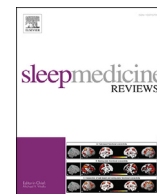




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CLINICAL REVIEW

Childhood maltreatment and sleep in children and adolescents: A systematic review and meta-analysis

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SUMMARY

Childhood maltreatment is a global problem with the risk of serious health consequences for children and adolescents, including sleep problems. Former systematic reviews have examined the association between childhood maltreatment and sleep problems in adults, but no systematic review has investigated the literature on childhood maltreatment and sleep problems in childhood and adolescence. We published a protocol (PROSPERO: CRD42021225741) and conducted a systematic literature search using nine electronic databases. Upon duplicate removal, 1530 records were screened against the inclusion criteria, and 26 studies were included in the review. The most studied sleep outcomes were symptoms of insomnia, sleep duration and nightmares. The results showed significant associations between exposure to childhood maltreatment and insomnia symptoms (OR 3.91, 95%CI: 2.64–5.79, $p < .001$), shorter sleep duration (-12.1 min, 95%CI: -19.4 to -4.7 , $p < .001$) and nightmares (OR 3.15, 95%CI: 2.38–4.18, $p < .001$). There was a considerable heterogeneity in measures and instruments used to examine sleep and maltreatment. Our findings highlight the importance of screening and intervening for sleep problems in children and adolescents exposed to childhood maltreatment.

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Introduction

Childhood maltreatment is a serious risk to the psychological and physical health of children worldwide [1]. According to The World Health Organization, child maltreatment includes all types of physical and/or emotional ill-treatment, sexual abuse and neglect, which occur in the context of a relationship of responsibility, trust or power, and which result in actual or potential

harm to children's health, survival, development or dignity [2]. The prevalence of child maltreatment varies across studies, maltreatment form, and measuring methods, but a review of meta-analyses reported an overall estimated prevalence for self-report studies of 13% for sexual abuse, 23% for physical abuse, 26% for emotional abuse, 16% for physical neglect, and 18% for emotional neglect [1]. Childhood maltreatment is linked to a range of negative health outcomes for children and adolescents, including increased levels of anxiety, depression and post-traumatic stress disorder compared to non-maltreated youth [3,4]. Childhood maltreatment further contributes to reduced daily-life functioning, such as decreased academic performance in adolescence [3,5,6].

Disturbed sleep is another commonly reported consequence of childhood maltreatment, although this has received less focus in the research literature compared to other negative health outcomes [7]. Also, the vast majority of research on childhood

Abbreviations: CI, Confidence interval; CMA, The Comprehensive Meta-Analysis Software; OR, Odds ratio; PROSPERO, International prospective register of systematic reviews; PTSD, Post-traumatic stress disorder; PRISMA, Preferred Reporting in Systematic Reviews and Meta-Analysis; RR, Risk ratio; SD, Standard deviation; SE, Standard error; SES, Socioeconomic status.

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maltreatment and subsequent sleep problems has focused on adult populations [8–13], and there is clearly a need to increase our knowledge on how childhood maltreatment may influence sleep problems in childhood and adolescence [7]. The most common sleep problem in childhood and adolescence is symptoms of insomnia, which is characterized by difficulties initiating sleep, frequent night awakenings, and related daytime impairment [14]. Nightmares is another prevalent sleep problem in children [15], defined as lifelike and terrifying dreams often accompanied by sudden awakenings from sleep [16].

The link between child maltreatment and subsequent sleep problems has been firmly established in adulthood [8–13], and several studies have demonstrated an increased risk of developing insomnia, shorter sleep duration and nightmares in childhood and adolescence [7,17,18]. Given the well-documented link between disturbed sleep in childhood and adolescence, and subsequent negative health outcomes for affected individuals [19–24], it is particularly important to increase knowledge on the association between maltreatment and sleep in childhood, as this may help improve the scientific basis for early interventions and provide targeted service delivery for this population. To the best of our knowledge, no systematic review of the association between childhood maltreatment and sleep in childhood and adolescence has been conducted. Therefore, the aim of the current study was to systematically review the association between childhood maltreatment and sleep problems in childhood and adolescence, defined as children aged 5–18 years.

Method

The current study was conducted in accordance with Preferred Reporting in Systematic Reviews and Meta-Analysis (PRISMA) Guidelines [25]. A protocol of the study is available at the International prospective register of systematic reviews (PROSPERO) [26].

Search strategy

The literature search was developed and conducted with assistance from a specialist librarian at the Norwegian Institute of Public Health. We conducted a systematic literature search in Ovid MEDLINE, Embase, APA PsycInfo, Cochrane, Cinahl, Web of Science, ERIC, SweMed+ and Epistemonikos from inception of the databases to 16.11.2020. We used MeSH-terms and keywords to identify all relevant studies on the concept of childhood maltreatment and sleep. The following search strategy for text words is a summarized version of the search conducted in Ovid MEDLINE®: (child* or teen* or adolescen*) and (child abuse or maltreat* or adverse childhood experience* or rape) and (sleep* or insomnia or parasomnia or nightmare or hypersomnia or night terror). See appendix A for full search strategy. The results were downloaded and duplicates removed in the Rayyan QCRI software [27]. Two reviewers independently screened the titles and abstracts of all articles using the Rayyan QCRI software [27]. Both reviewers had an initial meeting to discuss inclusion- and exclusion criteria and agreed to include studies in cases of doubt. If one reviewer included an article for full-text assessment, the study would be assessed in full-text. An inclusion form with detailed criteria was developed for the present study and piloted before full-text assessment. Four reviewers divided the full-text articles, with one reviewer (VS) screening all studies, and three reviewers (BS, MH, KGA) assessing 1/3 of the studies each. All disagreement regarding inclusion were resolved through a discussion between all four reviewers. See Fig. 1 for a flow chart of the selection process.

Inclusion and exclusion criteria

The following inclusion criteria were used for study eligibility: peer-reviewed full text articles published in scientific journals, a population of at least 80% of participants between 5 and 18 years, measures of exposure to childhood maltreatment, a sleep related outcome, a similar control group with no alleged experiences of maltreatment and English or Scandinavian languages. Childhood maltreatment was broadly defined, and included sexual-, physical-, or emotional abuse, neglect, and witness to violence in the context of a relationship of responsibility. Sleep was also broadly defined, with any sleep-related diagnoses or symptoms, and sleep timing indicators such as sleep onset latency and wake after sleep onset.

Exclusion criteria were case studies, systematic reviews or meta-analyses, studies with no control group or a control group with alleged experiences of maltreatment, and studies with a population outside the age range 5–18 years.

Data extraction

The following study characteristics were extracted: country of study, sample size, age of sample, forms of maltreatment assessed, and type of sleep outcome and instrument used. Based on how the data was reported and which outcomes were used, we extracted mean scores, events and non-events, standard deviations (SD), odds ratio (OR), risk ratios (RR), Confidence intervals (CI), and P-values.

