RESEARCH

Predictors of suicidal behaviors among school-going adolescents: a cross sectional study in Indonesia

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Abstract

Background Adolescents are a high-risk age group for committing suicide, and the risk substantially increases from early to late adolescence. Adolescence also serves as critical time period for early detection and intervention to prevent suicidal behaviors. This study aimed to assess the prevalence of suicidality and identify significant predictors of suicidality among adolescents.

Methods A cross-sectional observational study was conducted between January-December 2023. Adolescents aged 14–18 years old ($n = 2317$) were consecutively recruited from 15 high schools across four provinces on Java Island in Indonesia. Self-reported validated instruments in Indonesian were used to assess sociodemographic profiles, self-esteem (RSES), hopelessness (BHS), loneliness (ULS-3), perceived social support (MSPSS), depression (PHQ-9), resilience (CD-RISC-10), suicidality (SBQ-R). With adjusted odds ratio (AOR) and 95% confidence interval (CI), binary logistic regression analysis was used to determine significant predictors of suicidality.

Results The prevalence of lifetime suicide ideation was 26.5%, lifetime suicide plans were 18.2%, lifetime suicide threat was 14.1%, and lifetime suicide attempt was 4.4%. The prevalence of 12-month suicide ideation was 43.1%. The following variables were identified and significantly associated with suicidality ($p < 0.05$): female students (AOR = 1.912; 95%CI:1.507–2.425), chronic illness (AOR = 2.886; 95%CI:1.545–5.389), low resilience (AOR = 1.347; 95%CI:1.036–1.750), low self-esteem (AOR = 2.020; 95%CI:1.578–2.585), low family support (AOR = 3.532; 95%CI:2.486–5.017), loneliness (AOR = 1.611; 95%CI:1.211–2.143), depression (AOR = 4.882; 95%CI = 3.861–6.175), and hopelessness (AOR = 1.602; 95%CI:1.154–2.224). Nagelkerke R square was 0.364 indicating the regression model explained 36.4% of variance in suicidality.

Conclusions Our study revealed several significant predictors of suicidality among adolescents which can be targeted to develop suicide prevention strategies.

Keywords Suicidality, Prevalence, Predictors, Adolescence, Indonesia

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Introduction

Suicide is when someone dies because they intentionally kill themselves, whereas suicidality is a term frequently used to describe a variety of suicidal behavior including suicidal ideation, plans, threats, attempts, and complete suicide [1, 2]. Suicidal ideation, plans, threats, and attempts considered as non-fatal suicidality, whereas complete suicide considered as fatal suicidality because it result in death [2].

Suicide is a major global health problem and has become the second leading cause of death among adolescents between 10 to 19 years of age [3]. The World Health Organization (WHO) estimated that the suicide rate for this age group from 2010 to 2016 was 3.77/100,000 people [4]. A recent study found that the global 12-month pooled prevalence of suicidal ideation among adolescents was 14.0% [5].

While early childhood is a relatively low-risk period for suicide, starting from early adolescence onward, the likelihood of this life-threatening behavior rises significantly [4, 6]. Suicidality can occur in adolescence even without underlying psychiatric illness [7]. Moreover, despite ranking among the high suicide-risk groups, adolescents are also renowned as poor help-seekers, which can contribute to their delayed care and unmet needs. For example, one recent study found that adolescents who were at risk for suicide saw a roughly one-year delay in seeking medical attention following their first attempted suicide [8], which underscores the need for more proactive detection and prevention strategies for this vulnerable and sometimes marginalized, at-risk group.

Suicidality is a complex multi-factorial phenotype [9]. This life-threatening behavior is considered the endpoint of a complex interaction involving genetic factors, including Single Nucleotide Polymorphism (SNP) in the DNA sequence of numerous protein-coding genes within the human genome such as BDNF, NTRK2, NLGN1, SOX5, THP1, 5-HTT [10, 11]; among others, and non-genetic factors including individual psychological-psychopathological characteristics [9]. Previous studies highlighted various risk factors of suicidality among adolescents, including dissatisfied grade results, poor social support [1, 12], alcohol use [13, 14], loneliness [5, 14, 15], depressive symptoms [16–19], hopelessness [16, 20, 21], low resilience [16, 22, 23], female gender and cigarette smoking [1, 14].

