Meta Analysis

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Mass hysteria attack rates in children and adolescents: a meta-analysis

Gang Zhao[1], **Qinglin Cheng**[1,2], **Xianming Dong**[3] and **Li Xie**[1]

Abstract

Objectives: There are few systematic assessments of mass hysteria (MH) attack rates (ARs) in adolescents and children. The study aim was to assess the ARs of MH in this population.
Methods: We used a meta-analysis to systematically review studies and assess ARs.
Results: The reviewed studies included 32,887 participants, of which 2968 were children and adolescents with a history of MH. Twenty-eight studies were included, of which 22 (78.6%) had high to moderate methodological quality. The pooled AR of MH was 9.8% (95% confidence interval [CI] 6.3, 14.0). Of MH studies between 2010 and 2020, 78.6% were conducted between 2010 and 2014. ARs were higher between 2010 and 2014 (10.3%) than between 2015 and 2020 (8.1%). Regarding population characteristics, the AR in girls was 2.43 (95% CI 1.70, 3.46) times higher than in boys. Most studies were on primary school students (46.4%), who showed the highest AR (15.4%). Of six trigger factors, water pollution showed the highest AR (16.3%). ARs were higher in rural areas (11.1%) than in urban areas (5.6%).
Conclusions: MH in children and adolescents seems prevalent and shows some epidemiological characteristics. These findings may assist governments to control and prevent MH epidemics among children and adolescents.

Keywords

Attack rate, mass hysteria, children, adolescent, prevalence, meta-analysis, water pollution

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[1]Hangzhou Center for Disease Control and Prevention, Hangzhou, China
[2]School of Medicine, Hangzhou Normal University, Hangzhou, China
[3]Feixi Center for Maternal Health, Child Health and Family Planning Service, Hefei, China

Corresponding author:
Qinglin Cheng, Division of Infectious Diseases, Hangzhou Center for Disease Control and Prevention, 568 Mingshi Road, Hangzhou 310021, China.
Email: chengqinglin888@sina.com

Introduction

Mass hysteria (MH) is a diagnostic term used to characterize unexplained outbreaks or epidemics of subjective somatic complaints among students or other vulnerable people that seem to have no physical, biological, or etiological causes.[1–3] According to the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition,[4] MH is the occurrence of shared psychogenic symptoms in a group of individuals in a similar environment, usually over a short time. MH is characterized by a group of symptoms that usually mimic organic disease, but with no identifiable cause. MH occurs in individuals who share a common belief that their symptoms constitute a definite illness.[5]

The symptoms of MH are usually caused by stress and anxiety associated with perceived threats.[6] MH is infectious and may be a contributing and amplifying factor in real epidemics.[6] Various other descriptive terms have been used to define this condition, such as collective hysteria, stress reaction, mass psychogenic illness, epidemic hysteria and mass sociogenic illness. MH is a cause of acute illness epidemics and is a complex biopsychosocial phenomenon involving the generation of subjective somatic complaints in patients exposed to various triggers in a particular psychological and social context.[7]

Recorded MH outbreaks have occurred in different sociocultural settings, such as schools, villages, homes and workplaces. MH often occurs among otherwise healthy people who suddenly believe they have been made ill by specific trigger factors.[1–3,7] MH spreads through visual and auditory contact and occurs most often among adolescents or preadolescent girls.[7] MH may involve the recurrence of a reaction in which the original psychological climate is duplicated or re-established. For instance, adolescents are susceptible to proposal and influence contagion and have a substantial need for acceptance and self-affirmation because they are eager to conform to the group by sharing its beliefs and ideals.[8] Thus, MH easily recurs through duplication or re-establishment of psychological symptoms in collective settings such as schools, particularly among female adolescents. The psychosocial environment is a frequently reported trigger factor for MH; however, there may be other trigger factors, such as concerns about supernaturalism, mass vaccination, air pollution, food poisoning and religious beliefs.[9]

Currently, MH in children and adolescents is a neglected social problem that is underreported; often places substantial financial burden on emergency services, public health and environmental agencies; and has a negative effect on social development and stability.[5] The literature on MH comprises mostly reports[2,7–9] that rarely include an accurate assessment of the MH attack rate (AR). The aim of this meta-analysis was to assess ARs of MH in children and adolescents. The findings from this analysis will be useful in designing assessment systems for MH in this population. In this study, we addressed two questions: (1) what is the overall AR of MH in children and adolescents? (2) how does the AR of MH in children and adolescents differ according to time period, gender, trigger factors, student type and geography?

Materials and methods

Data sources and search strategies

The present meta-analysis was performed according to the guidelines of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement.[10] This was a review study and did not involve a research protocol requiring approval by a relevant institutional review board or ethics committee.

Informed consent was also not applicable. The study was registered with PROSPERO (https://www.crd.york.ac.uk/prospero/#myprospero) (registration number: CRD42021257401).

