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Analysing the effectiveness of cognitive behavioural therapy in university students with ADHD: A systematic review

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ABSTRACT

Background: Attention-deficit hyperactivity disorder (ADHD) is a neurodevelopmental disorder that begins in childhood and often persists into adult life. University students with ADHD frequently experience great difficulty with global academic functioning, resulting in higher drop-out rates and, consequently, higher unemployment rates.

Objective: This literature review aims to analyse the effectiveness of cognitive behavioural therapy (CBT) interventions to reduce ADHD-related symptoms in university students with ADHD.

Materials and methods: A literature search was conducted via EBSCO database in October 2023 using key terms: ADHD OR attention deficit hyperactivity disorder AND cogniti* intervention OR cogniti* therapy AND college student* OR university student*. The inclusion criteria were studies using cognitive behavioural therapy as their primary intervention for individuals with ADHD who are enrolled in university or college and are 18 years or above in age.

Results: Seven out of 115 papers were deemed eligible and were included in this review. This review's studies included four randomized control trials and three before and after open trials. Three key themes were identified through data extraction: intervention design, outcome measures used, and effectiveness of interventions on ADHD-related symptoms. All the studies tailored their CBT intervention toward university students. There was a statistically significant improvement in core domains of ADHD-related impairment, in particular, inattention (N=7), overall executive functions (n=5), and hyperactivity-impulsivity (N=1).

Conclusion: While the current findings suggest positive results of CBT for reducing ADHD-related symptoms in university students with ADHD, further research should explore the sustainability of these gains over the long term. Due to the lack of explicit published study on this topic in the United Kingdom, further research should be conducted in the UK to assess the applicability and effectiveness of tailored CBT interventions within the British university environment.

Introduction

Attention-Deficit Hyperactivity Disorder (ADHD) is a neurodevelopmental disorder that begins in early childhood and often persists into adult life.[1] As stated in the Diagnostic and Statistical Manual-5 (DSM-5), ADHD is characterized by persistent inattention, hyperactivity, and impulsivity.[2] These symptoms will manifest in two or more settings, such as home and work.[2] A study conducted by Emmers *et al*. identified that university students with ADHD have more difficulty with global academic functioning compared to those without ADHD. These academic

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difficulties can be seen as poor academic performance in time-limited exams, lower social adjustments, social skills etc. impacting academic performance.[3] Academic difficulties in turn may result in a higher risk of dropping out of university causing individuals with ADHD to have fewer years of education and higher unemployment rates compared to those who do not have ADHD.[4] Along with academic difficulties, it has been reported across the board that students with ADHD have higher rates of comorbidities that include both internal and external symptom domains negatively impacting the mental wellbeing of students.[5] Cognitive Behavioural Therapy (CBT) is a structured and time-limited approach which aims to reduce individuals' distress and promote adaptive cognitions and behaviours by exploring the links between thoughts, emotions and behaviours.[5]

A consensus statement from the United Kingdom (UK) Adult ADHD Network highlighted that within the UK's Higher Education Institutions (HEIs), ADHD is categorised as a Specific Learning Disability or Difference (SpLD) rather than a mental health condition. This categorisation as an SpLD makes ADHD a hidden disability in HEIs, contributing to the marginalization of affected students.[3] Unfortunately, this classification hinders data collection on the prevalence of ADHD in UK HEIs. As a result, the only available prevalence data is for ADHD in adults, estimated at 3-4%.[6]

With an increasing number of ADHD diagnoses in the UK, understanding the efficacy of ADHD interventions is crucial for Occupational Therapists (OTs) seeking evidence-based practices. ADHD influences several dimensions of an individual's life, and OTs recognise that these impacts extend beyond the immediate domains, encompassing academic and social realms. University students with ADHD face unique academic and personal challenges that significantly impact their success. These students often struggle with time management, poor study skills, and difficulty focusing, which leads to procrastination and missed deadlines.[7] These difficulties are exacerbated by the transition to independent living, as students must manage responsibilities formerly overseen by parents or teachers, such as organizing belongings and structuring their time.[7] Consequently, students with ADHD tend to have lower Grade Point Averages (GPA), higher rates of academic probation, and are more likely to withdraw from courses or not graduate. Moreover, the heightened presence of immediate social rewards in college settings can further distract students from academic tasks, leading to increased engagement in activities like partying or social media use over studying, a phenomenon known as "temporal discounting".[7] The presence of comorbid conditions such as anxiety, depression, or substance use disorders further complicates their academic and emotional regulation, posing additional challenges to their executive functioning.[8]