High-income countries have conducted extensive research on suicidal behaviors. However, there is still limited evidence on this topic in low-income and middle-income countries (LMICs) [17]. It is estimated that 75% of global suicides occur in LMICs, but the suicide data in these countries remains under-reported [1]. Indonesia, a predominately Muslim LMIC in Southeast Asia and regarded as the fourth most populous country in the world, currently suffers from under-reporting regarding the suicide rate data due to poor suicide data registry in the country [24]. According to recent WHO classifications, Indonesia's suicide data registry has the lowest quality score, suggesting unreliable and less valid data. The reported data from 2016 to 2018 revealed that the suicide rate in Indonesia ranged from 46.65 to 52.10 per 100,000 deaths, and it is estimated that the suicide deaths could be as much as four-fold higher than that reported [24].

In Indonesia, the Global School-Based-Students Health Survey (GSHS) was conducted in 2015 to assess the prevalence of suicidality among adolescents [1, 14]. However, more recent research to explore possible risk factors and protective factors among adolescents in Indonesia is still limited. Moreover, suicide prevention programs specifically targeting these possible protective and risk factors of suicidality for adolescents in this region remain inadequate [1, 17]. Considering the insufficient evidence regarding this serious problem in Indonesia, the purpose of this study was to investigate the prevalence and risk factors of suicidality in Indonesian adolescents. Since adolescence is also considered a critical period for early detection and intervention to prevent suicidal behavior [6], the identification of risk and protective factors for suicidal behaviors in adolescents is urgently needed. Understanding the risk and protective factors of suicidality among adolescents would serve as an important 'stepping stone' toward the development of novel early detection strategies to identify adolescents who are at risk for suicide and the implementation of more effective and proactive suicide prevention strategies for these vulnerable populations in the country.

Methods

Study design, setting, and period

This cross-sectional study was conducted at 15 public high schools across 4 provinces in Java Island, Indonesia: West Java, Central Java, Yogyakarta, and East Java. The data were collected in an 12 months period from January until December 2023.

Sample size calculation and sampling method

Calculation using the logistic regression rule of thumb equation was performed to determined minimum sample size for this study, described as $n = 100 + 50(i)$ where i refers to the number of independent variables in regression model [16]. Based on the assumption above, the minimum sample size was $n = 100 + 50(14) = 800$. The participants were recruited using consecutive sampling, and the eligibility criteria for this study were: high school students aged 14 to

18 years old, had academic grade of 10 until 12, using WhatsApp as a means of communication, and agreed to voluntarily participate by signing the informed consent form.

Data collection

The academic affairs office of each high school provided the student demographic data, including their name, students ID number, academic grade, sex, age, and WhatsApp number, that were used to identify the students who met the eligibility criteria. The eligible students were then contacted by the researchers via WhatsApp and explained about the study information. After this recruitment step, the researchers asked for their willingness to participate in the study. If they consented to participate, the researchers then made a schedule for when the data collection process would be done, and then the researchers made an appointment with the participants based on the previously made schedule.

The data collection process was carried out through a face-to-face interview. To ensure the participants privacy, confidentiality, and comfort when they fill out the study questionnaires, the data collection process was conducted in the consultation room of the Student's Guidance and Consultation Unit in each high school. Additionally, to further provide privacy and comfort to participants, there was only one participant and one researcher in the room at a time. Firstly, the researchers once again explained the study information to the participants, and then the researchers asked them whether they were still willing to voluntarily participate in the study. If they consented to participate, they were asked to sign the informed consent form as a prerequisite to participating in the study. After participants signed the informed consent, the researchers explained to them the information about each study questionnaire and how those questionnaires were filled out. If the participants understood, they were asked to fully complete the study questionnaires. The researchers then left the participants alone and stayed a short distance away during the process of filling out the questionnaires, so that the researchers would be available if there were questions from the participants. Participants are able to reach the researchers with any questions they may have while completing the questionnaires, and the researchers will be delighted to answer them. After the participants completed the questionnaires, the researchers checked them out, and if there was an incomplete questionnaire, the researchers asked the participants to complete it. This procedure was repeated to recruit participants until the end of the data collection period.

Instruments

The data was collected using a sociodemographic questionnaire and seven standardized self-rated instruments in Indonesian language that have been validated in previous studies.

A sociodemographic profile questionnaire was administered to assess several participant's information, including sex, age, academic grade, origin of school, religion, monthly family income, financial issues, smoking status, alcohol consumption status, participation in extracurricular activities, and satisfaction with grade point average (GPA).