We searched the PubMed, Elsevier Science Direct, Cochrane Library, Google Scholar, SpringerLink, ProQuest Dissertations, China National Knowledge Infrastructure (CNKI) and WANFANG databases for the ARs of MH in children and adolescents from 1 January 2010 to 31 October 2020. An inclusive search of each database was performed using subject headings, text words and keywords; the Boolean logic terms 'or' and 'and' were used to combine searches. A search was conducted for articles pertaining to MH in children and adolescents, using the search term 'mass hysteria' and other related terms (e.g., hysteria, epidemic hysteria, mass psychogenic illness, mass sociogenic illness). Studies identified using this search strategy were first screened using titles and abstracts, and then by reviewing full-text articles. Two reviewers independently selected studies using predetermined inclusion and exclusion criteria. Differences in opinion were resolved through consensus.

Study inclusion criteria

Two reviewers independently applied the following inclusion and exclusion criteria to the articles retrieved. The inclusion criteria were (1) published articles/reports; (2) observational studies; (3) investigations of MH in children and adolescents; (4) participants aged from 6 to 20 years; and (5) only Chinese and English language articles.

Study exclusion criteria

The exclusion criteria were (1) participants older than 20 years or younger than 6 years; (2) clinical studies; (3) high-risk adolescents; that is, those with first-degree relatives with hysteria, anxiety, depression or other mental illnesses (to reduce bias owing to family genetic factors); and (4) studies with substantial missing data.

Extraction of data

Data were independently extracted by two reviewers into a standardized scheme for each article on ARs of MH in children and adolescents. Any differences in data extraction between reviewers were resolved by consensus through discussion. Data were obtained directly from the reports and articles. For articles that did not explicitly state the data, data were derived from graphs, tables or charts included in the reports or data supplements. The following data were collected: title, report location, report dates, authors, literature sources, essential characteristics of participants and epidemiologic characteristics of MH in children and adolescents.

The completed extraction form for each study was sent electronically to its first author, with a request to check the accuracy and integrity of the extraction. Of the authors, 11 responded and 6 provided supplementary information[11–16] that we used to modify the extracted data.

Determination of ARs

AR refers to the cumulative incidence of infection or disease in a group of people observed over time during an outbreak or an epidemic. It is calculated by dividing the number of exposed individuals who developed the disease by the total number of individuals at risk.[6] Exposed individuals are those individuals who are present in the same setting as the infected individual. ARs are measured from the beginning (the onset of illness in the index case) to the end (the first day of illness of the last person to become ill) of an epidemic.

AR meta-analysis

The primary study outcome was ARs. Therefore, we calculated a pooled AR with 95% confidence interval (CI). We also calculated ARs and 95% CIs for each study. Our secondary outcome was epidemiologic characteristics of ARs, namely, year, gender, trigger factors, geography (i.e., rural/urban), location of occurrence (i.e., China/outside China), education levels and student type (resident/nonresident).

Quality assessment

The principal author (QC) and a coauthor (XD) independently assessed the quality of the included studies using a modified version of the Critical Appraisal Skills Programme tool (CASP) (available at: http://www.casp-uk.net/). The modified CASP consists of 10 questions (available from the authors) on the credibility and relevance of studies and has been used in previous reviews of qualitative studies.[17] Each item was scored as 2 (fully met the quality criteria), 1 (partially met the quality criteria) or 0 (did not meet the quality criteria). Studies scoring in the 75th percentile or higher on quality ($\geq$15) were categorized as high quality studies. Studies scoring between 50% and 75% were rated as moderate quality studies (11–14). Studies scoring lower than 50% were considered low quality studies ($\leq$10).

Statistical analysis

We used the statistical software R, version i386 4.0.3 (www.r-project.org), to conduct all statistical tests and generate associated graphic results. To sum the AR findings, we computed ARs and 95% CIs using the Freeman–Tukey double arcsine transformation (FT) to stabilize the variances: let '*event*' be the nominator and '*n*' the denominator for the proportion, then $p = event/n$. If $p < 0.3$ or $p > 0.7$, the FT is given by $FT = \text{arcsine}(\sqrt{(n/N+1)}) + \text{arcsine}(\sqrt{(n+1/N+1)})$. Heterogeneity assessments preceded all meta-analytical tests on the retrieved articles. If the sample size of at least one study is very small (<10), back transformation of the pooled effect may be misleading if the FT is used. In such cases, we used other transformations (e.g., sm = 'PAS' or sm = 'PLOGIT').

There was significant heterogeneity across the studies. Therefore, we calculated the results using a random effects model and reported corresponding p values and I^2 values.

Risk of bias

The included studies and reports were based on field investigations, and therefore there was potential heterogeneity in terms of the number of individuals assessed. Owing to the extent to which cross-sectional study designs were used and the nature of the data collected, we assumed the existence of risk of bias (e.g., recall, diagnosis, reporting). We thus collected data and presented ARs based on confirmatory diagnostic criteria and quality control.

