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The relationship between emotion dysregulation and sleep in children and adolescents with ADHD: protocol for a systematic review

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ABSTRACT

Introduction Over half of children and adolescents with attention-deficit/hyperactivity disorder (ADHD) have difficulties with emotion dysregulation (EDR) and/or sleep, yet the interrelations between emotional regulation and sleep are not well-characterised in this population. This systematic review will address the relationship between these difficulties and investigate whether specific aspects of EDR are more strongly related to sleep problems in youth with ADHD.

Methods and analysis We will adhere to the Preferred Reporting Items for Systematic Reviews and Meta-analysis guideline for systematic reviews. A wide set of electronic databases will be searched for peer-reviewed quantitative studies investigating the relationship between EDR and sleep in children and adolescents (ages 5 to 18 years) with ADHD. In addition, the reference list of all studies will be searched for other relevant studies, and Scopus will be used to search for citations of the included studies. We will also contact experts in the field to request published and unpublished studies. The primary outcome will be the effect size of the relationship between EDR and sleep in children and adolescents with ADHD. We will look at EDR and sleep broadly and also consider the multifaceted nature of both terms. Secondary outcomes will include which facets of EDR and sleep have been measured and how they have been measured, developmental differences between children and adolescents with ADHD and how—and the extent to which—studies controlled for the use of CNS medications and cooccurring disorders in their study design and/or statistical analyses. The quality and risk of bias of the included studies will be assessed using the Mixed Methods Appraisal Tool.

Ethics and dissemination This protocol is for a review of studies and does not involve any new data collection and therefore does not need ethical or human subjects approval. The results will be presented at international conferences and in a peer-reviewed journal.

PROSPERO registration number CRD42024612984.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ The study will be conducted by a team with expertise in attention-deficit/hyperactivity disorder (ADHD), sleep and emotion dysregulation in children and adolescents.
⇒ We will consider the complexity of investigating the relationship between sleep and emotion dysregulation in ADHD by taking into account the multifaceted nature of emotion dysregulation and sleep.
⇒ The protocol was designed, and the systematic review will be conducted, in collaboration with a user organisation to embrace the perspectives of patients with ADHD.
⇒ A limitation is that we will predominantly include peer-reviewed studies.

INTRODUCTION

Everyday challenges that children and adolescents with attention-deficit/hyperactivity disorder (ADHD) experience often extend beyond what can be explained by the core symptoms of inattention and hyperactivity/impulsivity.[1 2] In particular, parents often report their children with ADHD to have either sleep problems[3] or problems regulating strong emotions.[4 5] Yet, there is still limited knowledge of how problems regulating emotions and sleep are related to each other, despite suggestions that they both are causally related to ADHD.[6] It is thus clinically relevant and timely to conduct a systematic review on the relationship between emotion dysregulation (EDR) and sleep in ADHD to (1) understand the current evidence for an association and (2) provide summative information that can guide future research and clinical work in this area.

EDR can be defined as when a child struggles significantly more than their peers with adaptively modifying their emotional state and responses according to the context they are in, to promote goal-oriented behaviour.[4 5 7 8] In ADHD, EDR is prevalent across the lifespan[4 5] and is found to be genetically connected with ADHD.[9 10] In ADHD, the focus has often been on EDR of negatively valenced emotions and mood, although

also on struggles regulating sadness, worry and positive emotions.[4]

Meta-analyses show that children[3] and adolescents[11] with ADHD have problems with numerous aspects of sleep. Caregivers[3] and adolescents[11] both report more subjective sleep difficulties than neurotypical controls, including problems falling asleep, wakening during the nights and early wakening in the mornings. Although differences between youth with and without ADHD are not consistently present when objective measures are used, meta-analytic findings indicate that actigraphy-assessed sleep onset latency and polysomnography-assessed number of stage shifts/hours sleep and apnoea-hypopnoea index are significantly higher in children with ADHD than their peers.[3] Additionally, children with ADHD also more often had delayed sleep phase and sleep-disordered breathing. Poorer sleep quality has been linked genetically with ADHD[12] and is reported consistently across the lifespan in ADHD.[13]