Self-esteem among high school students was assessed using the Rosenberg Self-Esteem Scale (RSES). The RSES is a self-rated scale that is widely used to examine self-esteem among clinical and non-clinical samples, both in adults and adolescents [25], and this instrument consists of 10 items with 5 items being favorable statements and 5 items being unfavorable statements. Each item has four possible answers and is ranked using a Likert scale [26]. Items 2, 5, 6, 8, and 9 were considered as unfavorable statements, and the scores ranged from strongly agree (1 point) to strongly disagree (4 points). Items 1, 3, 4, 7, and 10 were considered as favorable statements and the scoring were reversed [26]. The RSES total scores can be obtained by adding the scores from each item, which range from 10 to 40 and are classified into 3 levels based on the total score obtained by the participants: low (10–25), moderate (26–29), and high self-esteem (30–40) [26]. Previous study provided evidence that the Indonesian version of this instrument is valid and reliable to assess self-esteem among general population with Cronbach's $\alpha = 0.82$ [27]. Moreover, this instrument has also been validated among Indonesian adolescents and showed high internal reliability with Cronbach's $\alpha = 0.899$ [28].

Loneliness among high school students was assessed using the UCLA Loneliness Scale Three-Item (ULS-3). This instrument is a self-rated scale that is widely used to examine degree of loneliness among adolescents [29]. ULS-3 consists of three items and each item had three possible answers which are ranked on a Likert scale as follows: hardly ever (1 point), some of the time (2 point), and often (3 point). The ULS total scores can be obtained by adding the scores from each item. The ULS-3 total score ranges between 3–9 with higher scores representing higher loneliness level [30]. Based on the total score obtained by participants, loneliness is categorized into two groups: lonely (≥ 6), and not lonely (< 6). A previous study validated the Indonesian version of ULS-3 among Indonesian adolescents and provided evidence that the Indonesian version of this instrument is valid and reliable to assess loneliness among adolescents with Cronbach's $\alpha = 0.81$ [31].

The social support perceived by high school students was rated using the Multidimensional Scale of Perceived Social Support (MSPSS). Originally developed to assess perceived social support among university students and adolescents [32], MSPSS has since been widely used to examine the social support perceived by adolescents [33]. This instrument comprise of 12 items and each item had 7 possible answers rated using a Likert scale ranging from "very strongly disagree" (1 point) to "very strongly agree" (7 points). The MSPSS is also divided into three domain that represent the source of social support: Family support consisting of 4 items (items 3, 4, 8, and 11), Friends support consisting of 4 items (items 6, 7, 9, and 12), and Significant Others support consisting of 4 items (items 1, 2, 5, and 10). The MSPSS total scores, which range from 12 to 84, can be obtained by adding the scores from each item, and better scores imply better social support as reported by a person. Moreover, by summing the items in each of the three domain and dividing the result by 4, one can find the social support score on each of the three domains [34]. The social support from each domain then can be categorized into three levels: low support (1–2.9), moderate support (3–5), and high support (5.1–7) [35]. A previous study validated the Indonesian version of MSPSS among Indonesian adolescents and provided evidence that the Indonesian version of this instrument is valid and reliable with Cronbach α of 0.81 for the Family domain, 0.82 for the Friend's domain, and 0.75 for the Significant others domain [34].

To assess hopelessness among high school students, the Beck Hopelessness Scale (BHS) was administered. The BHS is a standardized self-rated instrument widely validated and used as a tool to examine hopelessness in the general population as well as adolescents, both in clinical and non-clinical settings [36]. The BHS consists of 20 items (11 negative statements and 9 positive statements) and each item has two possible answers: true/false. Items with negative statements were scored as follows: true (1 point) and false (0 point), whereas the items with positive statements were reverse scored. The BHS total scores, which range from 0 to 20, can be obtained by adding the scores from each item, with higher scores representing a higher severity of hopelessness [2]. The BHS total score ≥ 9 was used as the cut off-point to determine the hopelessness status among participants [2]. The Indonesian version of the BHS is considered to be a valid and reliable instrument for assessment of hopelessness among general population (Cronbach's $\alpha = 0.918$) [37]. Moreover, this instrument has also been validated among Indonesian adolescents and showed high internal reliability with Cronbach's $\alpha = 0.867$ [38].

The 9-Item Patient Health Questionnaire (PHQ-9) was used to assess depression symptoms among high school students [2]. The PHQ-9 is a standardized self-rated instrument widely validated and used as a tool for screening for depression in different age groups including adolescents, both in clinical and non-clinical settings [39]. The PHQ-9 consists of nine items and each item has four answer choices rated using a Likert scale ranging from 0 (never at all) to 3 (almost every day). The PHQ-9 total scores, which range from 0 to 27, can be obtained by adding the scores from each item, with higher scores indicate more severity of depression. The PHQ-9 total score that each participant received was further categorized into two groups: normal (< 10) and depression (≥ 10) [2]. A previous study provided evidence that the Indonesian version of this instrument is valid and reliable to assess depression symptoms among university students with Cronbach's $\alpha = 0.89$ [40]. Moreover, this instrument has also been validated among Indonesian adolescents and showed robust internal reliability with Cronbach's $\alpha = 0.777$ [41].