Results

Characteristics and methodological quality of included studies

The database search produced 5907 abstracts. Twenty-eight articles[11–16,18–39] met the inclusion criteria and were included in the meta-analysis (Figure 1). The characteristics of these studies ($N = 32{,}887$)[11–16,18–39] were categorized and are shown in Table 1. The meta-analysis incorporated AR data from 2968 children and adolescents with a history of MH. The studies were assessed in terms of publication year, gender, location of

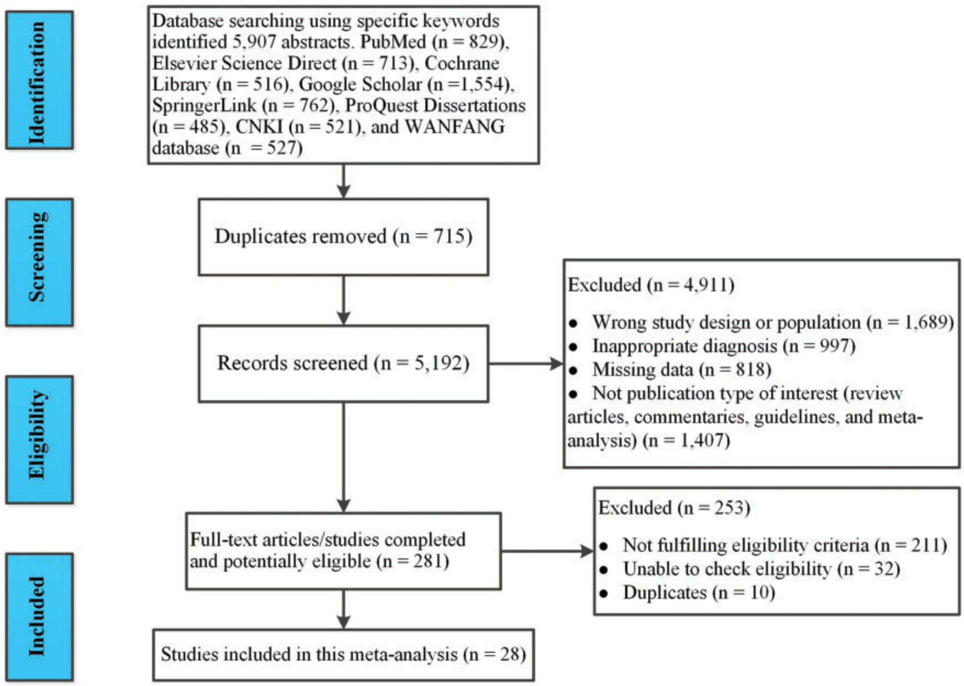

Figure 1. PRISMA flow chart of study selection.

occurrence, education level, student type, area and MH trigger factors.

The evaluation of the methodological quality of the 28 full articles reviewed by two authors (QC and XD) yielded the following results. The mean quality score was 13.0 with a standard deviation of 2.3 and a range of 9 to 17. There were 8 articles (29%)[25,26,30–32,35,37,38] of high quality, 14 articles (50%)[11–13,16,19–22,27,28,33,34,36,39] of moderate quality and 6 articles (21%)[14,15,18,23,24,29] of low quality (See Table 1 for quality scores of the studies).

ARs of MH for children and adolescents

There was statistical heterogeneity ($I^2 = 99.0\%$) among the 28 studies.[11–16,18–39] A random effects meta-analysis model was used. The results showed that the total AR of MH was 9.8% (95% CI 6.3, 14.0, $p < 0.001$) for children and adolescents (Figure 2).

As can be seen from Figure 3 and Table 2, the random effects meta-analysis model showed significant heterogeneities ($I^2 > 50.0\%$) among the included studies. Meta-analysis indicated that the AR of MH in boys was 4.0% (95% CI 1.5, 7.6, $p < 0.001$, nine studies[15,25–27,31,32,36,38,39]) and in girls was 8.5% (95% CI 5.2, 12.6 $p < 0.001$, nine studies[15,25–27,31,32,36–38]). The AR of MH in girls was 2.43 (95% CI 1.70, 3.46, $p < 0.001$) times higher than in boys.

The meta-analysis indicated that most studies of MH (46.4%, 13/28) were on primary school students.[11,14,15,22–24,28–30,34,35,38,39] In contrast, studies on MH in the whole school population (including middle and high school students) comprised the lowest percentage of reviewed studies (7.1%, 2/28).[25,31] The highest AR of MH

Table 1. Characteristics and methodical quality of included studies.