The aim is to conduct a systematic review of existing peer-reviewed studies to investigate if EDR and sleep are related in children and adolescents between 5 and 18 years old with ADHD. To our knowledge, such a systematic review has not been published on youth with ADHD, which is important for advancing future research and clinical care. The primary research question is the extent to which EDR is associated with poor, insufficient and/or misaligned sleep in children and adolescents with ADHD. It is anticipated that EDR and sleep problems will be at least moderately associated. This expectation is in alignment with the meta-analytic results of average moderate effect sizes in the relationship between EDR and sleep in non-ADHD samples.[14 15] We will be looking at EDR and sleep broadly and consider the multifaceted nature of both terms. The heterogeneous nature and sample characteristics of ADHD are also important to consider in the relationship between EDR and sleep in ADHD. CNS medications seem to have a limited effect in improving EDR in ADHD,[16] whereas mixed findings are reported on their effects on sleep.[17 18] The high prevalence of cooccurring disorders in ADHD[4 19 20] and a stronger circadian preference towards eveningness[21] may also affect EDR and sleep. Therefore, as secondary outcomes, we will consider if the effect sizes reported of the relationship between EDR and sleep are affected by how EDR and sleep are measured, age group included, and further if the effects are affected by how studies have controlled for the use of CNS medication, the presence of cooccurring disorders and/or circadian preference.

METHODS AND ANALYSIS

We will follow the guidelines as stated in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses in this proposed study.

The protocol for this proposed systematic review is preregistered in PROSPERO. In the preregistration, pilot work on this systematic review is noted based on a master's thesis in clinical psychology.[22] We plan to start the study on 1 June 2025 and complete it by 31 June 2026.

Search

We will conduct a search of numerous electronic databases, including PsychINFO, Medline, EMBASE and Web of Science. For the specific syntax that will be used for each database, see online supplemental file 1. In addition, the reference list of all studies will be searched for other relevant studies, and Scopus will be used to search for citations of the included studies. The search will be conducted with the support of the library consultancy at the University of Bergen. Duplicates will be removed by following the methods described by Hair *et al*.[23]

Selection criteria

Study design

We will include all types of studies that have investigated the relationship between EDR and sleep in youth diagnosed with ADHD or in a sample with a high symptom load of ADHD symptoms. This includes randomised controlled trials of sleep and/or EDR, other types of intervention studies, experimental studies (eg, effects of sleep restriction on EDR), population-, community- or clinic-based studies of the concurrent correlations between EDR and sleep, and longitudinal studies.

Participants

We will include children and adolescents between 5 and 18 years old who have ADHD or elevated ADHD symptoms. In studies including a wider age range than our inclusion criteria, we will use a mean sample age ≥5 or ≤18. We will define adolescence as starting at 10 years old in accordance with the WHO's definition[24] and define childhood as <10 years old and adolescence as ≥10 years old.

Reporting method and language

Original publications published in peer-reviewed journals that are written in English or in a Scandinavian language will be included. This could pose a limitation by not including relevant work published as preprints or grey literature and/or publications in other languages.

Outcomes

The primary outcome of this systematic review will be the effect of the relationship between EDR and sleep in children and adolescents with ADHD. Secondary research questions comprise (1) whether *specific* aspects of EDR are more strongly related to *specific* sleep domains in children and adolescents with ADHD, (2) whether the method for measuring EDR and/or sleep influences the effects of the relationship between sleep and EDR, (3) whether there are developmental differences between children and adolescents with ADHD in the relationship between EDR and sleep, (4) whether studies have controlled for use of CNS medications (or excluded participants based on medication use) and (5) whether studies have controlled for cooccurring psychiatric disorders in their study design

and/statistical analyses and circadian preference (morningness/eveningness).[21] Both EDR and sleep are multifaceted terms and important to consider when evaluating the secondary outcomes. EDR can comprise negative and positive expressions of emotions and mood, the recognition of and/or response to emotional expressions and the regulation process per se, such as the use of strategies for coping with difficult emotions.[4 5] Sleep can comprise sleep duration, sleep quality, sleep timing, night wakings and daytime sleepiness; other sleep parameters will be coded if available.

