.3-1.7) ^d	1.8 (1.5-2.1) ^d	1.3 (1.0-1.7)	1.5 (1.3-1.9) ^d	1.2 (0.5-2.5)	0.8 (0.5-1.1)
Christian	61.9 (0.7)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)
	F(ndf,ddf)[p-value] ^c	23.63(2,1364) _d [<0.01]	28.96(2,730)[<0.01] ^d	4.10(2,145)[0.02] ^d	9.65(2,1035)[<0.01] ^d	0.27(2,402)[0.76]	2.29(2,202)[0.10]
Sexual orientation							
Non-heterosexual with same-sex sexual intercourse	5.4 (0.3)	4.2 (3.3-5.2) ^d	5.6 (4.4-7.2) ^d	7.9 (5.4-11.6) ^d	2.9 (2.1-3.9) ^d	6.1 (2.5-14.5) ^d	2.5 (1.6-4.0) ^d
Non-heterosexual without same-sex sexual intercourse	8.0 (0.4)	3.3 (2.7-3.9) ^d	4.3 (3.5-5.3) ^d	4.3 (2.9-6.5) ^d	2.4 (1.8-3.1) ^d	/	1.9 (1.1-3.1) ^d

Heterosexual - some same-sex attraction	14.1 (0.5)	1.9 (1.6-2.2) ^d	2.2 (1.9-2.7) ^d	2.3 (1.7-3.2) ^d	1.6 (1.3-2.0) ^d	1.0 (0.3-3.2)	1.3 (0.9-1.9)
Heterosexual - no same-sex attraction	72.6 (0.6)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)
F(ndf,ddf)[p-value] ^c		100.66(3,220)[<0.01] ^d	110.57(3,402)[<0.01] ^d	39.60(3,100)[<0.01] ^d	24.94(3,655)[<0.01] ^d	2.10(3,16)[0.14]	5.32(3,146)[<0.01] ^d
Current living situation							
Other	1.6 (0.2)	1.5 (0.9-2.3)	1.1 (0.7-2.0)	1.3 (0.5-3.5)	0.8 (0.4-1.7)	2.7 (0.5-15.8)	0.6 (0.2-2.3)
Private hall of residence	3.2 (0.3)	1.0 (0.7-1.4)	1.0 (0.7-1.5)	1.6 (0.9-3.0)	1.0 (0.6-1.7)	2.1 (0.4-10.7)	2.0 (0.9-4.4)
Shared house or apartment/flat	11.1 (0.4)	1.0 (0.8-1.2)	0.9 (0.7-1.2)	1.2 (0.8-1.7)	0.9 (0.7-1.2)	0.9 (0.3-2.9)	1.5 (0.9-2.4)
University or college hall of residence	27.8 (0.7)	1.1 (0.9-1.3)	1.1 (0.9-1.4)	1.0 (0.7-1.6)	1.1 (0.8-1.4)	2.3 (0.6-8.3)	0.8 (0.5-1.4)
Parents or other relative or own home	56.3 (0.7)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)
F(ndf,ddf)[p-value] ^c		0.75(4,200)[0.56]	0.40(4,160)[0.81]	0.59(4,135)[0.67]	0.21(4,332)[0.93]	0.68(4,158)[0.60]	2.04(4,323)[0.09]
Expected to work on a student job	72.4 (0.6)	0.8 (0.7-0.9) ^d	0.9 (0.7-1.0)	1.0 (0.7-1.3)	1.0 (0.8-1.3)	1.0 (0.5-2.1)	1.1 (0.8-1.6)
Self-reported ranking high school							
Bottom 70%	22.7 (0.6)	1.2 (1.0-1.4) ^d	1.1 (0.9-1.3)	1.2 (0.8-1.7)	0.9 (0.7-1.2)	1.1 (0.4-2.6)	1.1 (0.7-1.8)
Top 30 to 10%	30.2 (0.6)	1.0 (0.9-1.1)	0.9 (0.8-1.1)	1.0 (0.7-1.4)	0.9 (0.7-1.1)	0.5 (0.2-1.5)	1.1 (0.7-1.7)
Top 10 to 5%	22.3 (0.6)	1.0 (0.9-1.2)	0.9 (0.8-1.2)	1.0 (0.7-1.4)	0.9 (0.7-1.2)	1.1 (0.4-2.9)	1.0 (0.6-1.6)
Top 5%	24.8 (0.6)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)
F(ndf,ddf)[p-value] ^c		2.72(3,327)[0.04] ^d	0.83(3,312)[0.48]	0.64(3,812)[0.59]	0.54(3,2489)[0.65]	0.78(3,1033)[0.51]	0.20(3,1057)[0.90]
Most important reason to go to college extrinsic	10.6 (0.5)	1.1 (0.9-1.4)	1.2 (0.9-1.5)	1.5 (1.0-2.2) ^d	1.1 (0.9-1.5)	1.2 (0.4-3.9)	1.3 (0.8-2.1)

Note: all models adjusted for the predictors shown in the rows, and for country membership. We additionally tested all possible two-way interactions between predictors shown in the rows; none were significant after adjusting for false discovery rate ($Q = 0.05$); $\alpha = 0.05$. aOR = adjusted odds ratio; SE = standard error.