First author (references)	Publication year	Event	N	Gender (event/n)	Location of occurrence	Education level	Student type	Area	Trigger factors	Quality score
Wang et al.[11]	2012	24	105	NA	China	PS	Nonresident	Urban	WP	11
Shang et al.[12]	2010	41	322	NA	China	JMS	Resident	Urban	SFP	12
Chen L et al.[13]	2013	5	1,250	NA	China	JMS	Nonresident	Urban	TT	11
Luo[14]	2011	84	226	NA	China	PS	Nonresident	Rural	MV	10
Lin et al.[15]	2010	4	1,176	Girls: 3/452; Boys: 1/717	China	PS	Resident	Rural	MV	10
Zhang[16]	2012	71	555	NA	China	JMS	Nonresident	Rural	SFP	12
He[18]	2010	37	395	NA	China	HS	Resident	Urban	PE	10
Xin et al.[19]	2011	3	600	NA	China	JMS	Nonresident	Urban	MV	12
Chen Y et al.[20]	2010	66	938	NA	China	JMS	Nonresident	Rural	MV	14
Yang et al.[21]	2012	29	1,098	NA	China	JMS	Resident	Rural	PS	12
Li et al.[22]	2013	22	79	NA	China	PS	Resident	Rural	S	13
Zhang et al.[23]	2012	23	386	NA	China	PS	Nonresident	Rural	MC	10
Qi et al.[24]	2013	41	193	NA	China	PS	Resident	Rural	MV	9
Song et al.[25]	2010	136	1,746	Girls: 91/845; Boys: 45/901	China	ES	Resident	Rural	SFP	15
Qin et al.[26]	2015	215	1,850	Girls: 98/675; Boys: 117/975	China	JMS	Resident	Rural	WP	16
Zhou et al.[27]	2015	34	538	Girls: 28/293; Boys: 6/245	China	JMS	Resident	Rural	SS	13
Ren et al.[28]	2015	43	269	NA	China	PS	Resident	Rural	SFP	14
Liu et al.[29]	2014	902	1,782	NA	China	PS	Nonresident	Rural	SFP	10
Zhu et al.[30]	2014	24	326	NA	China	PS	Nonresident	Rural	SFP	15
Huang et al.[31]	2010	272	9,115	Girls: 184/4,404; Boys: 88/4,711	Taiwan, China	ES	Nonresident	Urban	MV	15
Al Mamun et al.[32]	2018	50	1,054	Girls: 39/632; Boys: 11/422	Narsinghdi, Bangladesh	JMS	Nonresident	Rural	SS	17
Beyene et al.[33]	2014	44	1,283	NA	Amhara Region, Ethiopia	HS	Nonresident	Rural	S	14
Lake et al.[34]	2016	32	1,000	NA	Northwest Ethiopia	PS	Nonresident	Rural	S	13
Haque et al.[35]	2013	98	1,173	NA	Gaibandh, Bangladesh	PS	Nonresident	Rural	SFP	15
Dominus[36]	2012	45	600	Girls: 44/432; Boys: 1/168	New York, USA	HS	Nonresident	Rural	PS	14

(continued)

(15.4%, 95% CI 6.2, 27.7, $p < 0.001$) was for primary school students (Figure 3). Conversely, the lowest AR of MH (5.1%, 95% CI 1.4, 10.8, $p < 0.010$) was for the whole school population.[25,31] As seen in Figure 3, there were six main potential trigger factors for MH in children and adolescents. The highest AR (16.3%, 95% CI 6.8, 28.8, $p < 0.001$) was for water pollution,[11,26] followed by suspected food poisoning (15.7%, 95% CI 5.1, 30.6, $p < 0.001$).[12,16,25,28–30,35] The lowest AR (5.4%, 95% CI 3.9, 7.0, $p < 0.001$)[27,32] was for the trigger factor of study pressure.

Figure 3 indicates an AR difference between rural (11.1%, 95% CI 6.8, 16.2, $p < 0.001$)[14–16,20–30,32–39] and urban areas (5.6%, 95% CI 2.2, 10.2, $p < 0.010$)[11–13,18,19,31] for MH in children and adolescents. The AR of MH within China was 10.8% (95% CI 5.9, 16.8, $p < 0.001$),[11–16,18–31,39] and outside China AR was 7.3% (95% CI 4.2, 11.2, $p < 0.010$).[32–38] This suggests a difference in the occurrence of the AR of MH in China compared with other countries included in the analysis (i.e. Nepal, Ethiopia, Bangladesh, Mexico and the USA).

The meta-analysis showed the following time differences in the AR of MH in children and adolescents: (1) of all studies conducted between 2010 and 2020, 78.6% (22/28) were conducted from 2010 to 2014;[11–16,18–25,29–31,33,35–37,39] (2) The highest AR (16.5%, 95% CI 0.1, 57.3, $p < 0.001$) was for 2014;[29–31] (3) the AR for the period 2010 to 2014 (10.3%, 95% CI 6.0, 15.6, $p < 0.001$)[11–16,18–25,29–31,33,35–37,39] was higher than that for the period 2015 to 2020 (8.1%, 95% CI 4.8, 12.3, $p < 0.010$)[26–28,32,34,38] (Figure 3).

