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RESEARCH ARTICLE

Risk Factors of Suicidal Ideation among Middle School Students in China: A Systematic Review and Meta-analysis

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ABSTRACT

Suicidal ideation has become a major issue. This review aimed to determine risk factors of suicidal ideation among middle school students in China. We performed an extensive search focused on cross-sectional studies. To examine the association between risk factors and suicidal ideation, meta-analysis was utilized. Twenty-nine studies with 266,762 middle school students aged 12-18 years were included. The pooled results indicated that gender, depression...etc. are all major risk factors. Family environment, school environment, lifestyle, negative life events, and psychological factors are associated with suicidal ideation.

INTRODUCTION

Suicide is the act of deliberately killing oneself and has received significant attention from the World Health Organization and additional medical fields (American Psychiatric Press [APP], 2013). Concerning data on suicide rates, given in the China Health Statistic Yearbook 2021, showing that one of the leading causes of death for Chinese society's 15-to-35-year-old population is suicide (Jiang et al., 2018).

Suicidal ideation is an accidentally experienced motivation for suicidal behaviour without adopting or having an outwardly apparent way of behaving to achieve it, and is a high-risk factor and an important precursor to suicidal behaviour. Adolescents, as a special group that is transitioning from minors to adults, are also affected by it. Some research findings suggest that suicide has become the second most important factor in adolescent deaths (Curtin et al., 2016) and the third most important factor in the deaths of girls aged 15-19 years (WHO, 2021), indicating that adolescent suicide is a very worthy and serious problem. And suicidal ideation as the most sensitive and important predictor of suicide (Brown et al., 2000; Groleger et al., 2003), it is necessary to study the generation of suicidal ideation in adolescents. If the factors influencing the development of suicidal ideation can be identified and timely interventions can be made to prevent the development of suicidal ideation and suicidal behavior in adolescents to a certain extent.

Individuals in adolescence tend to be more independent and have a stronger sense of self, and the rapid development of independence and self-awareness makes this group of adolescents more likely to experience loneliness than others (Zhang et al., 2011; Hawkley & Cacioppo, 2010). Individuals may experience negative emotions such as anxiety, and some may commit suicide as a result (Chang et al.,

2015). A number of studies have been conducted and found that many factors can lead to suicidal ideation (Wei & Liu, 2023), which can be broadly categorised into three types, the first of which are demographic factors, including age and gender; Physical illnesses, mood disorders such as depression, bipolar disorder, or physical and mental health triggered by smoking, drinking, and internet addiction are of the second types while the third one generated by the environmental factors that include family environment, school environment, negative life events and sleep disorders, such as bullying, parenting styles, and academic stress. These factors are widely ranging and vary considerably between studies conducted at different times and due to the different ways in which suicidal ideation and risk factors have been defined and measured in various studies while social ideologies and educational policies for middle school students have continued to evolve and change. Hence, the results obtained vary greatly.

This meta-analysis aimed to further clarify the risk factors associated with suicidal ideation among Chinese middle school students over the past decade. From our findings, we were able to draw a series of recommendations for future intervention programs and studies.

METHODS

Materials and Methods

This study adheres to the reporting guidelines outlined in the PRISMA framework. The research procedure has been properly recorded with PROSPERO and given the distinct registration code CRD42023486724.

Search Strategy

To examine the risk factors of suicidal ideation among middle school students in China, nine databases underwent scrutiny. The Chinese databases consisted of CNKI (China National Knowledge Infrastructure), VIP (Chinese Journal of Science and Technology of VIP), Wanfang Database, CBM (SinoMed, Chinese Biomedical Literature Database) and ChiCTR (Chinese Clinical Trial Registry). The English databases consisted of PubMed, Embase, Web of Science and Cochrane library. Research conducted from January, 2014 to November, 2024, was explored in databases using both the Chinese and English languages. To search, we employed a mix of Medical Subject Headings (MeSH terms) and free-text terms, which were categorized into three main term groups (“suicidal ideation”, “risk factors" and "adolescent"). In addition, to guarantee the inclusiveness of the literature, a manual examination was performed on the bibliographies of eligible studies and previous systematic reviews to discover possible studies for incorporation. The search encompassed articles published in both Chinese and English languages to encompass a broad spectrum of relevant research.