Risk of bias assessment

All included studies were assessed using a risk of bias checklist previously developed [31] based on published guidelines [32] and tools [33] following criteria suggested by the Cochrane Collaboration [34,35]. The checklist included assessments of study sample representativeness, acceptability of control group, acceptable percentage of non-responders, sufficient quality of measures and outcomes, completeness of outcome data and adequate control of distorting influences. Each domain is assessed as having low, high or unclear risk of bias according to a detailed criteria description (see Fig. 2). Two authors independently assessed all included studies using a checklist for each domain and a reason for the assessment. As with the full-text assessment, four reviewers divided the full-text articles. One reviewer (VS) assessed all studies, and three reviewers (BS, MH, KGA) assessed 1/3 of the studies each. Any disagreements were solved through discussion between all four authors. See appendix 2 for the full risk of bias criteria used.

Preparation of data

Several calculations were necessary before conducting the meta-analyses. The meta-analyses on insomnia and nightmares relied on ORs and CIs, but some studies reported several ORs for maltreated children/adolescents. April-Sanders and colleagues [36] reported adjusted prevalence ratios and CI, and we obtained adjusted ORs and CI on the relevant measures by contacting the authors. The results were reported separately for “trouble falling/staying asleep” and “daytime sleepiness”, for two age groups and 4 different maltreatment types. We first computed the combined OR and CI for each type of maltreatment in both age groups using the CMA, resulting in 4 ORs for the combined age group [28]. Further, the 3 ORs for children and adolescents who had experienced maltreatment were combined to one population with maltreatment experiences. We then combined the two sleep problem

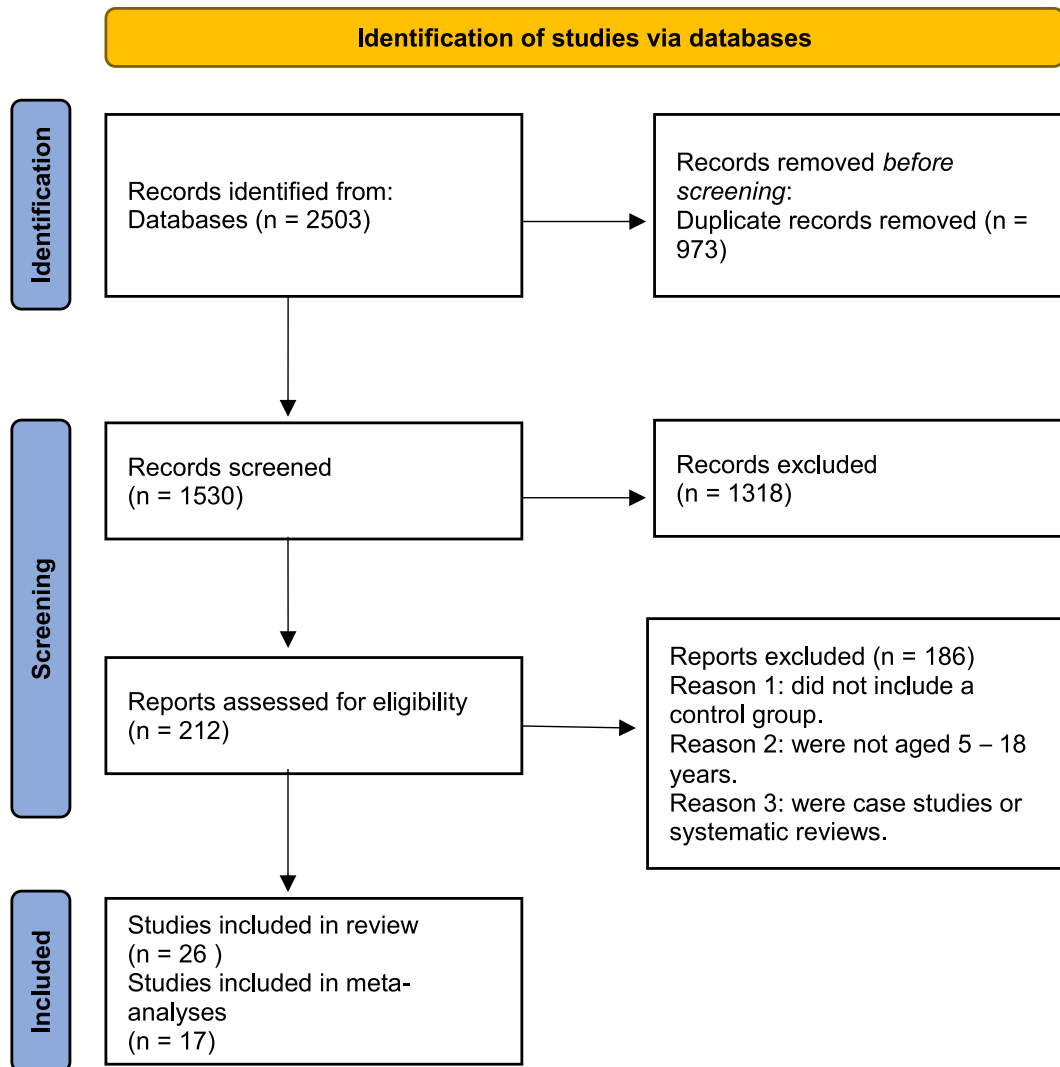


Fig. 1. Flow chart of the study selection process.

categories into a single group of insomnia symptoms and included it in the meta-analysis.

We conducted similar computations for Xiao [17] where OR and CI was reported separately in six groups with different maltreatment scores. The 6 ORs were combined into one indicating maltreatment exposure. For Hibbard et al. [37] we combined three groups with different maltreatment experiences into one. The percentage of exposed participants in each group was reported and calculated into number of participants with sleep problems in the control group and the exposed group. These were included in the meta-analysis. For Mignot et al. [38] we combined the ORs and CIs of the four variables “not satisfactory sleep”, “difficulty falling asleep”, “nocturnal awakenings” and “awakening too early in the morning” using CMA. Langevin et al. [39] reported means and SDs for the items “difficulty to fall asleep” and “wakes often up at night” which were combined into a variable of insomnia symptoms by calculating and combining the effect sizes (Hedge’s g) and standard error (SE). The total variance was computed taking the correlation of the items into account [40]. The resulting effect size and SE were included in the meta-analysis.

The meta-analysis on sleep duration relied on means and SDs from the different studies. Turner et al. [18] reported sleep duration for weekends and weekdays, which was combined by multiplying

the weekday mean by five, and the weekend mean by two divided by seven, and the CI was used to calculate SDs by dividing it by 3.92 and multiplying by the square root of the sample size [41]. The same formula to impute SD was used on data in the study by Bicanic et al. [42]. For Keeshin et al. [43], means and SDs were combined by multiplying means and N for each reported sleep duration and dividing by number of participants [41]. For Sadeh et al. [44] we combined three groups with different maltreatment exposures into a combined group [41]. The same technique was used for Usta et al. [45], combining the means from both genders and calculating the pooled SD.