Resilience among high school students was measured using the 10-Items of the Connor-Davidson Resilience Scale (CD-RISC-10). The CD-RISC-10 is a standardized self-rated instrument widely validated and used as a tool to examine psychological resilience in different age groups of populations including adolescents, both in clinical and non-clinical settings [42, 43]. The CD-RISC-10 consists of 10 items with five possible responses rated using a Likert scale ranging from "not true at all" (0 point) to "true nearly all the time" (4 points) [44]. The total scores of this instrument, which range from 0 to 40, can be obtained by adding the scores from each item, with higher scores representing higher resilience [44]. Furthermore, the psychological resilience level was categorized into two groups based on the total score obtained by participants: high resilience (≥ 25.5), and low resilience (< 25.5) [44]. A previous study provided evidence that the Indonesian version of this instrument is valid and reliable to assess the resilience level in general population with Cronbach's $\alpha = 0.868$ [45]. Additionally, this instrument has also been validated among Indonesian adolescents and showed high internal reliability with Cronbach's $\alpha = 0.919$ [46].

To assess suicidality among high school students, the Suicidal Behaviors Questionnaire-Revised (SBQ-R) was administered. The SBQ-R is a standardized self-rated instrument widely validated and used as a tool for screening the presence of suicidal behavior in different age groups including adolescents, both in clinical and non-clinical settings [47, 48]. This instrument consists of four items rated using Likert-scale [2]. The first item has six possible responses to determine lifetime suicide ideation and/or suicide attempts. The second item has five possible responses to determine 12-months suicide ideation.

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The third item has five possible responses to determined lifetime suicide threat. The last item has seven possible responses to determine the future probability of conducting suicide. The total score ranges from 3 to 18 and was categorized into two groups: high suicidality (≥ 7), and low suicidality (<7) [2]. Previous study provided evidence that the Indonesian version of this instrument is valid and reliable to assess suicidality among general population with Cronbach's $\alpha = 0.760$ [49]. Moreover, this instrument has also been validated among Indonesian adolescents and showed high internal reliability with Cronbach's $\alpha = 0.89$ [50].

Ethical considerations

The ethical clearance (number: 005.3/FIKES/PL/I/2023) was granted by the Institutional Review Board of Universitas Respati Yogyakarta, Indonesia on January 27, 2023. Before the data collection, detailed research information was provided to the participants and the informed consent was obtained from them before commencing the study. The participant's identity and their data were kept confidential throughout the study, with only the researcher having access to the study data.

Statistical analysis

The Windows Version of SPSS 24 (IBM Corp, Armonk, NY) was used as software to perform statistical analysis. Bivariate analysis utilizing Chi-square test was employed for all independent variables to obtain p-value and crude odds ratio (COR) along with its associated 95% confidence interval (CI). Binary logistic regression analysis was performed as multivariable analysis to obtain *p*-value and adjusted odds ratio (AOR) along with its associated 95% confidence interval (CI). The *p*-value < 0.05 was considered statistically significant. Independent variables with $p < 0.25$ in the Chi-square tests were included in the logistic regression analysis. To test the goodness of fit in the logistic regression model, Hosmer and Lemeshow tests were employed. The Nagelkerke R Square value was obtained to analyze the extent to which the whole model accounted for the variance observed in the dependent variable.

Results

Sociodemographic profiles of the participants

In this study, 2317 high school students who meet the eligibility criteria voluntarily participated and their sociodemographic data are provided in Table 1. The average age of the participants was 16.30 years with standard deviation (SD) of 0.98 and ranged between 14 to18 years. Most participants are female ($n = 1375$; 59.3%). In the Indonesian education system, high school education program is a 3-year program and divided into 3 academic

Table 1 Sociodemographic characteristics of the participating high school students ($n = 2317$)