Study Selection Criteria

The inclusion criteria consist of the following: (1) reports on the association between risk factors and suicidal ideation using multifactorial analyses of variance; (2) samples consisting of Chinese middle school students aged 12-18 years; (3) literature types including cross-sectional, case-control and cohort studies; (4) literature published in either Chinese or English; (5) no limitations on the particular scale employed to evaluate suicidal ideation. Exclusion criteria: (1) Bipolar disorder, mental retardation, personality disorders, substance use disorders (except tobacco); (2) literature lacking adequate data for extraction; (3) literature categories encompassing literature reviews, conference abstracts, comments, and case reports; (4) duplicate publications, with the sample size determined by the largest study.

Data Extraction

In this study, the NoteExpress software was utilized for the management and elimination of duplicate records in the collected literature. The screening and quality assessment of the articles were independently conducted by two trained researchers using predefined inclusion and exclusion criteria. The entire process encompassed three steps. During the first step, the titles and abstracts of all studies were independently screened to identify potentially eligible articles. Any discrepancies that arose were

discussed, and consensus was reached through negotiations. The second step, further screening of the retained full-text articles was conducted. In cases of uncertainty, consultation with a third researcher was sought until a consensus was achieved. In the third step, data extraction was primarily performed by one researcher, with comprehensive verification conducted by another researcher to ensure accuracy. The data were cross-checked and allocated to a third investigator. Simultaneously, in cases where acquiring the necessary data from the included literature posed challenges, the respective authors were contacted via email to obtain the required research data. The extracted data included author information, publication year, region, sample size, age, correlation coefficients (r-values), and measurement tools.

Quality Assessment

To evaluate the standard of the cross-sectional studies incorporated in this analysis, we employed the criteria specified by the agency for healthcare research and quality (AHRQ). The quality of the study source, variables, time frame, sample, bias, statistical analysis, data collection, and follow-up are assessed using a set of 11 criteria. The adequacy of the specific aspect was indicated by classifying each item as either "yes," "no," or "unclear." Question 5 is a reverse scoring question, A score of 1 point is given for "no" answers, while "yes" and "unclear" answers receive 0 points, as for other questions, a score of 1 point is given for "yes" answers, while "no" and "unclear" answers receive 0 points. The score varies between 0 and 11, with scores below 4 being classified as low quality, scores between 4 and 7 as moderate quality, and scores between 8 and 11 as high quality. Both researchers autonomously conducted every phase of the quality evaluation procedure.

Statistical Analysis

To estimate the associations between risk factors and suicidal ideation, we calculated pooled odds ratios (OR) for suicide ideation using RevMan 5.3 software. We evaluated heterogeneity between the studies using the Q test and the I-squared statistic ($I2 = 100\% \times (Q-df)/Q$). For the Q test, a P value of less than 0.10 was considered statistically significant. If $P>0.10$, there was a lack of heterogeneity between the studies. If $P\leq 0.10$ (i.e., heterogeneity was significant), we calculated I2. If $I2\leq 50\%$, the heterogeneity might be acceptable; otherwise, there was significant heterogeneity between studies and we conducted a subgroup analysis. For the subgroup analyses, heterogeneity within groups was also tested. If there was no significant heterogeneity ($P > 0.10$ or $P\leq 0.10$, but $I2< 50\%$), a fixed effects model was used to pool the data. If significant heterogeneity ($P\leq 0.10$, $I2 >50\%$) was found between studies, the meta analysis was conducted using a random effects model. Subgroup analyses were performed to explore possible reasons for the heterogeneity.