Data analysis

The Comprehensive Meta-Analysis Software v3 (CMA) was used for all analyses [28]. The most commonly reported statistics were independent groups (means and standard deviations), OR, and events and non-events. A few studies reported RR. The CMA is able to combine data in various formats for the meta-analyses. We chose a random-effects model as the inclusion criteria were broad and the included studies were expected to be heterogeneous. A random-effects model was considered appropriate as we do not assume a common effect size and seek to generalize the results to a range of

0–40% represents heterogeneity that might not be important, 30–60% represents moderate heterogeneity, 50–90% represents substantial heterogeneity and 75–100% represents considerable heterogeneity [30].

Results

Study selection

Our search identified 1530 articles. All 1530 articles underwent title- and abstract screening, and 1318 articles were excluded. The remaining 212 articles were submitted to a full-text screening. 186 articles were excluded based on the exclusion criteria and 26 articles were included in the review [17,18,36–39,42–60]. See Fig. 1 for the flow chart of the study selection process.

Table 1 shows the study characteristics of the included studies: country, study design, sample size, age of the sample, measurement used for maltreatment, and the sleep outcome and instrument used. The table also indicates which meta-analyses each study was included in, or the reason for not including the study in any of the meta-analyses. Of the included studies, 12 were conducted in the United States (US) [36,37,43,44,46,50,51,53,58–61], two in China [17,56], two in France [38,55], two in Canada [18,39], and one in Iran [57], the Netherlands [42], the UK [47], Turkey [54], Brazil [48], Israel [52], Lebanon [45], and Taiwan [17]. 13 of the 26 included studies used a cross-sectional design [17,18,37–39,42,48,52,53,55,57,58,61], 10 of the studies used a case–control design [43–47,50,51,54,59,60], one used a longitudinal design [36], one used a cohort study design [56], and one used a retrospective matched cohort design [49]. The sleep outcome measures varied across studies and included The Pittsburgh Sleep Quality Index, The Child Sleep Habits Questionnaire, The Child Behaviour Checklist and actigraphy. Instruments to measure maltreatment varied greatly, with most studies using self-developed questions. The age of the participants varied, with most studies including a sample of teenagers. Publication date of studies varied from 1989 to 2020.

Risk of bias

The risk of bias assessments are presented in Fig. 2. Only four of the 26 included studies were assessed as having a low risk of bias in all six domains, while one study was assessed as having unclear or high risk of bias in all 6 domains. Of the remaining studies, 5 had high or unclear risk of bias in 1 domain, 8 in 2 domains and 5 in 3 domains. Eleven of the included studies were assessed as having a high risk of bias on distorting influences, mainly because key potential confounding variables were not considered or adequately handled in the analyses. Fourteen studies were assessed as unclear on non-responders as the response rate was not reported, or there was no information available on the difference between responders and non-responders. Thirteen studies were considered unclear on the completeness of outcome data, mainly because the studies did not report whether there were any missing outcome data and we were not able to assess if there was a risk of bias. On study sample representativeness, 23 studies were considered representative, and the comparison group were assessed as acceptable in 24 of the studies, as comparators were appropriately matched for the study sample or differences in background factors were statistically controlled for.

Meta-analyses

Three separate meta-analyses were conducted, investigating insomnia symptoms, sleep duration and nightmares. 16 of the 26 studies were included in at least one meta-analysis. The main

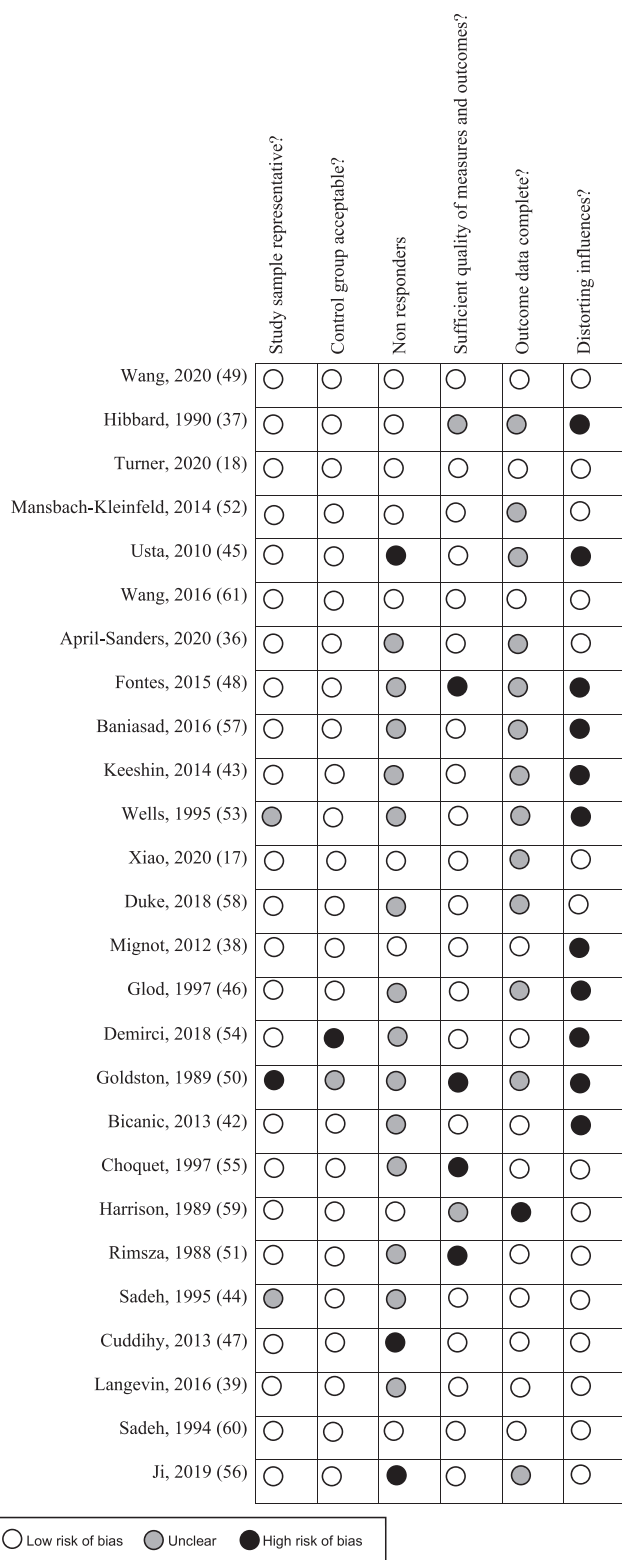


Fig. 2. Risk of bias assessment.

scenarios [29]. The effect size of the meta-analysis on childhood maltreatment and sleep duration was reported in mean difference and Hedge's G. All meta-analyses were tested for heterogeneity using I² which describes the percentage of variation across studies due to heterogeneity [30]. Recommended interpretation of I² is that

Table 1
Characteristics of included studies as reported.