Assessment of heterogeneity and publication bias

For each meta-analysis outcome, Table 2 shows the heterogeneity variance between

Table 1. Continued.

First author (references)	Publication year	Event	N	Gender (event/n)	Location of occurrence	Education level	Student type	Area	Trigger factors	Quality score
Loa Zavala[37]	2010	512	4,000	Girls: 512/4,000	Mexico	HS	Resident	Rural	S	16
Poudel et al.[38]	2020	47	435	Girls: 37/244; Boys: 10/191	Puythan, Nepal	PS	Nonresident	Rural	EST	17
Jie[39]	2010	64	393	Boys: 64/393	China	PS	Nonresident	Rural	PS	14

PS, primary school; JMS, junior middle school; HS, high school; ES, entire school; SFP, suspected food poisoning; PS, psychological suggestion; PE, physical examination; MV, mass vaccination; WP, water pollution; EST, emotional stress; S, supernaturalism; MC, mumps case; SS, stress of studying; OA, oral anthelmintic; TT, tuberculin testing; NA, not available.

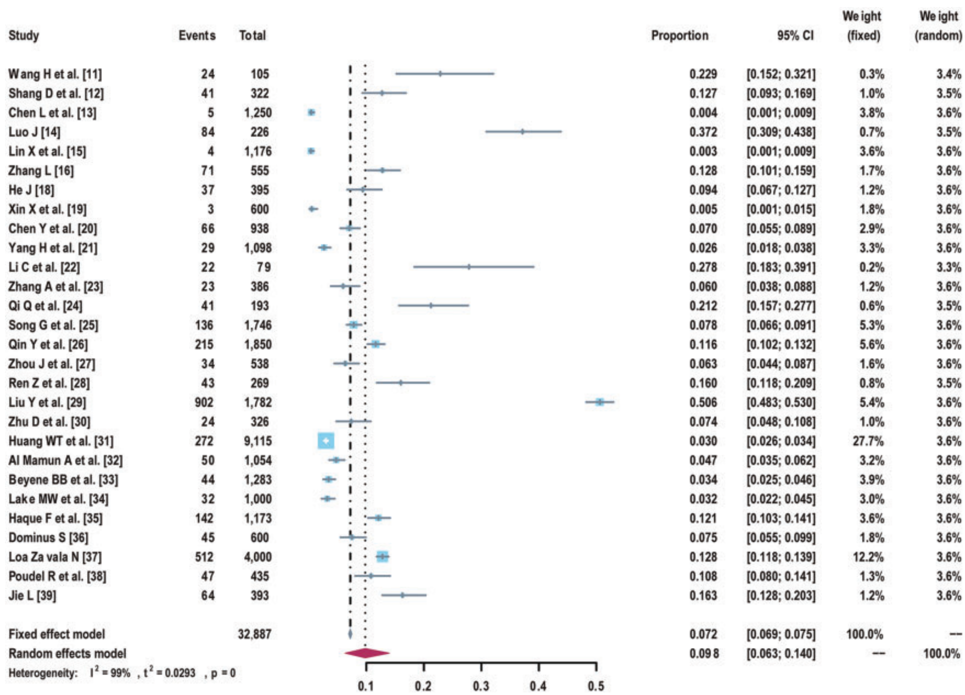

Figure 2. Forest plot for pooled attack rates of mass hysteria in children and adolescents.
CI, confidence interval.

studies (measured by the I^2 statistics) and publication bias assessments using the Egger test and the Begg test. The I^2 statistics indicated that there was significant heterogeneity in the included studies (Table 2). Thus, the random effects model was selected for analysis.

The funnel plot presents the association between the log of the odds ratio of the x-axis and the standard error of the y-axis. It shows the results of the meta-analysis; each point represents a study (Figure 4). The funnel plot, and the results of the Egger and Begg tests, showed no evidence of publication bias among the included observational studies (Table 2).

Sensitivity analysis

The sensitivity analysis indicated that the omission of any one study led to no significant changes in estimates (Figure 5). For instance, the pooled estimate of the AR of MH in children and adolescents was between 9.0% (95% CI 6.0, 14.0) and 10.0 (95% CI 6.0, 15.0) (Figure 5). Furthermore, the estimated effect sizes after adjusting (i.e. the omission of any of the studies) for the effects of gender, education level, area, publication year, trigger factors, location of occurrence and student type in the statistical model, showed no significant differences for the included observational studies.