Sociodemographic profiles	n	%
Age (years)—Mean (SD)	16.30 (0.98)	
Sex		
Male	942	40.7
Female	1375	59.3
Family Income (IDR)/Month		
Under 500 thousand	259	11.2
500 thousand—1 million	561	24.2
1 million–2 million	542	23.4
2 million–3 million	379	16.4
Above 3 million	576	24.9
Grade		
10	`1016	43.8
11	750	32.4
12	551	23.8
Religion		
Muslim	2024	87.4
Christian	147	6.3
Catholic	126	5.4
Hindu	13	0.6
Buddhist	4	0.2
Others	3	0.1
Financial difficulties		
No	1284	55.4
Yes	1033	44.6
Smoking		
No	2219	95.8
Yes	98	4.2
Alcohol consumption		
No	2281	98.4
Yes	36	1.6
Participation in extracurricular activity		
No	761	32.8
Yes	1556	67.2
Self reported chronic medical condition		
No	2261	97.6
Yes	56	2.4
Satisfaction with academic achievement		
Satisfied	792	34.2
Dissatisfied	1525	65.8

Abbreviations: *SD* standard deviation, *IDR* Indonesian Rupiah

grades (grade 10 to 12). Most of the high school students who participated in this study were grade 10 students ($n = 1016$; 43.8%). Based on their religion, most of the participants are Muslim ($n = 2024$; 87.4%). Most of the participants self-reported a monthly family income above IDR 3 million ($n = 576$; 24.9%) and indicted they did not have financial difficulties ($n = 1284$; 55.4%). The majority

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Table 2 Profile of major individual psychological independent variables (*n* = 2317)

Variables	n	%
Self-esteem		
High	516	22.3
Moderate	1045	45.1
Low	756	32.6
Loneliness		
Lonely	1624	70.1
Not lonely	693	29.9
Family Support		
High	1147	49.5
Moderate	952	41.1
Low	218	9.4
Friends support		
High	1037	44.8
Moderate	1096	47.3
Low	184	7.9
Significant others support		
High	691	29.8
Moderate	975	42.1
Low	651	28.1
Hopelessness		
Yes	264	11.4
No	2053	88.6
Depression		
Yes	901	38.9
No	1416	61.1
Resilience		
High	1245	53.7
Low	1072	46.3

of the high school students participated in some extra-curricular activities (*n* = 1556; 67.2%) and were dissatisfied with their current academic achievement (*n* = 1525; 65.8%). Only 4.2% of the students reported they were smoking, and 1.6% reported consuming alcohol. As many as 56 students (2.4%) reported that they had a chronic illness.

Profile of major individual psychological predictor variables

Table 2 shows the detailed information about the individual psychological predictor variables assessed in this study. Most of the participants had high resilience (*n* = 1245; 53.7%) and moderate self-esteem (*n* = 1045; 45.1%). Based on the source of social support, almost half of the participants reported receiving high Family support (*n* = 1147; 49.5%), while reported moderate Friends support (*n* = 1096; 47.3%) and Significant others support (*n* = 975; 42.1%). The prevalence of loneliness and depression among students were surprisingly high (70.1% and 38.9%, respectively), whereas the prevalence of hopelessness among students were 11.4%.

Suicidality among high school students in Indonesia

Table 3 shows the trends of suicidal behavior among high school students as determined by the SBQ-R. Our study indicated that 601 (25.9%) of the high school students had high suicidality. In their lifetime, 26.5% of the participants had a suicide ideation, 18.2% had suicide plans, 14.1% had a suicide threat, and 4.4% had suicide attempts. It should be noted that logically suicide ideation is also present among the participants with suicide planning, threats, and attempts. In the last 12-months

Table 3 Suicidal behavior among high school students assessed using SBQ-R (*n* = 2317)

Aspect of Suicidal Behavior assessed by SBQ-R	n	%
Lifetime suicide ideation and/or suicide attempt		
Never	1181	50.9
Suicide ideation	613	26.5
Suicide plan	422	18.2
Suicide attempt	101	4.4
12-Months suicide ideation		
Never	1319	56.9
At least 1 time	998	43.1
Lifetime threat of suicide attempt		
No	1992	85.9
Yes	325	14.1
Suicidality	**High suicidality** *F* (%)	**Low suicidality** *F* (%)
	601 (25.9%)	1716 (74.1%)

Abbreviation: *SBQ-R* Suicidal Behaviors Questionnaire-Revised

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period, 998 (43.1%) of participants reported that they had suicide ideation.