First author, year	Country	Study design	Sample size (victims and controls)		Age of sample and assessment	Forms of maltreatment	Sleep outcome and instrument	Included in meta-analysis
April-Sanders A et al., 2020 [36]	The US & Puerto Rico	Longitudinal	2070	421	5–16 years (mean age 9.23 years).	Youth- and parent-reported lifetime history of cumulative childhood adversities (parental loss, maltreatment, parental maladjustment)	Youth- and parent-reported current sleep disturbance questions from DISC-4: trouble falling asleep, staying asleep, or waking up too early, daytime sleepiness and bad dreams/nightmares.	- Symptoms of insomnia - Nightmares
Baniasad MH et al., 2016 [57]	Iran	Cross-sectional	215 (sample not specified to groups)	215 (sample not specified to groups)	13–15 years	Child abuse self-report scale assessing lifetime exposure to childhood maltreatment	Self-reported general health questionnaire with seven items related to current anxiety and insomnia.	Not included as sleep outcome is not reported separately from anxiety.
Bicanic IAE et al., 2013 [42]	The Netherlands	Cross-sectional	52	37	Mean age victims: 16.1 years Mean age comparators: 15.6 years	Self-reported single rape event minimum 4 weeks prior to study admission.	Self-reported sleep duration over three days.	- Sleep duration
Choquet M et al., 1997 [55]	France	Cross-sectional	61	122	16.2 years (SD = 2.02)	Experience of rape during lifetime: "I have at some time during my life been victim of sexual assault (yes/no)"	Frequency of current sleep problems: sleeping badly, nightmares, waking during the night.	- Nightmares The study was not included in the meta-analysis on symptoms of insomnia as the measures did not cover insomnia sufficiently
Cuddihy C et al., 2013 [47]	The UK	Case-control	34	29	Mean age victims: 9.32 years Mean age comparators: 9.07 years.	History of pre-adoption lifetime maltreatment confirmed from social work documents.	Parent-report of current sleep problems via the Child sleep habits questionnaire with eight subscales. The study reported total sleep scores.	- Symptoms of insomnia
Demirci E 2018 [54]	Turkey	Case-control	52	33	10–18 years	Self-reported/clinician-reported maltreatment history assessed in a psychiatry department.	Self-reported insomnia symptoms assessed 6 months after assessment of maltreatment using the Pittsburgh sleep quality index.	- Symptoms of insomnia
Duke NN et al., 2018 [58]	The US	Cross-sectional	126 868 (sample not specified to groups)	126 868 (sample not specified to groups)	12–19 years (mean age 14.8 years)	10 self-report questions of lifetime maltreatment were organized into two major categories (household dysfunction, four questions; and abuse, four questions).	Self-reported current sleep duration (≥ 8 h of sleep (recommended for the participant age groups) versus < 8 h)	Not included as the measure of sleep duration was not specified into minutes/hours.
Fontes LFC et al., 2017 [48]	Brazil	Cross-sectional	2 473 368	101 901	14 years (9th grade)	Self-reported question of lifetime abuse: "Have you ever been forced to have sexual intercourse?"	Self-reported current sleep problems assessed with an insomnia variable that equals one if the student always has or almost always has trouble sleeping because something worries him/her and 0 if he/she never, rarely or sometimes has trouble sleeping.	Not included as the measure of insomnia is deemed not specific enough to cover symptoms of insomnia.
Glod CA et al., 1997 [46]	The US	Case-control	19	15	Mean age victims: 9.4 years (SD = 2.3 years)	Clinician-reported experiences of lifetime physical and/or	Actigraphy measures of sleep latency, total sleep time, wake	- Symptoms of insomnia - Sleep duration

(continued on next page)

Table 1 (continued)

First author, year	Country	Study design	Sample size (victims and controls)		Age of sample and assessment	Forms of maltreatment	Sleep outcome and instrument	Included in meta-analysis
Goldston DB et al., 1989 [50]	The US	Case-control	128	67	Mean age controls: 8.3 years (SD = 1.9 years) 2–18 years (mean age 10 years)	sexual abuse substantiated by social services. Clinician-reported lifetime experience of maltreatment.	after sleep onset and number of awakenings Clinician-reported sleep problems during the 3 years prior to enrolment in study. The sleep outcome was “sleep disturbance” and not specified further	The study is not included in any meta-analyses as the sleep outcome of “sleep disturbance” is not sufficiently specified.
Harrison PA et al., 1989 [59]	The US	Case-control	291	1124	Mean age 15.9 years.	Self-reported experience of lifetime sexual abuse through semi- structured interview.	Self-reported current “sleeplessness” not specified further.	The study is not included in any meta-analysis as “sleeplessness” is not sufficiently specified.
Hibbard RA et al., 1990 [37]	The US	Cross-sectional	754	3215	12–18 years	2 questions on self-reported lifetime physical abuse and two questions on lifetime sexual abuse.	Self-reported current sleep problems. The sleep outcome is “having trouble sleeping” and not specified further	The study is not included in any meta-analysis as “having trouble sleeping” is not sufficiently specified.
Ji X et al., 2019 [56]	China	Cohort study	209	498	Mean age 13.16 years (SD = 0.9 years)	Self-reported physical abuse during the last 12 months, assessed through the Parent-child conflict tactics scale.	Self-reported sleep duration, sleep latency, subjective sleep quality, sleep efficiency, sleep disturbances and day-time function over the last month	- Symptoms of insomnia Not included in meta-analysis on sleep duration as this is not reported specifically.
Keeshin BR et al., 2014 [43]	The US	Case-control	24	12	Mean age victims: 15.04 years (SD = 1.45) Mean age controls: 14.84 years (SD = 1.34)	Self- and caregiver-reported sexual abuse 1–6 months prior to enrolment in study as documented in medical record.	Self-reported sleep duration over three days.	- Sleep duration
Langevin R et al., 2017 [39]	Canada	Cross-sectional	85	73	Mean age 5.5 years (SD = 0.6). Data extracted from T2 only, where participants where within our pre-defined age range.	Parent-reported lifetime sexual abuse assessed through an adaptation of the History of victimization questionnaire.	Parent-reported sleep problems through a 7-item subscale from the Child behavior checklist. “Difficulty to fall asleep”, “Nightmares” and “Wakes often up at night” are extracted.	- Symptoms of insomnia - Nightmares
Mansbach-Kleinfeld I et al., 2016 [52]	Israel	Cross-sectional	28	878	14–17 years	Self-reported lifetime sexual abuse assessed with a question worded according to the official guidelines of the Israel association for child protection.	Sleep problems were assessed through self-report asking how often they had experienced difficulty falling asleep in the past 6 months.	- Symptoms of insomnia
Mignot S et al., 2018 [38]	France	Cross-sectional	59 (Sleep-related outcomes only assessed in part of the population)	847 (Sleep-related outcomes only assessed in part of the population)	15 years.	Self-reported lifetime history of sexual abuse was assessed by the question: “During your life, have you ever been the victim of sexual assault (including attempted assault)?” (Yes/No)	Current sleep problems were assessed by self-report on quality of sleep, nightmares, difficulty falling asleep, nocturnal awakenings and awakening too early in the morning.	- Symptoms of insomnia - Nightmares
Rimsza ME et al., 1989 [51]	The US	Case-control	72	Not mentioned	2–17 years (Mean age 10 years”	Clinician-reported lifetime sexual abuse and medical examination. Defined as forced sexual activity or sexual activity between child/adolescent and an adult.	Self-reported current sleep problems were assessed through a telephone interview about “sleep problems” and if confirmed, “what problem?”. Not specified further.	Not included in any meta-analysis as the sleep outcome is not sufficiently specified.
Sadeh A et al., 1994 [60]	The US	Case-control	72	28	2–13 years (mean age 8.07 years (SD = 2.55))	Self- and caregiver reported lifetime sexual and physical abuse through interview.	Medical charts were used to document difficulties with sleep onset, night waking and	Not included in meta-analysis as measures of