Data collection

We will include studies and extract data in a two-step process. First, two independent investigators will screen for titles and abstracts of the studies after the initial search. Second, two independent investigators will read the full texts of all potentially relevant studies and decide on the final list of studies to include in the systematic review. Any disagreement after a discussion between the two independent investigators will be resolved by an independent third investigator. The data will be extracted on study characteristics, such as facets of EDR and sleep investigated, how EDR and sleep were measured, sample description (eg, ADHD diagnosis or elevated ADHD symptoms), sample size, sample demographics (eg, percentage of boys/girls, race/ethnicity, use of CNS medication and psychiatric comorbidities), study design and how use of CNS medication and comorbid disorders have been controlled for in the study design/statistical analyses. Additionally, the data will be extracted on effect sizes reported in the studies, such as Cohen's *d* and partial eta-squared (n^2_p). The reported effect sizes will be used for estimating the size of the association/effects between EDR and sleep quality (eg, Cohen's *d of* 0.2, 0.5 and 0.8 will be used as benchmarks for small, medium and large effects, respectively, and n^2_p of 0.01, 0.06 and 0.14 as benchmarks for small, medium and large effects, respectively).[25] We will systematically contact authors when needing to gather unpublished information/data.

Study quality and risk of bias assessment

We will assess the quality and risk of bias of the included studies by using the Mixed Methods Appraisal Tool (MMAT; see Hong et al., 2018). This assessment will be done in connection with the data extraction and will be assessed by at least two independent investigators, with disagreement resolved by a third independent investigator. Four of the authors (LS, DAJ, SA and EFG) will train beforehand to calibrate the assessment of quality and risk of bias with the MMAT.

Patient and public involvement

Ms. Nina Holmen is the user and public involvement coauthor to embrace the perspectives of patients with ADHD in the design of this protocol and further, in the data extraction and interpretations of results when conducting the systematic review.

ETHICS AND DISSEMINATION

Ethics

This is a protocol of an aggregated summary of existing studies and as such does not involve any new human subjects data collection or require ethical approval.

Dissemination

The procedures for data inclusion and extraction will be described to ensure transparency and replicability. The results of the systematic review will be disseminated in an internationally peer-reviewed journal, in addition to national (eg, organised by the Norwegian ADHD Association, the Norwegian ADHD Research Network) and international conferences (eg, ADHD World Congress, Annual Meeting of the European Society for Child and Adolescent Psychiatry Congress).

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Contributors LS designed the study and developed and wrote this protocol and the planned search strategies. EF-G codesigned the study and contributed together with DAJ and SA in developing and writing the protocol and plan for search strategies. AL was involved in the design of the study and piloting of search strategies and data extraction. SPB and NH were involved in developing and writing this protocol. LS is the guarantor for the article.

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Competing interests LS receives editorial honoraria as Associate Editor of Journal of the International Neuropsychological Society (JINS) and received a small research funding for speaking and conference support from Medice in 2023. In the past year, Stephen Becker discloses grant funding from the Institute of Education Sciences (IES), US Department of Education; National Institute of Mental Health (NIMH); and Cincinnati Children's Research Foundation (CCRF) and has received book honoraria from Guilford Press, editorial honoraria as Joint Editor of JCPP Advances, grant review panel honoraria from the IES and educational seminar speaking fees and continuing education course royalties from PESI and J&K Seminars. All other authors have no competing interest to declare.

Patient and public involvement Patients and/or the public were involved in the design, conduct, reporting or dissemination plans of this research. Refer to the Methods section for further details.

Patient consent for publication Not applicable.

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terminology, drug names and drug dosages), and is not responsible for any error and/or omissions arising from translation and adaptation or otherwise.

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