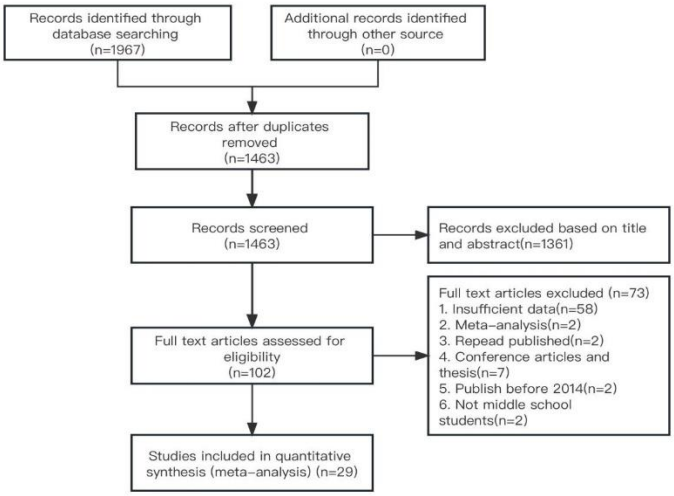

Figure 1. Literature selection process

Table 1. Characteristics of the included article

Authors (Year) Country	Study population	Sampling size	Data collection time	Study quality scores
Chang et al. 2014		2265		6
Li et al. 2019	Grade 7-12	4903	September-December 2016	6
Wei et al. 2021	12-15 years	10289	June-September 2020	8
Yang et al. 2019	(15.16±1.76) years	6139	2015-05-01	6
Wang and Sun 2023	(13.83±1.1) years	1143		5
Yu et al. 2018	Grade 10-12	1455		5
Zhu et al. 2017	13. 07±1. 08	1011	First semester of year 2015	6
Ou et al. 2016	13. 88±1. 15	5608	November-December 2012	6
Xu et al. 2023	(14. 05±0. 88) years	1459	1-5 June 2022	6
Guo et al. 2022	12-18 years	112	September 2020-March 2022	8
Wu et al. 2015	(14. 99 ± 1. 81) years	3206	November-December 2014	6
An et al. 2023		19341	1/1/2018 - 31/12/2021	8
Jin et al. 2022	(14.79 ± 1.78) years	8276	November-December 2019	5
Pu et al. 2023	middle school students	2639	October-November 2021	7
Fu et al. 2018	Grade 7, 8, 10, 11	7129		6
Wen et al. 2020	Grade 7, 8	884	Jun-15	7
Lan et al. 2019	(15. 48 ± 1. 65) years	7129	May 2017	7
Cong et al. 2021	(16. 4 ± 1. 9) years	6194	2014-2018	7
Jia et al. 2016	middle school students	1378	2007/11/1	7
Yang et al. 2020	15.2 (SD: 1.9) years	23392	2014	9
Gong et al. 2020	high school students	20517	2018-2019	7
Guo et al. 2018	high school students	20895	2017	7
Zhou et al. 2022	Grade 7	5026	2016.11-2017.1	8
Yao et al. 2014	middle school students	5249	2012-March	7
Yan and Gai 2022	adolescents	69519		8
Huang et al. 2022	high school students	12507	2019.06 to 2019.11	7
Yen et al. 2015	adolescents	4533	2009	8
Tan et al. 2018	9-18 years	12733	2011–2012	9
Liu et al. 2019	adolescents	1831	November-December 2015	8

RESULTS

Characteristics and Quality Assessment of the Studies Included

A detailed diagram of the full review process is presented in Figure 1. We identified 1967 potentially relevant articles. After duplicates removed using NoteExpress, 1463 papers were obtained. After reviewing their titles, abstracts and full text, 29 studies with 266,762 subjects had suitable data for meta-analysis and were therefore included in our study which were all cross-sectional studies. The methodological characteristics of the included studies were then evaluated. In most studies, participants were well represented. However, only 7 studies explained the reasons for excluding any students from the analysis. 14 studies described how confounding factors were evaluated and/or controlled and only one study that did not report the non-response rate.Only 5 studies explained how missing data were handled in the analyses. Overall, only 9 studies scored above 8. Other 20 studies scored five to seven and were judged as being of moderate quality.