Sadeh A et al., 1995 [44]	The US	Case-control	27	12	7–14 years	Self- and caregiver reported lifetime sexual and physical abuse through interview.	parasomnias prior to admission in a psychiatric hospital. Measures of sleep duration assessed by actigraphy for 1–three nights.	sleep difficulties are considered unreliable.
Turner S et al., 2020 [18]	Canada	Cross-sectional	768	2142	14–17 years	Self-reported lifetime history of sexual abuse, physical abuse and exposure to intimate partner violence were measured using the Childhood experiences of violence questionnaire. Self-reported lifetime history of neglect was measured using items derived from the National longitudinal study of adolescent to adult health.	Current self-reported sleep outcomes included time it takes to fall asleep, waking during the night, and hours of sleep on weekdays and weekends.	- Sleep duration Not included in meta-analysis on symptoms of insomnia as the measure of time it takes to fall asleep is < 10 min or >10 min and not sufficient to be characterized as symptoms of insomnia.
Usta J et al., 2010 [45]	Lebanon	Case-control	249	779	8–17 years	Self-reported lifetime history of sexual abuse using the international child abuse screening tool, which includes 35 questions about their experience of sexual abuse.	Self-reported sleep problems during the last month using a four-item sleep disturbance subscale of the Trauma symptom checklist.	- Symptoms of insomnia
Wang Y et al., 2016 [61]	The US	Cross-sectional	5693	3889	13–18 years	A structured interview of self-reported lifetime history of potentially traumatic events. Included parent violence, other violence, rape or kidnappings.	Self-reported insomnia was measured by ICD criteria: problems falling asleep, problems staying asleep, and early morning awakenings for at least two weeks during the last 12 months.	This study reports risk ratios, and could therefore not be included in the meta-analysis, as the estimates could not be accurately converted to odds ratios.
Wang D et al., 2020 [49]	Taiwan	Retrospective matched cohort	9837	29 511	Mean age: 14.1 years (SD = 4.9)	Data on childhood maltreatment extracted from the outpatient and hospitalization records in the Taiwan longitudinal health insurance database.	The presence of sleep disorders were extracted from the Taiwan national health insurance research database. The type of sleep disorders is not specified.	Not included in any meta-analysis as sleep disorders are not specified further.
Wells RD et al., 1995 [53]	The US	Cross-sectional	68	68	2–11 years (mean age: 7 years)	A structured interview of parent-reported symptoms of sexual abuse.	Parent-reported current sleep problems through a structured interview about frequency of difficulty getting to sleep and nightmares.	- Symptoms of insomnia - Nightmares
Xiao D et al., 2020 [17]	China	Cross-sectional	78 925	74 470	Mean age: 15 years (SD = 1.8)	Self-reported lifetime history assessed through the childhood trauma questionnaire: five subscales of childhood maltreatment, including physical abuse, emotional abuse, sexual abuse, physical neglect, and emotional neglect	Self-reported sleep problems over the last month were assessed through the Pittsburgh sleep quality index.	- Symptoms of insomnia

Note. SD: Standard deviation. If no instrument is mentioned, the study used a self-developed measure, or the instrument was not mentioned in the publication.

reason for not including the remaining ten studies in the meta-analyses was that the sleep outcome measures used were not sufficiently specified or thorough enough to be included. All studies not included in any meta-analysis reported sleep outcomes, but some studies did not specify the measure beyond a single item assessing *sleep disorders* [17,37,50,51,59]. Other studies did not cover insomnia symptoms sufficiently to be included in the meta-analysis [48,55]. Baniasad et al. [57] reported a sleep- and anxiety outcome jointly and could therefore not be included. Duke et al. [58] measured sleep duration but reported the outcome as ≥ 8 h of sleep or < 8 h of sleep. Wang et al. [61] reported results which could not be accurately converted to odds ratios.

Insomnia symptoms

Children and adolescents with experiences of maltreatment had significantly higher odds of reporting insomnia symptoms compared to their peers without such experiences. See Fig. 3 for the meta-analysis. The random effects model showed an overall effect size of OR 3.91, (95%CI: 2.64–5.79, $p < .001$). Eleven studies were included in the meta-analysis on insomnia symptoms [17,36–39,45,47,52–56,60,61]. The total population included in the meta-analysis consisted of 81 798 children and adolescents exposed to maltreatment and 78 111 controls. The strength of the association varied somewhat between included studies. The heterogeneity of the studies included was I^2 93%, P-value < 0.001 which can be interpreted as considerable heterogeneity.

Sleep duration

Children and adolescents with experiences of maltreatment had a significantly shorter sleep duration compared to their peers without such experiences (see Fig. 4 for the meta-analysis). The mean difference in sleep duration of children with experiences of maltreatment was 12.1 min (95%CI: -19.4 to -4.7, $p < .003$) shorter than the mean sleep duration of controls. The effect size was -0.23 (SE: 0.04 95%CI: -0.31, -0.15). Five studies were included in the meta-analysis on sleep duration [18,42–44,46] and the total population consisted of 890 children and adolescents exposed to maltreatment and 2218 controls. The result of the heterogeneity test was not significant (I^2 0%, $p = .528$). As one of the studies

included was very influential [18] we conducted a sensitivity analysis without the study by Turner et al. and the results of the meta-analysis with the study excluded did not yield significant findings, with a shorter mean difference in sleep duration for children being 11.1 min (CI: -32.3 to 9.9, $p = .299$).

Nightmares

Children and adolescents exposed to maltreatment had a significantly higher odds of having nightmares compared to their non-exposed peers. See Fig. 5 for the meta-analysis. The OR was 3.15 (95%CI: 2.38–4.18, $p < .001$). Five studies were included in the meta-analysis on nightmares [36,38,39,53,55] and the total population consisted of 2343 children and adolescents exposed to maltreatment and 1531 controls. All studies included in the meta-analysis showed the same trend, with a significantly increased risk of experiencing nightmares after being exposed to childhood maltreatment. The result from the heterogeneity test was not significant (I^2 0%, $p = .776$).