^a to obtain pooled estimates of predictor distributions across countries, each country was given an equal sum of weights.

^b 16 and 17 year old respondents ($n = 2$ [$<0.01\%$], and $n = 307$ [0.8%], respectively) were classified in the 18 year old respondent group for all analyses.

^c F-test to evaluate joint significance of categorical predictor levels based on multiple imputations. ndf = numerator degrees of freedom; ddf = denominator degrees of freedom.

^dSignificant findings

Table 4. Socio-demographic and college-specific factors for lifetime suicidal thoughts and behaviors (STB) in the WMH-ICS Surveys, country effect vs. overall effect.

	Overall Effect	Australia	Belgium	Germany	Mexico	Northern-Ireland	South-Africa	Spain	USA
	aOR (95%CI)	aOR (95%CI)	aOR (95%CI)	aOR (95%CI)					
Being female	1.3 (1.2-1.5) ^b	0.6 (0.5-0.9) ^b	0.8 (0.7-1.0) ^b	0.9 (0.7-1.3)	1.4 (1.2-1.7) ^b	1.4 (1.0-1.9) ^b	1.1 (0.8-1.5)	0.9 (0.8-1.2)	0.9 (0.7-1.3)
Age									
20 years or more	1.2 (1.0-1.5) ^b	1.6 (1.0-2.4) ^b	1.6 (1.1-2.2) ^b	0.6 (0.4-0.9) ^b	0.8 (0.7-1.1)	1.2 (0.8-1.8)	0.8 (0.5-1.3)	0.7 (0.5-1.0) ^b	1.1 (0.4-3.1)
19 years	0.9 (0.8-1.1)	0.9 (0.5-1.4)	1.5 (1.2-1.9) ^b	1.0 (0.7-1.5)	1.2 (0.9-1.4)	0.8 (0.5-1.2)	0.8 (0.5-1.1)	1.0 (0.8-1.3)	1.1 (0.8-1.6)
18 years ^b	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)
Parental education									
Low	1.0 (0.8-1.2)	1.1 (0.6-2.0)	1.1 (0.8-1.5)	0.9 (0.6-1.3)	0.9 (0.7-1.2)	1.0 (0.6-1.4)	1.6 (1.0-2.8)	1.0 (0.7-1.3)	0.7 (0.3-1.6)
Medium	0.9 (0.7-1.0) ^b	1.0 (0.6-1.9)	1.0 (0.8-1.4)	1.2 (0.8-1.8)	1.0 (0.8-1.3)	0.9 (0.6-1.3)	1.1 (0.7-1.6)	1.1 (0.8-1.3)	0.7 (0.4-1.2)
High	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)
Parents not married or at least one parent deceased	1.4 (1.3-1.6) ^b	1.1 (0.6-1.9)	1.0 (0.8-1.3)	1.0 (0.7-1.4)	1.0 (0.8-1.2)	1.5 (1.0-2.1) ^b	0.8 (0.6-1.1)	1.2 (1.0-1.6)	0.6 (0.4-0.9) ^b
Place raised									
Rural area	1.0 (0.7-1.3)	0.9 (0.3-3.0)	1.2 (0.7-2.1)	0.8 (0.4-1.5)	1.1 (0.7-1.7)	0.7 (0.4-1.3)	1.6 (0.7-3.7)	1.5 (0.7-3.0)	0.6 (0.2-1.7)
Suburbs	1.0 (0.8-1.2)	1.2 (0.6-2.6)	1.4 (0.9-2.2)	0.7 (0.4-1.2)	1.2 (0.7-1.9)	0.7 (0.4-1.3)	1.7 (0.9-3.1)	0.6 (0.4-1.0)	1.1 (0.7-1.7)
Town/village	1.1 (0.9-1.4)	1.2 (0.6-2.5)	1.2 (0.8-1.7)	0.7 (0.5-1.1)	1.0 (0.7-1.4)	0.9 (0.5-1.5)	1.0 (0.3-3.1)	1.0 (0.8-1.4)	1.1 (0.6-2.0)
Large city	0.9 (0.7-1.1)	1.3 (0.7-2.3)	1.2 (0.9-1.6)	0.7 (0.4-1.1)	1.0 (0.8-1.3)	0.6 (0.3-1.4)	1.3 (0.7-2.4)	1.5 (1.1-1.9) ^b	0.7 (0.5-1.2)
Small city	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)
Religion									
Another religion	1.4 (1.0-1.8) ^b	1.2 (0.5-2.7)	1.3 (0.8-2.1)	0.8 (0.4-1.5)	1.2 (0.8-1.9)	0.6 (0.2-2.3)	1.1 (0.6-2.0)	1.6 (0.8-3.0)	0.6 (0.4-1.1)
No religion	1.5 (1.3-1.7) ^b	1.1 (0.7-1.7)	1.1 (0.8-1.3)	1.3 (0.9-1.9)	1.1 (0.9-1.4)	1.1 (0.8-1.6)	0.7 (0.5-1.1)	0.8 (0.7-1.0)	0.9 (0.6-1.3)
Christian	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)
Sexual orientation									
Non-heterosexual with same-sex sexual intercourse	5.1 (3.9-6.8) ^b	1.4 (0.6-3.3)	1.0 (0.6-1.8)	1.2 (0.5-2.7)	0.5 (0.3-0.7) ^b	1.5 (0.7-3.3)	1.0 (0.3-3.1)	0.6 (0.4-1.0)	1.2 (0.6-2.4)
Non-heterosexual without same-sex sexual intercourse	3.6 (2.8-4.5) ^b	1.2 (0.5-2.8)	1.1 (0.7-1.6)	0.9 (0.5-1.5)	0.6 (0.4-0.8) ^b	0.9 (0.5-1.8)	1.4 (0.6-3.4)	1.0 (0.7-1.7)	1.2 (0.7-1.9)
Heterosexual - some same-sex attraction	2.1 (1.8-2.5) ^b	0.8 (0.5-1.5)	1.0 (0.7-1.4)	1.1 (0.8-1.7)	1.0 (0.7-1.2)	2.4 (1.4-4.1) ^b	0.9 (0.5-1.8)	0.7 (0.5-0.9) ^b	0.7 (0.5-1.1)
Heterosexual - no same-sex attraction	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)
Current living situation									
Other	1.5 (0.8-3.0)	1.3 (0.3-5.9)	1.0 (0.4-2.7)	0.4 (0.1-1.2)	0.7 (0.3-1.9)	1.0 (0.3-3.6)	0.6 (0.0-10.4)	1.2 (0.5-2.7)	4.0 (0.2-78.1)