Predictors of suicidality among participating high school students

We performed binary logistic regression as multivariable analysis to determine the significant predictors of suicidality among high school students, and 14 independent variables with p values < 0.25 in the Chi-square tests were included. Table 4 provides more detailed information regarding the results of the regression analysis. Among the participating high school students, significant associations were found with suicidality and the following risk factors: female student (AOR = 1.912; p = 0.001; 95%CI:1.507–2.425), chronic illness (AOR = 2.886; p = 0.001; 95%CI:1.545–5.389), low resilience (AOR = 1.347; p = 0.026; 95%CI:1.036–1.750), low self-esteem (AOR = 2.020; p = 0.001; 95%CI:1.578–2.585), low family support (AOR = 3.532; p = 0.001; 95%CI:2.486–5.017), loneliness (AOR = 1.611; p = 0.001; 95%CI:1.211–2.143), depression (AOR = 4.882; p = 0.001; 95%CI = 3.861–6.175), and hopelessness (AOR = 1.602; p = 0.005; 95%CI:1.154–2.224). The AOR value indicated that depression acted as the strongest predictor of suicidality. The Nagelkerke R Square value of 0.364 indicated that the binary logistic regression model explained 36.4% of suicidality. The Hosmer–Lemeshow test with p = 0.341 indicated the goodness of fit of the model.

Discussion

Our study elucidated that the prevalence of lifetime suicide ideation was 26.5%, while the 12-months suicide ideation was 43.1%, lifetime suicide plans was 18.2%, lifetime suicide threats was 14.1%, and lifetime suicide attempts was 4.4%. The adolescent's suicidality found in our study is remarkably higher compared to the findings from a previous study conducted in Indonesia which ranged between 4.75% and 5.2% for suicidal ideation, 2.46% and 2.7% for suicide attempt, and 5.6% for suicidal plans [1, 14]. This remarkable disparage may be due to the differences in study settings and participants as well as unprecedented personal, social, and economical disruption derived from the COVID-19 pandemic when global tragedy suddenly struck fear into everyone, which impacted on adolescent's psychological well-being [31]. Those previous studies used secondary data from the Indonesian GSHS in 2015. GSHS was conducted among junior and senior high school students from 75 schools located in Sumatera and Java as well as other regions [14]. This current study only involved senior high school students as participants and was also conducted in Yogyakarta, a province with a high suicide rate in Indonesia [24], which was not originally

Table 4 Predictors of suicidality among high school students based on binary logistic regression (n = 2317)

Predictors	COR [95% CI]	p	AOR [95% CI]	p
Sex				
Male	**Reference**		**Reference**	
Female	2.333 [1.901–2.863]	0.001	1.912 [1.507–2.425]	**0.001**
Academic grade				
Grade 10 and 11	**Reference**		**Reference**	
Grade 12	1.141 [0.920–1.414]	0.229	1.276 [0.982–1.658]	0.069
Financial difficulties				
No	**Reference**		**Reference**	
Yes	1.531 [1.270–1.845]	0.001	1.071 [0.852–1.345]	0.558
Alcohol consumption				
No	**Reference**		**Reference**	
Yes	2.600 [1.342–5.036]	0.003	1.437 [0.624–3.308]	0.394
Chronic Illness				
No	**Reference**		**Reference**	
Yes	3.965 [2.316–6.788]	0.001	2.886 [1.545–5.389]	**0.001**
Satisfaction with academic achievement				
Yes	**Reference**		**Reference**	
No	1.505 [1.227–1.846]	0.001	1.150 [0.900–1.469]	0.264
Resilience				
High	**Reference**		**Reference**	
Low	2.513 [2.027–3.114]	0.001	1.347 [1.036–1.750]	**0.026**
Self-esteem				
High + Moderate	**Reference**		**Reference**	
Low	4.929 [4.044–6.007]	0.001	2.020 [1.578–2.585]	**0.001**
Loneliness				
Not lonely	**Reference**		**Reference**	
Lonely	3.331 [2.595–4.277]	0.001	1.611 [1.211–2.143]	**0.001**
Family support				
Moderate + High	**Reference**		**Reference**	
Low	7.682 [5.676–10.399]	0.001	3.532 [2.486–5.017]	**0.001**
Friends support				
Moderate + High	**Reference**		**Reference**	
Low	3.114 [2.294–4.227]	0.001	1.279 [0.879–1.862]	0.199
Significant others support				
Moderate + High	**Reference**		**Reference**	
Low	1.505 [1.232–1.838]	0.001	0.887 [0.689–1.142]	0.353
Hopelessness				
No	**Reference**		**Reference**	

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Table 4 (continued)

Predictors	COR [95% CI]	p	AOR [95% CI]	p
Yes	5.124 [3.925–6.689]	0.001	1.602 [1.154–2.224]	**0.005**
Depression				
No	Reference		Reference	
Yes	7.882 [6.380–9.739]	0.001	4.882 [3.861–6.175]	**0.001**

Abbreviations: *COR* crude odds ratio, *AOR* adjusted odds ratio, *CI* confidence interval

included in the GSHS [14]. It is shown in several studies that the risk of suicide dramatically increases from early to late adolescence and early adulthood [4, 6]. Empirical evidence also indicated that the prevalence of adolescent suicidality was highly varied in different study settings [5]. For example, one recent study of variations in global suicide trends found that Asia had the lowest pooled prevalence of suicidal ideation (8%) while the highest was in Africa (21%) [5]. This variability was also observed in other studies in the prevalence of suicide ideation (ranging from 0.9% – 38.7%), suicide plans (5.5% – 8.7%), and suicide attempts (0.9% – 20.5%) among different study settings [51].