Occupational therapists have the potential to integrate CBT-informed strategies into their practice to address academic challenges, executive-functioning deficits and emotional well-being with this population. Additionally, the Royal College of Occupational Therapists (RCOT) recently highlighted the important role OT's have within a university in supporting students' wellbeing.[9] A consensus statement from the UK ADHD Network highlights areas for potential occupational therapy development. These areas include organisation of environments, enhancing social interactions and awareness, developing stress management techniques as well as monitoring and regulating sensory integration for students with ADHD.[10]

When a broad literature search was conducted, there appeared to be a shortfall in published research regarding the university-based and adult population compared to that found regarding ADHD interventions within school-based settings, paediatric and adolescent populations. This literature review therefore aims to bridge this gap by analysing the effectiveness of CBT interventions to reduce ADHD-related symptoms in university students with ADHD. The formulation of this review question adhered to the Population, Intervention, Comparison, Outcome (PICO) model[11] where the population included university students with ADHD, intervention being cognitive behavioural therapy and effect of the intervention on ADHD-related symptoms as the outcome ensuring a well-constructed and organised structure.

Methodology

A literature review is the comprehensive study and interpretation of literature that addresses a specific question with the aim of identifying and critiquing the existing literature on a specific topic.[12] Literature reviews support healthcare professionals in fulfilling their professional obligations by ensuring they stay informed about the latest developments and research that shape their practice.[12]

Search strategy

A systematic and rigorous approach was undertaken when designing and conducting the search for literature to ensure that all relevant literature was retrieved.[12]

Guided by the terms characterised by the PICO model[11], relevant search terms were generated, ensuring to include relevant synonyms and spellings (Supplementary material Appendix A). These search terms were entered into EBSCO host database (including Academic Search Ultimate, APA PsycArticles, APA PsycBooks, APA PsycInfo, Art & Architecture Complete, Business Source Ultimate, Communication Source, eBook Collection (EBSCOhost), eBook Academic Collection (EBSCOhost), eBook Open Access (OA) Collection (EBSCOhost), Education Source, Environment Complete, ERIC, European Views of the Americas: 1493 to 1750, GreenFILE, Hospitality & Tourism Complete, Library, Information Science & Technology Abstracts, MEDLINE Complete, Regional Business News, SocINDEX with Full Text, SPORTDiscus with Full Text, CINAHL Ultimate) in October 2023, which identified 209 records. Whilst screening the titles and abstracts of the resulting records, the inclusion and exclusion criteria (Table 1) were applied to identify studies that are eligible to be included in the final literature review.

Table 1. Inclusion and exclusion criteria.

Inclusion	- Primary research that included interventions incorporating cognitive behavioural therapy (CBT) techniques, characterised by the adaption of cognition and behaviours designed to enhance coping mechanisms and reduce individual's distress. - Studies that are published in peer reviewed journals. - Studies involving adult participants (aged 18 years and older) with diagnosed ADHD, who were enrolled in college or university at the time of study. - Studies that utilise a minimum of one ADHD-related outcome measure specifically assessing core ADHD-related domains.
Exclusion	- Studies that are qualitative in nature. - Studies that are published in languages other than English language.

Participants with comorbidities such as substance abuse disorder, suicidality, psychotic disorder, bipolar disorder and autism spectrum disorder posed a significant challenge to establish the true relationship between the intervention and outcome in the extracted data. This was seen as a potential weakness of extracted data as it negatively influenced the outcomes with increased numbers of confounding variables. Despite this, samples with comorbidities were retained. This decision was driven by the belief that including such samples would enhance the generalisability of the findings 1.[3] Given that 75% of adults with ADHD also experience at least one other mental health disorder, often anxiety or mood disorders, the inclusion of comorbidities ensured a more accurate representation of the overall population.[14] Inclusion criteria affirmed that the study participants were enrolled in college or university with a confirmed diagnosis of ADHD which aided strict adherence to the target population. Given the prior description of CBT, Dialectical Behaviour Therapy (DBT) is within this category, allowing its inclusion in the literature review.[15] As detailed in the PRISMA flow diagram[16] (Figure 1), the inclusion and exclusion were applied and seven out of the original 115 records were deemed eligible and were included for this literature review.