Private hall of residence	1.2 (0.7-1.9)	0.9 (0.3-3.0)	1.0 (0.4-2.2)	0.8 (0.4-1.7)	0.7 (0.4-1.3)	1.9 (0.5-7.1)	0.8 (0.2-3.2)	0.9 (0.3-2.2)	1.5 (0.2-13.1)
Shared house or apartment/flat	0.9 (0.5-1.5)	1.2 (0.5-3.0)	1.2 (0.7-2.3)	1.2 (0.6-2.4)	1.1 (0.6-1.9)	1.2 (0.6-2.5)	1.2 (0.4-3.4)	1.2 (0.7-2.2)	0.3 (0.0-10.0)
University or college hall of residence	1.1 (0.8-1.5)	0.8 (0.4-1.6)	1.1 (0.7-1.7)	0.9 (0.5-1.5)	0.8 (0.4-1.6)	1.1 (0.7-1.8)	1.1 (0.6-1.8)	0.8 (0.5-1.3)	1.6 (0.3-10.2)
Parents or other relative or own home	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)
Expected to work on a student job	0.8 (0.7-1.0) ^b	1.1 (0.6-1.8)	1.0 (0.8-1.3)	0.6 (0.5-0.9) ^b	1.2 (0.9-1.4)	1.4 (0.9-2.1)	1.0 (0.6-1.6)	0.7 (0.6-0.9) ^b	1.4 (1.0-1.9)
Self-reported ranking high school									
Bottom 70%	1.2 (1.0-1.4)	1.0 (0.6-1.9)	1.0 (0.8-1.5)	0.6 (0.4-1.0) ^b	0.8 (0.7-1.1)	0.8 (0.5-1.4)	0.8 (0.5-1.4)	1.9 (1.4-2.5) ^b	1.4 (0.8-2.5)
Top 30 to 10%	0.9 (0.8-1.1)	0.9 (0.5-1.6)	1.2 (0.9-1.7)	0.8 (0.5-1.3)	1.0 (0.8-1.2)	1.0 (0.6-1.8)	0.7 (0.5-1.1)	1.4 (1.1-1.9) ^b	1.0 (0.7-1.5)
Top 10 to 5%	1.0 (0.8-1.1)	1.3 (0.7-2.3)	1.1 (0.8-1.5)	0.9 (0.5-1.5)	1.0 (0.7-1.2)	0.8 (0.4-1.5)	0.6 (0.4-1.0) ^b	1.5 (1.1-2.1) ^b	1.0 (0.7-1.5)
Top 5%	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)
Most important reason to go to college extrinsic	1.1 (0.8-1.3)	1.1 (0.5-2.5)	1.2 (0.8-1.8)	1.1 (0.6-1.9)	1.1 (0.9-1.5)	1.0 (0.5-2.0)	1.1 (0.6-2.1)	0.6 (0.4-1.2)	0.8 (0.4-1.6)