Table 2. Results of meta-analysis of the studies on association between factors and suicidal ideation Chinese meddle school students

Factors	No. of studies	No. of participants	Variance between studies		Pooled OR	95% CI	Test for overall effect (p)	Model
			Q(p)	I^2(%)				
Gender	13	157059	P< 0.00001	81	1.55	1.38, 1.74	P< 0.00001	RE
Depression	10	134414	P< 0.00001	94	1.48	1.33, 1.65	P< 0.00001	RE
Physical abuse	6	45568	0.22	29	1.47	1.42, 1.52	P< 0.00001	FE
Parental style	3	15481	P< 0.00001	94	1.41	1.21, 1.64	P< 0.00001	RE
Family Integrity	5	88748	0.91	0	1.84	1.68, 2.02	P< 0.00001	FE
Physical illness	4	28714	0.51	0	1.58	1.37, 1.84	P< 0.00001	FE
Anxiety	4	21362	P< 0.00001	95	1.08	1.02, 1.14	0.009	RE
Study pressure	4	22555	0.65	0	1.29	1.19, 1.39	P< 0.00001	FE
Sex abuse	4	40151	0.15	43	1.37	1.30, 1.44	P< 0.00001	FE
Alcohol	3	27259	0.0005	87	1.62	1.25, 2.11	0.0003	RE
Smoking	3	27752	0.004	82	1.73	1.06, 2.83	0.03	RE
Family poverty	3	84083	0.45	0	1.83	1.65, 2.03	P< 0.00001	FE

teacher-student relation	3	32377	0.01	77	1.44	1.10, 1.89	0.008	RE
emotional neglect	3	30918	P< 0.00001	91	1.38	1.05, 1.80	0.02	RE
being bullied	3	28057	0.91	0	2.44	1.76, 3.40	P< 0.00001	FE
Stressful life events	3	90691	P< 0.00001	91	1.52	1.20, 1.93	0.0005	RE
Physical neglect	3	36945	0.003	82	1.3	1.06, 1.59	0.01	RE
Verbal Bullying	3	16416	0.49	0	1.42	1.30, 1.55	P< 0.00001	FE
Human relationship	3	9328	0.33	9	1.06	1.03, 1.08	P< 0.00001	FE
sleep disorder	3	30243	P< 0.00001	99	1.42	1.16, 1.73	0.0007	RE

Homogeneity Test and Meta-analysis

There were 29 studies available for a meta-analysis of the factors associated with suicide ideation respectively. Heterogeneity tests were carried out on all of these studies and the results are presented in Table 2. Meanwhile, significant heterogeneity was found for studies of the association of suicide ideation with gender, depression, parental style, anxiety, alcohol, smoking, teacher-student relation, emotional neglect, stressful life events, physical neglect and sleep disorder. The pooled ORs and 95% CIs indicated that gender, depression, parental style, anxiety, alcohol, smoking, teacher-student relation, emotional neglect, stressful life events, physical neglect and sleep disorder were risk factors for suicide ideation among middle school students (pooled OR (95% CI): 1.55 (1.38, 1.74), 1.48 (1.33, 1.65), 1.41 (1.21, 1.64), 1.08 (1.02, 1.14), 1.62 (1.25, 2.11), 1.73 (1.06, 2.83), 1.44 (1.10, 1.89), 1.38 (1.05, 1.80), 1.52 (1.20, 1.93), 1.3 (1.06, 1.59), 1.42 (1.16, 1.73), respectively). Physical abuse, family Integrity, physical illness, study pressure, sex abuse, family poverty, being bullied, verbal bullying and human relationship were significant risk factors for suicide ideation among middle school students (pooled OR (95% CI): 1.47 (1.42, 1.52), 1.84 (1.68, 2.02), 1.58 (1.37, 1.84), 1.29 (1.19, 1.39), 1.37 (1.30, 1.44), 1.83 (1.65, 2.03), 2.44 (1.76, 3.40), 1.42 (1.30, 1.55), 1.06 (1.03, 1.08), respectively) (Table 2).