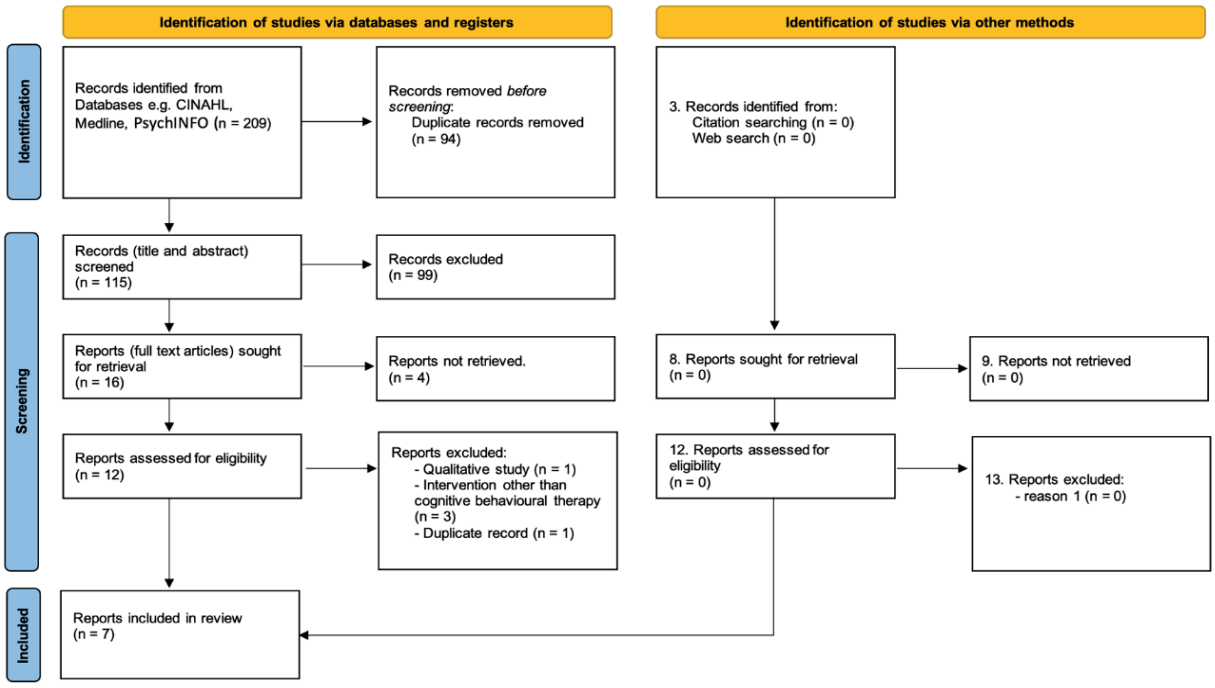

Figure 1. *PRISMA diagram (Page et al. 2021)*

Critical appraisal

Critical appraisal involves the methodical evaluation of research evidence to assess its reliability, significance and applicability within a specific context.[17] It is important to critically appraise the literature to ensure that the findings are interpreted considering the strengths and weaknesses apparent to the researcher's methodology.[18]

The selected articles (n=7) were all critically evaluated using The McMaster Critical Review Form for Quantitative Studies[19] (Supplementary material, Appendix B and C) with an overview table is presented in (Supplementary material, Appendix D). Use of a standard critical appraisal tool ensured the consistency of quality appraisal process in an unbiased manner.[20] The 'McMaster Critical Review Form for Quantitative studies' proves to be an appropriate tool to use due to its comprehensive assessment of methodological quality of quantitative evidence as well as its accommodations to a wide range of research designs. This tool also contains a detailed guideline to assist reviewers maintain their consistency in evaluating methodological quality.[20]

The before and after study design was adopted by three studies resulting in the researchers omitting the use of a control group.[13,21,22] The absence of a control group precludes blind assessments of outcomes and does not account for confounding factors.[23] Whilst medication co-intervention was not avoided across the included studies and in attempt to reduce impacts on outcomes, and supported by Aggarwal and Ranganathan (2019), authors reported that the students were required to be on a stable dose of medication for a minimum of four weeks prior to and throughout the intervention program and to report any changes where applicable.[7,8,15,22,24] All studies had a strength of detailing the participant characteristics, remaining focused on the aim and justifying their studies in relation to previous literature. This is seen as a strength as it is important to have clear direction and justifications.