Note: each row shows a separate logistic regression model with any lifetime STB as the outcome variable, adjusting for all other predictor variables (rows), country membership, and predictor-by-country interaction dummies. The second column shows the overall adjusted predictor variable effect; the country columns show to what extent the country-specific adjusted predictor variable effect deviates from the overall adjusted predictor variable effect. For example, the country-specific effect for “Non-heterosexual with same-sex sexual intercourse” (versus “Heterosexual - no same-sex attraction”) in Mexico can be obtained by multiplying aOR = 5.1 (the overall effect) by aOR = 0.6 (the country-specific deviation), i.e., aOR = 2.6. $\alpha = 0.05$. aOR = adjusted odds ratio; CI = confidence interval; SE = standard error.

^a 16 and 17 year old respondents (n = 2 [$<0.01\%$], and n = 307 [0.8%], respectively) were classified in the 18 year old respondent group for all analyses.

^bSignificant findings

Figure 1. Cumulative age of onset distribution for suicidal thoughts and behaviors (STB) in the WMH-ICS.

Note: projected age of onset distributions are based on first-year students only, limiting the representativeness of the estimated distributions above age 18-19 years (i.e., the typical age of entering college).

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Suicidal Thoughts and Behaviors Among First-Year College Students: Results From the WMH-ICS Project

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Dr. Ebert has served as a consultant to/on the scientific advisory boards of Minddistrict, Lantern, Schoen Kliniken, and German health insurance companies (BARMER, Techniker Krankenkasse). He is also stakeholder of the Institute for health training online (GET.ON), which aims to implement scientific findings related to digital health interventions into routine care.

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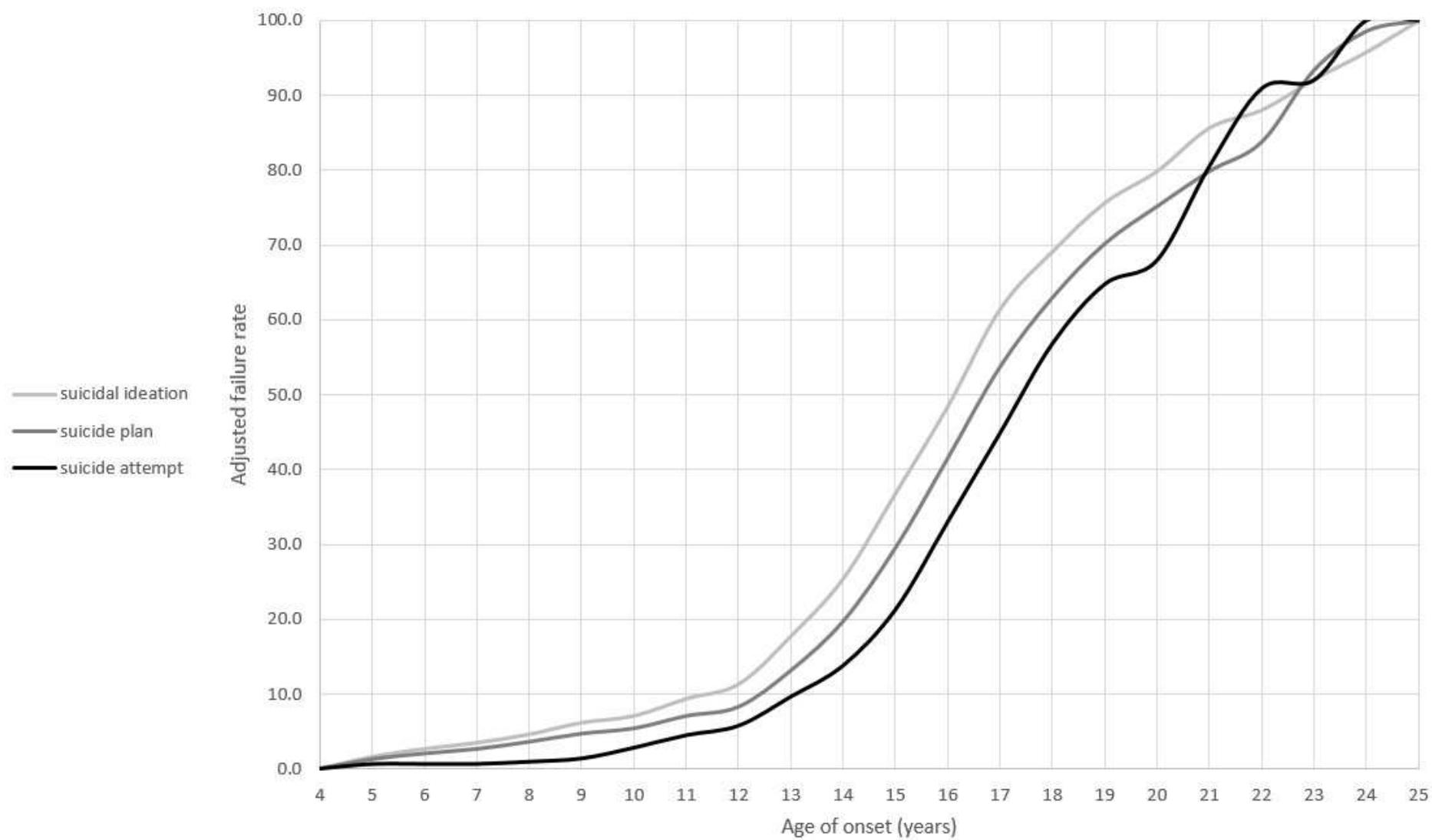