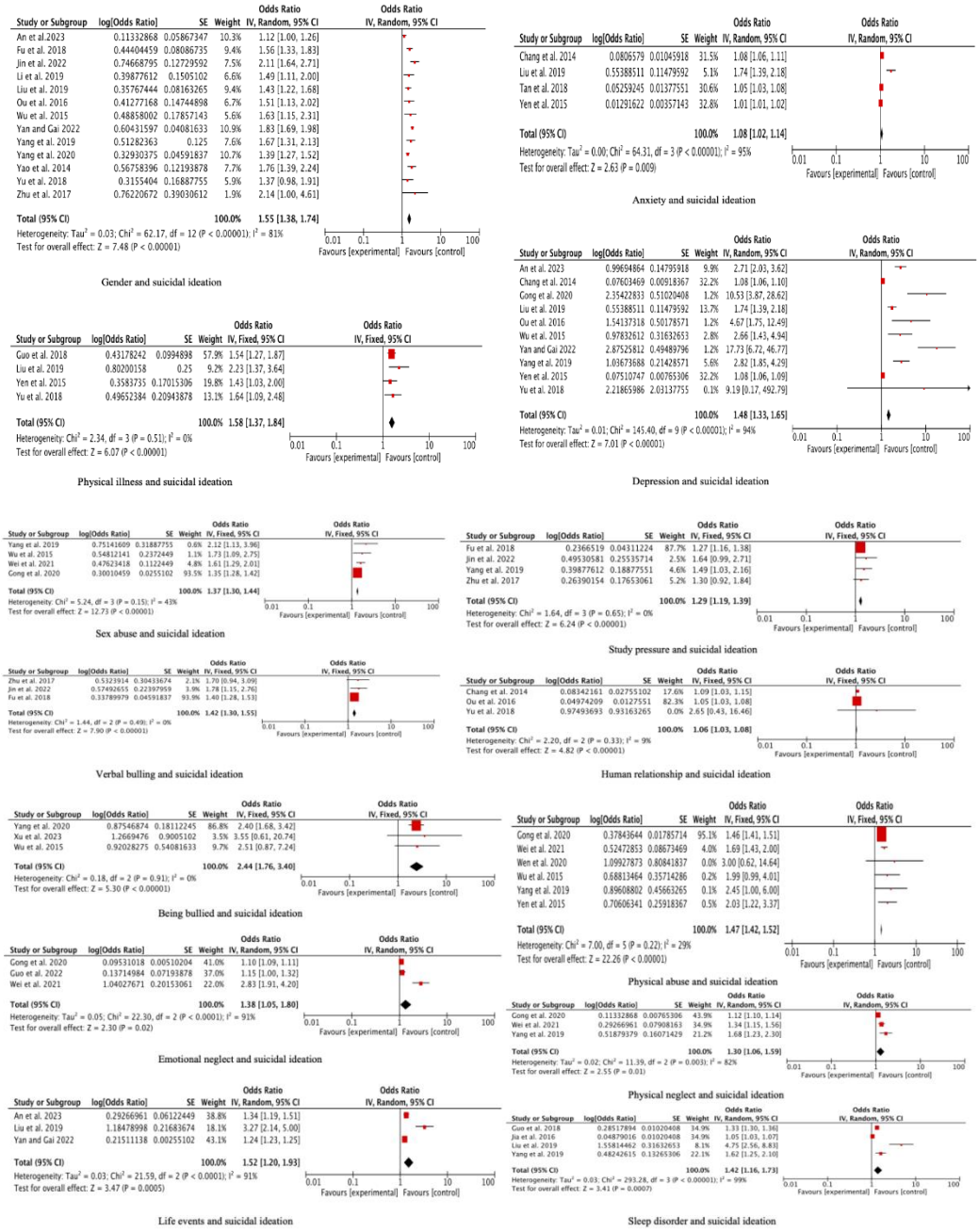

Figure 2. Forest plots of subgroup analysis of factors associated with suicidal ideation