Our study found that 8 out of 18 independent variables acted as significant risk factors of suicidality among Indonesian adolescents, indicating the complex nature of this life-threatening behavior. Moreover, some of our predictors were not identified in previous studies conducted in Indonesia [1, 14], such as chronic illness, low resilience, low self-esteem, low family support, depression, and hopelessness. Our findings provide additional evidence regarding the risk factors of adolescent suicidality in this country. Based on the Nagelkerke R square value, our identified predictors only contributed to 36.4% in explaining the variance of suicidality, suggesting there are other factors that contribute to suicidality among Indonesian adolescents that still have to be identified. It is well-established that suicidality is complex and multi-factorial phenotype involving both endogenous and exogenous risk factors [9].

Our study found that sex is the only sociodemographic variable that had a significant association with suicidality, with females having 1.912 times higher risk of suicidality compared to males. The higher risk of suicidal behaviors among adolescent girls is consistent with a previous study [52]. Our findings also support the results from a previous study that reported the higher risk of suicidality among Indonesian adolescent girls [1, 14]. The prevalence of suicidality among adolescent girls is shown to significantly increase after the transition to puberty [53]. Female youths tend to have higher levels of depression and hopelessness and these predictor risk factors are known to contribute to higher suicidal ideation among females [52].

Empirical evidence indicated that chronic medical conditions had a significant association with increased risk for the suicidal ideation, plans, and attempts in adolescents [54, 55]. Consistently, our study demonstrated that chronic illness was a significant predictor of suicidality among adolescents, indicated by those participants with a chronic medical condition having 2.886 fold increased risk of suicidality compared to their counterparts. Long-term medical issues increased the likelihood of depression in adolescents, which might result in suicide thoughts and attempts [56]. The incurable state of their disease, the symptoms and treatment are potentially significant sources of stress. Perceived as a burden to their lives, they did not know how to manage their disease properly. Research has shown that physical deterioration combined with inability to cope adaptively with an illness and its symptoms could lead to suicidality [57].

Our study demonstrated that self-esteem had a significant association with suicidality, indicated by adolescents with low self-esteem are 2.020 times more likely to experience suicidality than their counterparts. In line with our findings, low self-esteem has been consistently identified among significant risk factors for suicidal behaviors among adolescents [58]. Contrarily, having a high level of self-esteem protects someone from suicidal behavior [59]. Adolescents with low self-esteem tended to have increased suicidal ideation and had a greater risk to commit suicide attempts [58]. Furthermore, depression and hopelessness, two of the most prominent risk factors for suicide, cannot fully explain the substantial variation in suicide ideation that low self-esteem accounts for [58].

Our study elucidated that loneliness, a condition in which someone perceives a disparity between their expected social relationships and their actual experiences [60], acted as a significant predictor of suicidality, in which adolescents who felt lonely had a 1.611 fold increased risk of suicidality compared to their counterparts. Consistently, previous studies showed that adolescents who felt lonely have a higher risk of suicidal behaviors [5, 15]. Our findings also support the results from previous studies that reported loneliness was a significant risk factor of suicidality among Indonesian adolescents [1, 14].

Our study provides evidence regarding the role of depression as the most robust predictor of suicidality among adolescents, indicated by adolescents with depression having 4.882 fold increased risk of suicidality compared to non-depressed adolescents. This finding was consistent with a previous study that reported the strong

positive association between depression and suicidal behaviors such as suicidal ideation [16, 18] and suicidal attempts [19]. Our findings also revealed that the high prevalence of depression among adolescents (38.9%) could have contributed to the higher prevalence of suicidal ideation found in our study compared to the previous research in Indonesia [1, 14]. The onset of depression commonly appears in adolescence and a recent meta-analysis identified depression to be a robust predictor of suicidal ideation among adolescents [18]. Depression possess numerous detrimental symptoms and in its most extreme form, it can lead to life threatening behaviors such as self-harm and suicide. Numerous studies have demonstrated that depression, particularly when coupled with hopelessness, is the most reliable indicator of suicide risk [16].