Table S1 WMH-ICS sample characteristics.

Country	Number of participating universities	Total size of the universities	Number of first-year students eligible	Number of first-year students participated	Response Rate	Survey Field Dates	Sampling and procedures
Australia	one public	~ 45,000	9,042	633	7.0%	2016	All first-year students were invited to participate through e-mail. Five reminder emails were sent with personalized links to the survey. Conditional incentives were applied (movie passes).
Belgium	one public	~ 40,000	8,530	4,580	53.7%	2014-16	All first-year students were invited for a psycho-medical check-up in the student mental health center. Surveys were completed in the waiting room. Students who did not show up for the psycho-medical check-up received up to eight reminder emails. Conditional incentives were applied (store credit coupons).
Germany	one public	~ 40,000	5,064	677	13.4%	2016-17	All first-year students were invited to participate through e-mail. Six reminder emails were sent with personalized links to the survey. Conditional incentives were applied (store credit coupons).
Mexico	four private/two public	~ 28,000	5,293	4,199	79.3%	2016	All first-year students were eligible for the survey. Initial contact differed by university: survey included in an obligatory health evaluation (1 university), as part of obligatory group tutoring sessions (1 university), or as part of required classes (2 universities) or teacher evaluations (2 universities). Two universities sent reminder emails (tutors sent out emails to their tutees; in a required class of personal development, reminders were sent out by faculty). No incentives were applied.
Northern- Ireland	one public	~ 25,000	4,359	739	17.0%	2015	All first-year students due to register were invited to participate. Following registration, ID numbers and links to the survey were provided. Five reminder emails/text messages were sent with personalized links to the survey. A 6th reminder involved a researcher telephoning non-responders. All responders were entered into a number of draws to win an iPad.
South-Africa	one public	~ 30,000	5,338	686	12.9%	2015	All first-year students were invited to participate through e-mail. Eight reminder emails and one text message were sent with personalized links to the survey. Conditional incentives were applied (5x R1000 draw).
Spain	five public	~ 96,000	16,332	2,118	13.0%	2014-15	All first-year students were eligible for the survey. Initial contact differed by university (information stands, information sessions in classrooms, through the university's website). Four reminder emails were sent with personalized links to the survey. Conditional monetary incentives were applied. Additionally, an end-game strategy was implemented by selecting a random proportion of non-respondents and offering all of them a monetary incentive.
United States	three private	~ 21,800	4,382	739	16.9%	2015-16	All first-year students were invited to participate through e-mail. Three reminder emails were sent with personalized links to the survey. Conditional incentives were applied (gift cards).
Total	12 public/7 private	~ 326,000	58,340	14,371	45.5% ^a	2014-17	

^a weighted by achieved sample size