Findings from studies not included in the meta-analysis

In general, the studies not included in the meta-analysis show the same trend as the included studies, with children exposed to maltreatment having an increased risk of reporting sleep problems. Baniasad et al. [57] concluded that sleep disturbances are higher in adolescents with experiences of neglect compared to those without experiences of neglect. Choquet et al. [55] reported that rape victims had a higher prevalence of sleep disorders, independent of sex and age. Fontes et al. [48] reported that the prevalence of insomnia was 10.9% in the non-abused population and 25.4% in the abused population. Goldston et al. [50] found a sleep disturbance prevalence rate of 20.7% in the group with experiences of sexual abuse compared to a prevalence of 8.3% in the non-abused group. Harrison et al. [59] reported a prevalence of sleeplessness in 60.1% of victims of maltreatment and 43.2% in non-victims. Hibbard et al. [37] found that being exposed to physical abuse was associated with a relative risk of 2.1 for having trouble sleeping, and exposure to physical & sexual abuse was associated with a relative risk of 2.5 for having trouble sleeping. Rimsza reported that 19% of children with experiences of sexual abuse reported sleep problems

Exposure to childhood malreatment and symptoms of insomnia

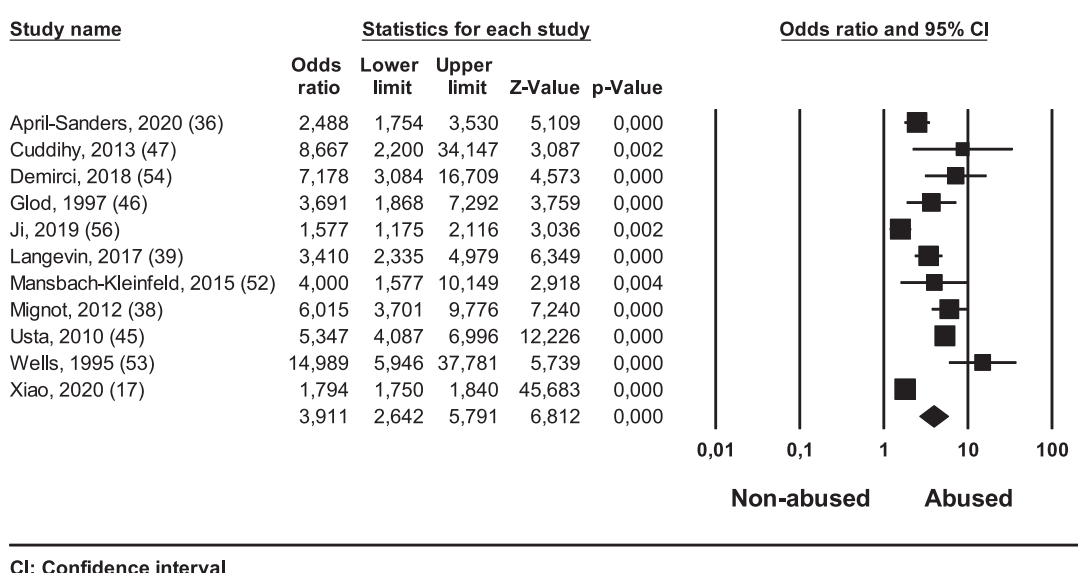
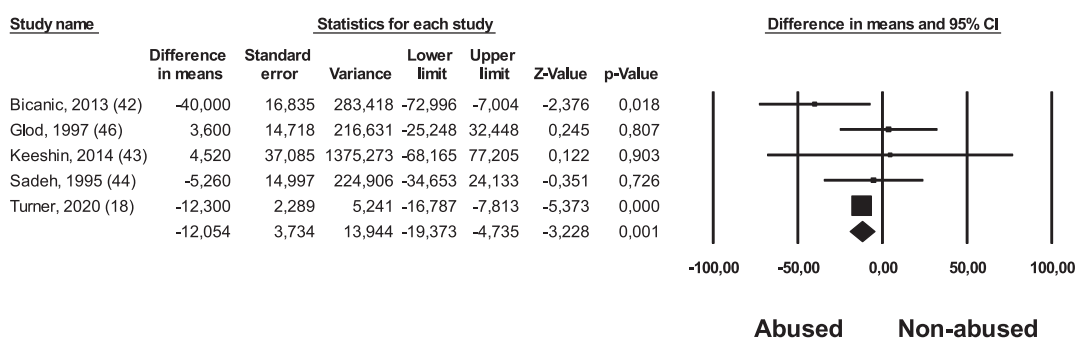


Fig. 3. Exposure to childhood malreatment and symptoms of insomnia.

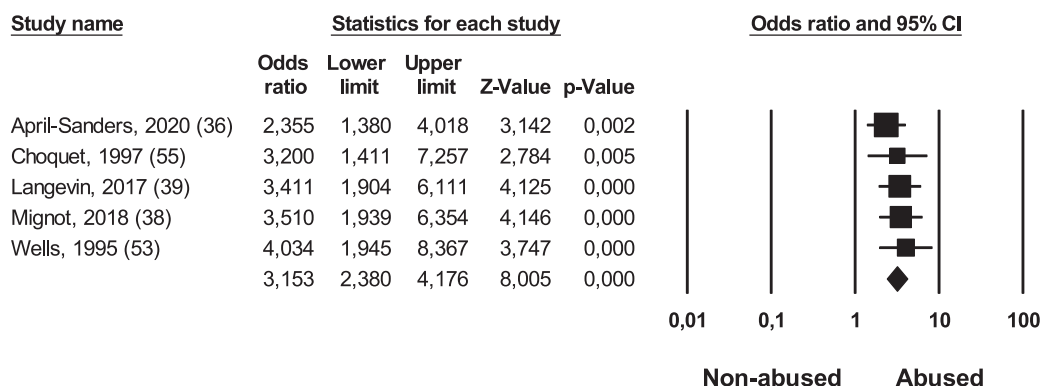
Exposure to childhood maltreatment and sleep duration



CI: Confidence interval

Fig. 4. Exposure to childhood maltreatment and sleep duration.

Exposure to childhood malreatment and nightmares



CI: Confidence interval

Fig. 5. Exposure to childhood malreatment and nightmares.

compared to 4% in the non-abused group [51]. Turner et al. [18] reported that all types of child maltreatment were associated with increased odds of taking longer time to fall asleep and waking more often during the night. Wang et al. [61] found that exposure to childhood adversity was associated with an elevated risk of insomnia. Xiao et al. [17] reported that the incidence of sleep disturbances was higher in children who have experienced child abuse compared to non-victims. Duke et al. [58] found that individual adverse childhood experiences were linked 14%–54% reduced odds of getting at least 8 h of sleep on a school night. Only the findings of Sadeh et al. [60] differed from the main findings of increased sleep problems among children and adolescents exposed to maltreatment. They reported similar prevalence of delayed sleep onset and night waking in victims of sexual abuse and non-abused adolescents, but significantly less problems with night waking in the group with experiences of physical abuse compared to controls.

Overall, the studies that were not included in the meta-analyses show the same direction of association as the meta-analyses. These studies have focused mostly on symptoms of insomnia and sleep duration. All but one of the studies [60] conclude that the prevalence of sleep problems are higher in populations with experiences of maltreatment than in controls [17,18,37,48,50,51,55,57–59,61].