Subgroup Analysis

Given the available collected data, we conducted subgroup analyses of risk factors with heterogeneity. After the subgroup analyses performed by father control, mother control, father despotism and mother despotism, the pooled ORs (and 95% CIs) showed that parental style were still risk factors for suicide ideation [pooled OR(95% CI): 1.08 (1.04, 1.12), 1.11 (1.07, 1.16), 1.36 (1.12, 1.66), 1.51 (1.21, 1.88), respectively].

Sensitivity Analysis

To evaluate the robustness of our study, we conducted sensitivity analyses for risk factors of suicidal ideation that were heterogeneous. Each analysis involved systematically removing one study at a time

and recalculating the summary correlation coefficient. The results of the sensitivity analysis showed that teacher-student relation, stressful life events, sleep disorder, emotional neglect, smoking and alcohol was lack heterogeneity after removing one study, indicating that these factors were still risk factors for suicidal ideation. [pooled OR(95% CI): 1.64 (1.44, 1.88), 1.26 (1.19, 1.34), 1.4 (1.18, 1.67), 1.1 (1.09, 1.11), 2.32 (1.77, 3.03), 1.38 (1.26, 1.52), respectively]

Publication Bias

Subjective assessment of funnel plot symmetry for the summary correlation coeficient of depression were tested. Egger's regression test showed statistically significant asymmetry ($p=0<0.05$), indicating significant evidence of publication bias detected in studies of depression.

DISCUSSION

The detection rate of suicidal ideation among middle school students in China is 16.7% (Zou et al., 2021). Therefore, the study of factors related to suicidal ideation is of great significance to the prevention of suicide among middle school students. By reviewing related studies, the factors associated with suicidal ideation among middle school students in China involved a variety of factors in five dimensions: demographic factors, physical health, emotional and behavioral problems, mental disorders and environmental factors. Among them, there are 20 factors that simultaneously satisfy the two conditions of homogeneity among merged articles, merged OR value > 1 and statistical significance. These are risk factors for suicidal ideation in middle school students, which should be given high priority in suicide prevention efforts.

As for demographic factors, 13 studies have shown that suicidal ideation is higher in girls than boys. This may be due to the fact that girls mature earlier and have more inner feelings than boys during adolescence (Zou et al., 2021). However, there are still unknown sources of heterogeneity that need to be further explored. 4 studies have shown the physical issue which included overweight or obesity, chronic disease or disability have higher suicidal ideation. Therefore, it is essential to pay attention to the mental health of these people while treating their physical illnesses, and to provide timely and effective intervention and counselling.

Emotional and behavioral problems included alcohol drinking, smoking and internet addiction. 3 studies confirmed the negative effects of alcohol on suicidal ideation, which is in line with the findings of Lee et, al. that excessive alcohol use is associated with suicidal ideation in middle school students, and that the earlier the age of initiation of alcohol use and the greater the frequency of alcohol intoxication, the higher the risk of suicidal ideation (Lee et al., 2021). 3 studies have shown that smoking is one of the risk factors of suicidal ideation, which is same as the finding of Wang (2019). Due to the test for overall effect for internet addiction $p=0.18$, this factor was not included in this meta-analysis.

Mental disorders, such as depression and anxiety, were significantly associated with a higher risk of suicidal ideation. Previous reviews also report that the significance of mental disorder (Zhang et al., 2011). Our mental analysis similarly found that people with a mood disorder had 1.48 and 1.08 higher risk of suicide ideation.