Results and findings

A data extraction table summarises the final seven studies included in this literature review (Supplementary material Appendix D). Only two of the final seven studies were conducted outside of the United States of America, namely Solanto and Scheres (2021) in the Netherlands and Van der Oord et al. (2020) in Belgium. The study's publication date ranges from 2010 to 2023. All papers focused on identifying the effectiveness of their respective tailored or adapted cognitive interventions for university students with ADHD. Throughout the seven studies, all participants had a confirmed diagnosis of ADHD prior to commencing the intervention with a cumulative age range of 18- to 38-year-olds. The most common comorbidity among the participants across these studies was anxiety and depression. Three studies conducted randomized control trials[8,15,24] whilst the remaining studies were conducted as open clinical trials, with a cumulative sample size range of 17-250 individuals. Overall, the included papers had moderate to strong quality appraised using the McMaster Critical Review tool.[19]

Type of intervention and design

The interventions were either specifically adapted from a previous adult ADHD programme or newly designed, to provide a tailored intervention for university students with ADHD as all the studies acknowledged that university students with ADHD experience different difficulties and have different priorities when compared to the remaining adult ADHD population.

The cumulative intervention timelines range from 6 to 12 weeks, with an average and modal length of 8 weeks, allowing the intervention to be run within the students' academic calendar. The interventions implemented in all the studies were designed to deliver weekly therapy sessions, with an average session duration of one hour. The sessions varied in format, encompassing group or individual formats. Majority of the interventions incorporated a blend of both group and individual sessions. Fleming *et al*. (2015), Van der Oord *et al*. (2020), Anastopoulos *et al*. (2021) and Anastopoulos and King (2015) invited participants to attend a booster session that took place in the following semester with the aim of maintaining the previously learnt skills.

All the interventions focused on aspects such as behavioural strategies and cognitive therapy, however Anastopoulos et al. (2021), Anastopoulos and King (2015), LaCount *et al*. (2015) and Hartung et al. (2022) had an additional focus on psychoeducation. Specific modules and topics addressed in each intervention are detailed in the data extraction table (Supplementary material Appendix D).

Outcome measures used

Within the seven final studies, 46 unique outcome measures were utilised. Among all the studies, assessments focusing on ADHD symptoms and ADHD-cognitive related impairments were used as the primary outcome measures. Majority of the studies included secondary outcome measures which assessed comorbidity symptoms such as depression and anxiety as well as assessed academic performance via participants' Grade Point Average (GPA). All studies employed one diagnostic measure at minimum for participant selection. The most commonly used primary outcome measure was the Conners Adult ADHD Rating Scale, Self-Report, Long Version[25] (CAARS-S:L) which was implemented by four studies[7,8,13,21] and the most common secondary outcome measure was Becks Depression Inventory – 2nd edition[8] (BDI-2) which was employed by five studies.[7,8,13,15,24]

Effectiveness of interventions on ADHD-related symptoms

All studies reported an improvement in the ADHD-related cognitive domains/impairments assessed in their respective primary outcome measures. The core domains of impairment for ADHD which yielded statistically significant improvements are inattention[7,8,13,15,22,24,26], overall executive functions[7,8,13,15,24], overall ADHD symptomology[8,13,26] and organisational, time management and planning skills.[7,24,26] Anastopoulos *et al*. (2021) was the only study to report statistically significant improvement

in hyperactive-impulsive symptoms.

Other statistically significant findings included improvement in quality of life, mindfulness[15] and memory[7], as well as improvements in the school and work domain[22] and self-concept domain[20] on the Weiss Functional Impairment Rating Scale[27] (WFIRS) and improvement on concentration and motivation on the Learning and Study Skills Inventory[7,29] (LASSI-3rd edition).

Additionally, Anastopoulos *et al.* (2021) and Anastopoulos and King (2015) reported several statistically significant improvements including, improvement in ADHD knowledge on Test of ADHD Knowledge (TOAK), improvement in behavioural strategies and a decline in maladaptive thinking.

Van der Oord *et al*. (2020) reported statistically significant improvements in attitude, motivation and test strategies measured on LASSI however there was no differential impact in experimental group when compared to the control group.

Contrary to Fleming *et al*. (2015), Anastopoulos and King (2015) and Anastopoulos *et al*. (2021), who reported anxiety and depression symptoms to have no statistical significance, Van der Oord *et al*. (2020) and Solanto and Scheres (2021) reported a statistically significant improvement in depression and anxiety symptoms. However, there was no differential impact on experimental group when compared to control group in Van der Oord *et al*.'s (2020) study.