Some of these studies has not specified which type of sleep problems they measure, but it seems that symptoms of insomnia is the most common. However, it is difficult to conclude whether or not the strength of the association is similar to the results of the meta-analyses.

Discussion

This is the first systematic review and meta-analysis on the association between childhood maltreatment and sleep in children and adolescents. We included 26 studies with study populations varying from 5 to 18 years in mean age. Overall, the three meta-analyses show that children and adolescents with experiences of childhood maltreatment are at an increased risk of developing symptoms of insomnia, shorter sleep duration and nightmares. Children and adolescents exposed to maltreatment have more than threefold higher odds of reporting symptoms of insomnia and nightmares. The results also indicate that they in general sleep 12 min shorter than non-victims, however, a sensitivity analysis with one study removed did not yield significant findings. The results from the meta-analyses on symptoms of insomnia and sleep

duration are supported by the studies included in the systematic review.

Our findings of increased risk of sleep problems for children and adolescents who have experienced child abuse are consistent with associations reported in former systematic reviews examining sleep outcomes in adults [8,63,64]. The observed increased odds of insomnia symptoms and reduced sleep duration in children and adolescents with experiences of maltreatment could be accounted for by several mechanisms [65]. One of the hypothesized mechanisms is the dysregulation of arousal pathways after experiencing traumatic events. Childhood maltreatment can lead to an increased and chronic activation in the stress regulation system of the body, increasing the release of hormones that promote increased attention and vigilance [65,66]. This chronic activation in the stress-regulatory system of the body has been linked to difficulties falling asleep [67]. Somatic hyperarousal is a similar phenomenon that has been linked to heightened nocturnal activity [68] which typically causes more frequent awakenings during the night, a core symptom of insomnia [46], and can lead to reduced sleep duration. Another possible mechanism is cognitive hyperarousal, as suggested in a recent systematic review and meta-analysis [68]. Cognitive hyperarousal can be described as a high level of arousal that is conflicting with the initiation or maintenance of sleep and can include pre-sleep rumination and emotional arousal [69]. Several studies have found that pre-sleep arousal indeed leads to a longer self-reported sleep onset latency and decreased sleep duration [70–72]. However, Pfaff and colleagues [68] conclude that cognitive hyperarousal is underrepresented as a potential mechanism in studies on childhood maltreatment and sleep, with only one study explicitly measuring the phenomenon in their systematic review and meta-analysis.

Our meta-analysis on the association between maltreatment and nightmares in children and adolescents showed more than a 3-fold increased odds of having troubles with nightmares after childhood maltreatment. One study suggest that the increased risk of nightmares in maltreated children and adolescents can be explained by increased psychological distress [7]. Nightmares are also a common symptom of post-traumatic stress disorder (PTSD), a disorder usually developed after traumatic events [73]. Sleep problems are indeed very common in people suffering from PTSD [74], and have been proposed as the hallmark of PTSD [75]. Several aspects of the trauma experience are thought to influence the characteristics of the sleep problems, such as type of trauma, duration, intensity and recency [76]. It is possible that sleep problems are a reflection of trauma symptoms. In the current review, few of the included studies has measured other trauma symptoms directly, but it is reasonable to believe that a proportion of the population included also meet the diagnostic criteria of PTSD. Future studies should strive to measure trauma symptoms as well as sleep problems when studying the effects of childhood maltreatment. Developing sleep problems after being exposed to childhood maltreatment can be considered a double burden, as both sleep problems and maltreatment have negative outcome profiles.

The heterogeneity between studies included in the meta-analysis on insomnia symptoms was considerable. As the individual studies included used different measures and criteria of insomnia, this is somewhat expected. Statistical heterogeneity in meta-analyses is common as there is usually substantial diversity in clinical and methodological approaches [77]. The two included studies reporting the highest ORs had participants with an average age of 9.3 [47] and 7 years [53]. As childhood maltreatment was disclosed at this early age in these two studies, it is possible that the maltreatment was more severe, and thus explaining the high odds for having symptoms of insomnia. This seems to hold true in the

study by Wells [53], as the population exposed to maltreatment was referred by Children's Protective Services or a sexual abuse clinic. Another reason for the observed heterogeneity could be the inclusion of studies reporting both adjusted and unadjusted results. Most studies have adjusted for the most common variables such as age and gender, and some have adjusted for parental income and parental education. We have used adjusted results where these are reported, as recommended in the Cochrane handbook [41]. Studies that report only crude ORs, such as many of the studies before year 2000, have also been included, which could possibly have resulted in the considerable heterogeneity seen in the meta-analysis on childhood maltreatment and insomnia symptoms. However, all studies included in the meta-analysis of maltreatment and insomnia symptoms were significant and showed the same direction of effect. As such, we believe our findings to be generalizable to diverse settings.

The heterogeneity between studies could also stem from a difference in study setting and recruitment, spanning from psychiatric departments [46,54] to schools [56] and national registers [52]. Populations from psychiatric departments are likely to have more severe symptoms than a population from a school setting that might not be in need of treatment. It should also be considered that the meta-analyses on sleep duration and nightmares did not show signs of heterogeneity. A reason for this could be that sleep duration is usually measured identically across studies. This also holds true for most of the included studies measuring nightmares, as they assessed it homogeneously through questions of prevalence and frequency.

Most studies included in the meta-analyses measure only sexual abuse and no other forms of maltreatment. Of all included studies, six of eleven studies on insomnia [38,39,45,52–54], four of five on nightmares [38,39,53,55] and two of five on sleep duration [42,43] focus exclusively on sexual abuse. Indeed, a recent systematic review found that sexual abuse is the most commonly studied form of maltreatment [78]. The focus on sexual abuse within the childhood maltreatment research field has been pointed out by several researchers, specifically when compared to the research on child neglect, a problem termed the neglect of neglect [79,80]. One of the reasons for the focus on sexual abuse within maltreatment research could be that definitions of neglect, physical abuse and emotional abuse are less clear-cut than that of sexual abuse [78]. Most definitions used do not consider cultural differences, or challenges related to lower SES, which can make these forms of childhood maltreatment more difficult to measure, as opposed to sexual abuse where there is a more worldwide agreement as to what constitutes the phenomenon [78]. Another noteworthy point is that some forms of maltreatment often overlap, with sexual abuse often including elements of physical abuse, and most maltreatment forms including some level of emotional abuse [78]. To successfully understand the health outcomes associated with childhood maltreatment, we recommend that broader assessments of childhood maltreatment experiences is needed. Turner et al. provides an example of a thorough assessment of childhood maltreatment experiences, assessing sexual abuse, physical abuse, neglect and exposure to intimate partner violence [18].