Discussion

There is a lack of systematic reviews and meta-analyses of the AR of MH in adolescents and children. One main reason for this is that many studies report the results of case and investigation analyses rather than the prevalence of MH.[39] In this study, we

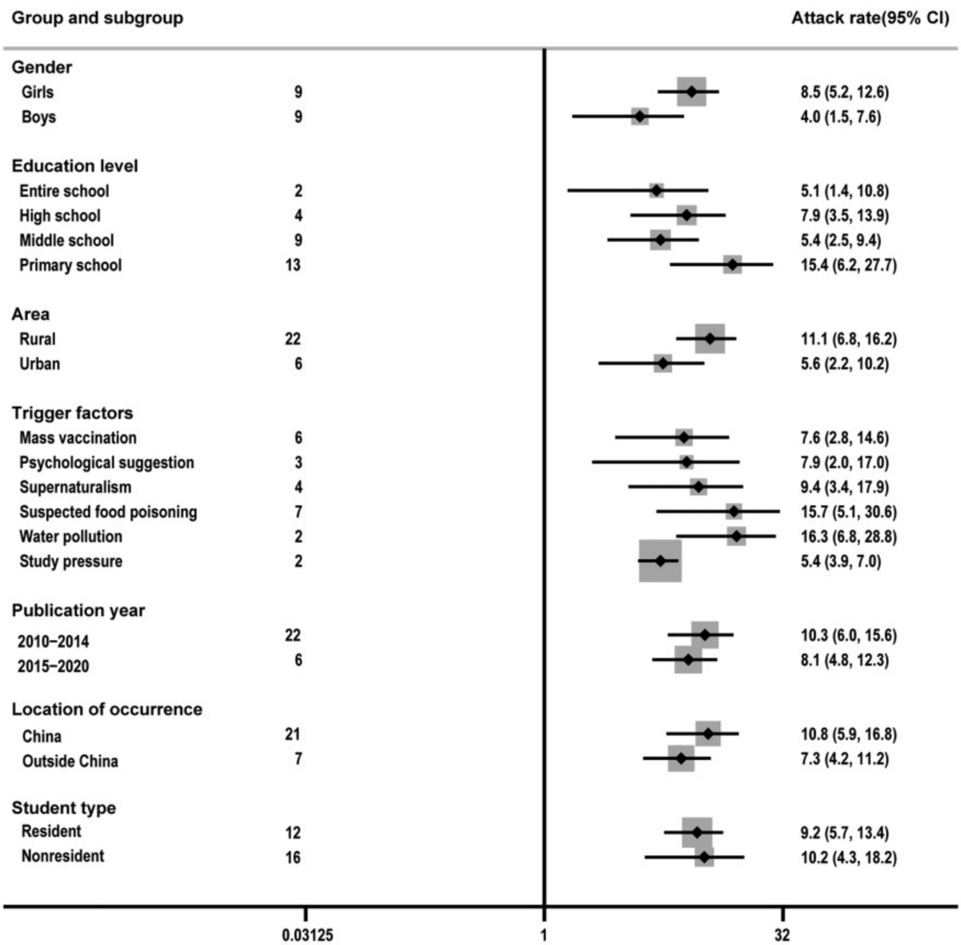

Figure 3. Forest plot for attack rates of subgroups of mass hysteria among children and adolescents. CI, confidence interval.

performed an epidemiological analysis of MH using MH prevalence data. The aim was to obtain data that could assist in the control and prevention of MH in adolescents and children. The meta-analysis results produced valuable information.

To our knowledge, this is the first comprehensive meta-analysis of the AR of MH among adolescents and children. Although only 28 articles met the criteria for inclusion in the meta-analysis, the findings may facilitate the identification of the AR of MH in children and adolescents. We confirmed that time period, population and area were important factors associated with the AR of MH in adolescents and children. The most important population characteristics were as follows. (1) Boys seemed to have a lower AR than girls, suggesting that gender may affect the risk of MH in children and adolescents.[40] The ARs for MH in boys and girls in the present study were very similar to those reported in previous studies.[40,41]Many studies[40–42] have shown that women/girls are more likely than men/boys to experience hysteria. (2) The

Table 2. Assessments of heterogeneity and publication bias for studies on attack rates of mass hysteria in children and adolescents.