Environmental factors influence suicidal ideation in many respects, for example, family environment such as parental style, family integrity, family poverty, emotional neglect and physical neglect contributed a higher suicidal ideation (pooled OR=1.41, 1.84, 1.83, 1.38 and 1.3, respectively), positive parenting styles are negatively correlated with suicidal ideation among middle school students. The more negative the parenting style, the higher the level of suicidal ideation among middle school students (Tian et al., 2021). Future research should focus on protective factors related to family environments. The family environment of middle school students needs to be given high priority because the family is the essential place for personal growth. However, school environment such as study pressure and teacher-student relation were included in this analysis (pooled OR=1.29 and 1.44), which is similarly to previous study (Flores et al., 2021). Our meta-analysis also indicated that people who had experienced

stressful life events such as neglect, abuse, bullying and negative human relation had a higher risk of suicidal ideation. Hence effective teacher-student relationships can be developed as a protective factor against suicide in middle school students, and middle school students who feel cared for and encouraged by their teachers have lower levels of suicidal ideation (Flores et al., 2021). Therefore, teachers need to pay more attention to students' mental health and school life while completing their teaching tasks, and make timely responses to school bullying incidents to avoid the seriousness of students' psychological problems. Schools at all levels need to proactively address negative factors in the education of middle school students and provide mental health education at regular intervals and frequencies.

Meanwhile, we also found that sleep disorder were risk factors for suicide ideation, which confirmed the previous study that sleep deprivation is an independent risk factor for suicidal ideation, with increased detection of suicidal ideation in middle school students who slept less than 4 hours or more per night (Flores et al., 2021). Therefore, it is important to raise parents' awareness of the importance of sleep quality among middle school students.

This review provides a relatively comprehensive picture of risk factors for suicidal ideation among middle school students in China. However, our meta analysis has some limitations. Firstly, the vast majority of the included studies were cross-sectional, which can not determine the causal relationship between risk factors and suicidal ideation among middle school students. Secondly, there was a lack of uniform measurement of complex risk factors among the included studies, and they covered widely different population groups. Thirdly, the study data was derived from self-reporting by participants, who tended to withhold information to avoid adverse effects, while the responses were also prone to recall bias, resulting in inaccurate data. fourthly, biases have been introduced because analyses of differences between countries or races were not included in the study.

Our study identified few suggestions for the future. First, to unify standard measurements for risk factors and suicidal ideation hence accurate data can be acquired. Second, Longitudinal studies based on different cultural contexts need to be conducted with groups among middle school students. Third, extensive and comprehensive predictor researches needs to be conducted on identifying risk factors that influence suicidal ideation in middle school students. Fourth, Effective suicide prevention strategies for middle school students need to be developed in a timely manner by relevant functional administrations to safeguard the mental health of the majority of middle school students.

CONCLUSION

Suicidal ideation, as a growing public health problem, has very complex risk factors. Gender, depression, physical abuse, parental style, family integrity, physical illness, anxiety, study pressure, sex abuse, alcohol, smoking, family poverty, teacher-student relation, emotional neglect, being bullied, stressful life events, physical neglect, verbal bullying, human relationship and sleep disorder are all major risk factors for suicidal ideation among middle school students, and comprehensive, effective, and long-term interventions should actively target these risk factors. In the case of adolescents, interventions should focus on making changes of family environment like parental style, abuse and neglect on both mental and physical, school environment as study pressure, teacher-student relation and bullying while providing multifaceted support to adolescents to improve their mental health during adolescence and reduce their suicidal ideation.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/Supplementary material, further inquiries can be directed to the corresponding author.

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AUTHOR CONTRIBUTIONS

GTT and Dr. Zahari participated in the study selection and evaluation of quality. The data conceptualization, literature search, critical appraisal, and statistical analysis were carried out by GTT and LYY. Dr. Zahari reviewed and edited the manuscript. All authors contributed to the article and approved the submitted version.

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