Based on the source of social support perceived by participants, our study elucidated that Family support is the only source of social support that has a significant association with suicidality, in which participants with low perceived Family support are 3.532 times more likely to experience suicidality than their counterparts. Empirical evidence emphasizes the important role of family factors on adolescent suicidal behaviors [12, 59]. It has been shown that negative relationships with parents, low parental concern and dysfunctional family interactions were significantly associated with greater suicide risk among adolescents [61–63], and this relationship were mediated by depression [61]. Similarly, another study discovered a negative relationship between family support and adolescent suicidal thoughts, depressive symptoms, and hopelessness [63].

Our study found that resilience, the individual's capacity to perform positive adaptation and 'bounce back' when facing hardships in their life, traumatic experiences, and stressful life events [44], acted as significant predictor of suicidality. Our study revealed that the risk of suicidality was 1.347 times higher in adolescents with low resilience than in those with high resilience. Previous studies demonstrated the protective role of resilience against suicidal behavior, with the low psychological resilience presenting as a risk factor for suicidal behavior [16, 22, 23]. It is well established that individuals who possess strong psychological resilience have the ability to preserve their positive mental health during adversity, trauma, and stressful events [44].

Our study identified that hopelessness had a significant association with suicidality among adolescents. The probability of suicidality was 1.602 fold higher in adolescents who felt hopeless than in those who did not. Hopelessness, defined as an individual's negative perceptions regarding their future [64], is consistently identified as a risk factor for suicidality, especially when combined with depression [20]. Consistently, previous studies demonstrated the strong positive association between hopelessness and suicidal ideation and behavior [16, 20, 21]. Hopelessness has a pivotal role in the trajectory from depression to suicide [64, 65].

Our study possesses several limitations that should be considered. First, since this was a cross-sectional study, the nature of this research design make it impossible to show a cause-and-effect association between the variables. The findings of this study support the recommendation for longitudinal research to be conducted in the future to provide better understanding regarding our identified predictors. Second, since we adopted consecutive sampling—a type of non-probability sampling strategy, to recruited the participants, the findings of our study had a limited generalizability due to the nature of the sampling strategy used. The findings of this study support the recommendation for further research to be conducted in the future with multi-stage stratified random sampling approach to retrieve nationally representative sample and to elevate the generalizability of the study conclusion. Third, the utilization of self-reporting questionnaires as instrument to measures study variables in this study may have raised the possibility of recall bias and social desirability bias. Mixed-methods research should be conducted in the future to obtain qualitative responses from the participants that could be used as supplementary information.

Conclusions

Our study provides additional evidence supporting the complex multi-factorial nature of suicidality among adolescents and identified depression as the strongest predictor of this life-threatening behavior. Our findings underscore the needs of strengthening the mental health care services for high school institutions and supporting more pro-active detection and suicide prevention strategies for at-risk adolescents. Assessments that target the significant predictors identified in this study should be performed on a regular basis as an early detection strategy. Special attention should also be provided for female adolescents and those with chronic medical conditions. Our findings also support the development of more pro-active interventions that target the identified predictors as suicide prevention strategies among adolescents in Indonesia.

Abbreviations

WHO	World Health Organization
SNP	Single Nucleotide Polymorphism
DNA	Deoxyribonucleic Acid
BDNF	Brain-Derived Neurotrophic Factor
NTRK2	Neurotrophic Receptor Tyrosine Kinase 2
NLGN1	Neuroligin 1
SOX5	SRY-Box Transcription Factor 5
THP1	Tryptophan Hydroxylase-1
5-HTT	Serotonin Transporter
LMIC	Lower Middle Income Country

RSES	Rosenberg Self-Esteem Scale
ULS-3	UCLA Loneliness Scale Three-Item
MSPSS	Multidimensional Scale of Perceived Social Support
BHS	Beck Hopelessness Scale
PHQ-9	The 9-Item Patient Health Questionnaire
CD-RISC-10	The 10-Items of the Connor-Davidson Resilience Scale
SBQ-R	Suicidal Behaviors Questionnaire-Revised
GSHS	The Global School Based-Students Health Survey

Availability of data and materials
Data will be available on reasonable request through contacting the corresponding author if needed.

Declarations

Ethics approval and consent to participate
Ethical clearance for this study was obtained from the Institutional Review Board of Universitas Respati Yogyakarta, Indonesia with approval code: 005.3/FIKES/PL/I/2023 on 27 January 2023. Before the data collection, detailed research information was provided to the participants and the informed consent was obtained from them before commencing the study.

Consent for publication
Not applicable.

Competing interests
All authors have no potential conflict of interest disclosed.

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