Subgroups	Sample size	Number of studies	Heterogeneity I^2 (%)	Heterogeneity p-value	Begg test Z value (p-value)	Egger test t value (p-value)
Gender						
Girl	11,977	9	95.0	<0.001	−1.64 (0.152)	−1.95 (0.099)
Boy	8,723	9	96.0	<0.001	−0.61 (0.453)	−0.36 (0.452)
Education level						
Entire school	10,861	2	99.0	<0.010	1.24 (0.115)	1.88 (0.067)
High school	6,278	4	98.0	<0.010	0.58 (0.464)	0.35 (0.789)
Middle school	8,205	9	98.0	<0.010	−1.91 (0.202)	−2.55 (0.037)
Primary school	7,543	13	99.0	<0.001	0.89 (0.251)	−3.05 (0.011)
Area						
Rural	21,100	22	99.0	<0.001	−1.95 (0.051)	1.99 (0.048)
Urban	11,787	6	98.0	<0.010	0.89 (0.224)	2.64 (0.035)
Trigger factors						
Mass vaccination	12,248	6	99.0	<0.001	−0.74 (0.112)	2.19 (0.022)
Psychological suggestion	2,091	3	97.0	<0.010	−1.26 (0.127)	1.98 (0.046)
Supernaturalism	6,362	4	99.0	<0.010	0.89 (0.184)	2.57 (0.031)
Suspected food poisoning	6,173	7	99.0	<0.001	1.98 (0.088)	1.75 (0.109)
Water pollution	1,955	2	91.0	<0.001	2.11 (0.077)	2.77 (0.023)
Study pressure	1,592	2	43.0	0.020	0.85 (0.144)	−1.03 (0.104)
Location of occurrence						
China	23,342	21	99.0	0.001	−2.85 (0.041)	2.63 (0.026)
Outside China	9,545	7	97.0	<0.010	1.04 (0.235)	0.89 (0.364)
Publication year						
2010–2014	27,741	22	99.0	<0.001	0.94 (0.207)	1.59 (0.126)
2015–2020	5,146	6	96.0	<0.010	−0.77 (0.164)	1.87 (0.061)
Student type						
Resident	20,781	12	99.0	<0.010	1.74 (0.091)	1.02 (0.303)
Nonresident	12,106	16	99.0	<0.001	1.49 (0.094)	−2.87 (0.025)

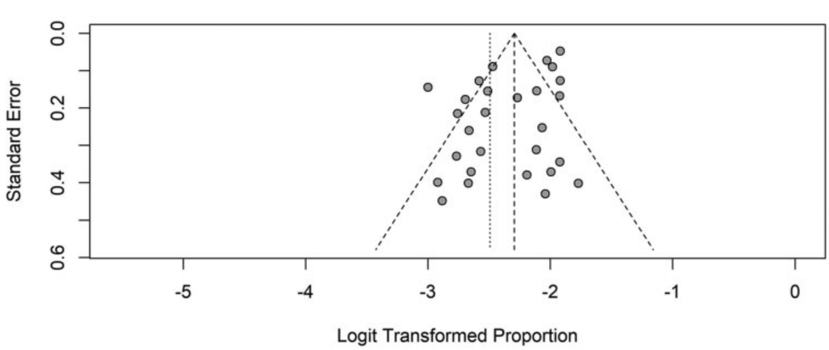

Figure 4. Funnel plot for meta-analysis of pooled attack rates of mass hysteria in children and adolescents.

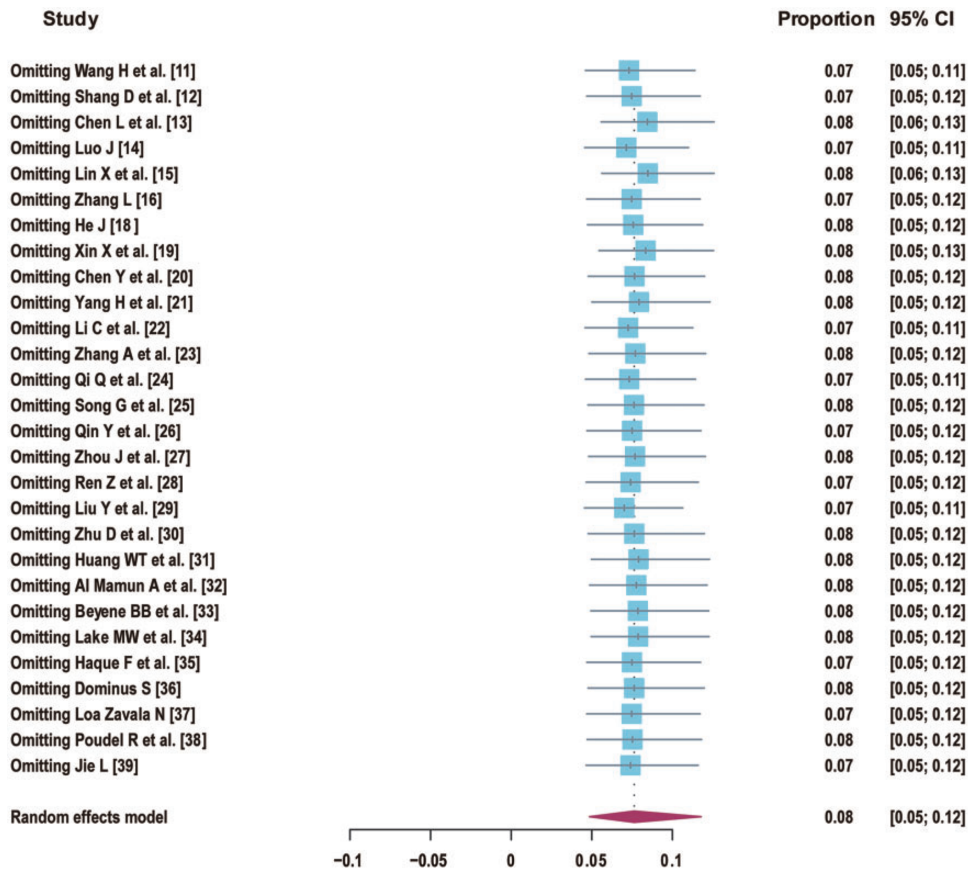

Figure 5. Sensitivity analysis plot for meta-analysis of pooled attack rates of mass hysteria in children and adolescents.
CI, confidence interval.