The current systematic review includes a large age-span from 5 to 18 years and it is likely that childhood maltreatment affects sleep differently depending on the developmental stage of the child. Both the rate and type of sleep problems change across childhood and thus the specific sleep outcomes child maltreatment will impact is likely to differ [81]. While parasomnias are frequent during early childhood, insomnia symptoms often increase from childhood to adolescence, and delayed sleep phase also peak during adolescence [81,82]. The included studies in this systematic review did not allow specific sensitivity analyses on how the association between

childhood maltreatment and sleep differs across age groups and developmental stages, and this should be addressed in future studies.

Most of the studies included in this systematic review were assessed as having some risk of bias. The most common domain for a potential high risk of bias was lack of adequately considering or including potential confounding variables. Many of the included studies controlled for some confounding variables such as sex and age, and some included parental education. A relevant covariate that might also be included is socioeconomic status (SES), as sleep problems are more frequent in lower socioeconomic strata [83], and similarly, there is a social gradient in maltreatment [84,85]. Some types of childhood maltreatment, such as physical abuse and emotional abuse are more common in populations with lower SES [85]. Another possible covariate is mental health problems such as anxiety, depression, and PTSD. These mental health problems are common in children and adolescent exposed to maltreatment [86], and sleep problems often co-occur with mental health problems [87]. Future studies should take care in considering and controlling for covariates such as mental health problems and SES.

The type of reporting varied amongst the studies included in this systematic review. Most of the included studies relied on self-report of childhood maltreatment and sleep problems and caregiver-reported assessments were most commonly used in studies with young children. There was a lack of standardized screening tools used to measure all forms of childhood maltreatment, which is something future studies should seek to utilize. Regarding sleep measures, some studies indicate that self-reported estimates of sleep patterns in adolescents are more accurate than caregiver-reported estimates [88]. In general, actigraphy has good agreement with subjective reports on sleep schedule parameters [89]. Two of the five included studies in the meta-analysis on sleep duration assessed sleep length using actigraphy. Objective measures of sleep such as actigraphy or polysomnography could be useful supplements to self-reported sleep measures in future studies, but currently, there is no consensus as to how sleep duration should be measured. Differences in measurement- and report format could affect the reported associations. However, in the meta-analysis on sleep duration, two [44,46] of the included five studies used actigraphy to measure sleep duration, and the results of these studies did not seem to differ from the three studies using other measurement methods.

An important aspect to consider when examining associations like sleep and childhood maltreatment is the timing of the exposure to maltreatment and the timing of sleep assessment. 22 of the 24 included studies assessed lifetime maltreatment history and current sleep problems, and only two studies [43,56] measured maltreatment during the last 1–12 months and current sleep problems. The results from these two studies [43,56] did not differ from the other included studies. Information about the timing of maltreatment exposure is important as it is likely that the association between maltreatment and sleep problems are stronger the closer they are in time. The fact that few studies report the timing of the childhood maltreatment in relation to the post-traumatic assessment is a problem formerly identified within the field [90]. A reason for this lack of reporting could be that it might be difficult for children and adolescents to state the timing and duration of the traumatic events, particularly with maltreatment spanning over a longer period of time [90]. As only two of the included studies specified the timing of the maltreatment exposure, we could not examine the importance of timing of exposure to timing of assessment. However, it is reasonable to believe that proximity in exposure and assessment could lead to a stronger association even though this is not observable in the two studies included in our systematic review. Future studies should seek to assess and report

the children's age at exposure to maltreatment as this information could be important in understanding how the effect of maltreatment may be different across developmental phases.

Strengths and limitations

The current study is the first comprehensive overview of the literature on the association between being exposed to childhood maltreatment and sleep in children and adolescents. However, there are some limitations to consider. Even though the focus of the current study is childhood maltreatment, some of the included studies used measures of both maltreatment and adverse childhood experiences. Studies that focused exclusively on adverse childhood experiences were not included. This review includes populations with various experiences of maltreatment, ranging from more severe forms of maltreatment such as sexual and physical abuse over several years, to phenomena normally defined as adverse childhood experiences, such as experiencing parental loss or having maladjusted parents. However, in studies reporting both maltreatment and adverse childhood experiences, we have only extracted and analysed data on the experiences considered childhood maltreatment. The initial plan as stated in the protocol [26] was to conduct sub-analyses examining the different outcome profiles of different forms and degrees of maltreatment. However, this was not feasible due to a limited number of included studies examining and reporting on specific forms of maltreatment. Another limitation was that ten of the twenty-six studies included in the systematic review could not be included in the meta-analyses, mainly due to lack of specificity of the sleep outcomes. A further limitation of this systematic review is the difficulty in combining heterogeneous studies into one meta-analysis. As the sleep outcome measures used across the included studies are as diverse as we found, it is not possible to combine all the included studies into one meta-analysis. Further, as several studies did not report standard deviations we chose to impute these following recommendations from the Cochrane handbook [41]. There was also a considerable risk of bias, particularly regarding distorting influences such as key confounding variables not being considered, which should be taken into account. Based on the limited number of included studies from countries other than the US, we were not able to conduct any analyses to examine possible geographical differences in the association between maltreatment and sleep. Another limitation is that few of the studies report the timing of maltreatment exposure in relation to the assessment of sleep problems, which may influence comparability of the studies. The homogeneity of study designs in the included studies can also be considered a limitation, as 23 of the 26 included studies were cross-sectional or case-control studies, which does not allow us to interpret causality.

Conclusion

This systematic review found that maltreated children and adolescents have significantly higher odds of symptoms of insomnia, shorter sleep duration and nightmares. These findings highlight the importance of screening for sleep problems in children and adolescents with experiences of childhood maltreatment in clinical paediatric settings. In a public health perspective, our findings add to the list of increased risk for negative health outcomes for victims of childhood maltreatment. Both sleep problems and childhood maltreatment are associated with several negative health outcomes, and it is important that this population receive early interventions to prevent further negative development of problems.

Practice points

1. Children and adolescents exposed to childhood maltreatment are at a significantly increased risk for developing insomnia symptoms, nightmares and shorter sleep duration.
2. Clinicians and other relevant health personnel should take care in assessing sleep problems in children and adolescents with experiences of childhood maltreatment.

Research agenda

Future studies should:

1. Seek to assess a broader spectrum of childhood maltreatment experiences, such as neglect, emotional abuse and exposure to intimate partner violence.
2. Use high quality, standardized screening tools and comprehensive measures to measure different types of childhood maltreatment and sleep problems.
3. Focus on assessing a broader spectrum of sleep problems and their association to childhood maltreatment, such as other parasomnias and circadian rhythm sleep disorders.
4. Include information about the timing and duration of the maltreatment exposure in relation to the post-traumatic assessment to further advance our knowledge on the effect of maltreatment across developmental phases.

Authors' contributions

VS, KGA, MH and BS conceived and designed the study. VS drafted the manuscript. VS, KGA, MH and BS conducted the study selection process and risk of bias assessments. VS and KGA conducted the analyses, with KGA providing statistical guidance. KGA, MH, AD and BS provided comments and reviewed the manuscript. All authors approved the final version.

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Conflicts of interest

The authors do not have any conflicts of interest to disclose.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.smr.2022.101617>.

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