meta-analysis identified three main trigger factors for MH in children and adolescents: water pollution, suspected food poisoning and supernaturalism. Previous studies[8,43] indicate that public health emergencies easily trigger the onset of hysteria. Our findings support this link. This association may partly be explained by individuals feeling particularly anxious or nervous[2] during public health emergencies. This finding has important implications for the control and prevention of MH in children and adolescents, and suggests the need to modify these risk factors. (3) We also found that MH outbreaks often occur in younger participants (i.e., primary school pupils). Our findings support those of previous studies[44] demonstrating that primary school children are likely to experience MH. A possible explanation for this finding may be a lack of adequate psychological coping ability in younger age groups.[44] Therefore, the government should enhance MH detection and intervention for younger students.

Interestingly, there were some main effects of time. We found that most studies of MH in children and adolescents were conducted between 2010 and 2014. Additionally, the highest AR was in 2014, and the general trend was that the AR of MH in adolescents and children declined between 2010 and 2020. The drop in AR may have been partly caused by recent improvements in the classification and diagnosis of MH.[42,45,46] An alternative explanation is that the Chinese government has improved the provision of mental health care for adolescents and children in the last decade.[47] However, we found an increase in MH in adolescents and children in the context of the COVID-19 pandemic in 2020, which supports recent similar findings.[1] This observed increase may be explained by the fact that children and adolescents have experienced clinical levels of posttraumatic stress disorder during the COVID-19 pandemic.[48] This finding provides further evidence that in response to public health emergencies, governments at all levels should actively strengthen mental health education for children and adolescents.

The meta-analysis also showed an effect for residential area, indicating a difference in the AR of MH between rural and urban areas. This supports the findings of Mink[49] and those of Serinken et al.,[46,] who showed that socioeconomic status often plays a major role in the occurrence of hysteria (e.g., individuals living in rural areas have low economic levels). This difference in economic levels may reflect low educational levels caused by poverty.[42,46]

Surprisingly, MH reports were not equally distributed throughout the world. Our meta-analysis did not include any studies from Europe, South America or Australia. It is possible that this reflects the different sociocultural backgrounds of Europe, South America and Australia. There is evidence that cognitive ability can be developed by engaging with people from different cultural backgrounds.[50] Recent reports of MH may be scarce because advanced educational programs have been developed to improve the mental health of adolescents in Europe.[51] It is also possible that Europeans are more likely to experience individual functional disorders than group disorders. Moreover, some physicians may not use the term MH because they may not understand the disorder and its symptoms, or may interpret the symptoms differently.

Limitations

There are several study limitations. First, there is a dearth of adequate data on this topic. We did not include unpublished articles or articles from non–peer-reviewed journals. Moreover, some clinical studies on related disorders are ongoing, and new research will probably be added to the existing literature in the near future, necessitating an updated systematic review. Second, the quality of the included studies was poor to moderate. Finally, the data may have been incomplete, which would have increased the bias. Despite these limitations, we believe that these findings provide important information about MH and could help in controlling and preventing MH epidemics among children and adolescents. Additional work may be required to confirm the validity of ARs using ecological study designs to investigate MH in children and adolescents.

Conclusion

We can conclude that there is a prevalent MH trend (9.8%) in children and adolescents. We found that the AR of MH in girls was higher than in boys, and that primary school students may be a high-risk population for MH. There may be three main MH trigger factors (water pollution, suspected food poisoning and supernaturalism) that contribute to the AR of MH in children and adolescents. This meta-analysis indicated a declining trend between

2010 and 2020 in the AR of MH in children and adolescents.

MH in children and adolescents may constitute a serious public health issue. MH in schools may lead to social/school dysfunction and public panic. The Chinese government should assess and improve the management of MH by enhancing public health monitoring and education regarding MH in children and adolescents. To prevent and control MH in this population, governments should establish an evaluation index system to assist professional and technical personnel to improve prevention, diagnosis and treatment measures, and strengthen mental health education. The present findings could provide a reference for governments when considering such regulatory measures.

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Author contributions

QC conceptualized and designed the study, carried out the literature search, analyzed the data and drafted the initial manuscript. XD performed the data analyses and assisted in the constructive discussions. LX contributed to analysis and manuscript preparation.

Declaration of conflicting interest

The authors declare that there is no conflict of interest.

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ORCID iD

Qinglin Cheng https://orcid.org/0000-0003-2899-7626

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