Four studies reported to have no statistically significant improvements on hyperactive-impulsive symptoms.[48,21,22,24] Additionally, there was no reports of statistically significant improvements of GPA[7,8,15], self-concept and life skills domain on WFIRS[22] and motivation on Barkley Deficits in Executive Function Scale[7,29](BDEFS).

Discussion

This literature review aims to identify the effectiveness of CBT interventions for reducing ADHD-related symptoms and deficits in university students with ADHD. Methodological analysis of the included studies revealed that number of studies reported a flaw regarding inadequate sample sizes to detect statistical power[8,15,24], adversely impacting the likelihood that a statistically significant finding actually reflects a true effect, furthermore, impacting generalisability.[30] There is a common threat to validity across the final studies. However, the findings from those studies may still be relevant as they do concur with findings reported in Hartung *et al*.'s (2022) study which has an adequate sample size to detect a medium effect. It is important to highlight the high prevalence of self-reported outcome measures across the final studies, acknowledging the potential for recall bias, however these outcome measures used are proven to be valid and reliable. As previously discussed, studies including comorbidities to their sample can be viewed in a negative light, however it may positively contribute to the generalisation of the findings as it mirrors the remaining ADHD population.[8] Participant recruitment via self-referral was frequently viewed across the studies. This recruitment method may lead to selection bias as it inherently targets high-functioning individuals with ADHD and those who are naturally motivated to instigate change and improvement, therefore potentially influencing results toward more favourable outcomes.

It must be highlighted that Anastopoulos and King (2015) and Hartung *et al*. (2022) had no reporting's on gaining informed consent, respective University Institutional Review Board approval or a description of ADHD diagnosis presentation, unlike the remaining studies.

This review focusses on discussion around three main themes such as location of the studies, the delivery format and the hyperactivity and inattention symptoms.

Location of the studies:

As previously identified and within the realm of this literature review's search strategy, no studies conducted in the UK were discovered. This is surprising as NICE (2019) guidelines for managing ADHD recommends CBT should be considered if the symptoms persist despite the use of medication. The lack of research published in the UK appears to be a common reporting across the board of research for ADHD in adults as Sedgwick (2018) too reported a paucity of research in the UK and Ireland in their literature review regarding the impact ADHD has on educational outcomes of university students. This lack of research could be due to the categorisation of ADHD as a disability in the UK and the HEIs providing reasonable adjustments for academic support, such as extended writing times or short rest breaks during exams, rather than providing interventions such as CBT.[29] Conducting additional research to explore the impact of reasonable adjustments and Cognitive Behavioural Therapy (CBT) interventions on university students with ADHD in the UK is recommended. The existing studies imply that CBT holds potential for enhancing academic performance and reduce ADHD-related deficits among students with ADHD.

Delivery format

Whilst traditional CBT interventions often include either group or individual therapy sessions, several studies have incorporated both group and individual sessions into their intervention. Individual sessions have advantages such as allowing the therapist to tailor their approach to the student and have a sole attention on that student whilst group therapy allows an opportunity for peer support, encouragement and a model of positive behavioural change.[21] University students with ADHD have reported lower levels of social adjustment, social skills and self-esteem compared their non-ADHD peers.[31] It is beneficial to incorporate group sessions as they are proven to foster a sense of belonging and reduce stigma both of which students with ADHD report have a negative impact on their wellbeing.[32,22] The most prevalent delivery format among the included articles is that of group sessions used to address the content and the individual sessions used for mentoring, application and maintenance of the skills learnt in the group session. Several studies included booster sessions in their interventions[8,13,15,24],

with Anastopoulos *et al*. (2021) highlighting the clinical benefits of members reconnecting and gaining additional peer support. Due the nature of the research studies, the lack of follow-up data and the similarity of findings, one cannot confidently conclude whether the delivery format impacts the effectiveness of the interventions on university students with ADHD. However, with the current level of knowledge and the acknowledged benefits, it is plausible to propose that integrating a combination of both group and individual sessions may have a greater impact on social domains of students. Consequently, this may lead to a reduction in ADHD-related symptoms, aligning with the aim of my literature review.

Hyperactive-impulsive and attention symptoms

The literature consistently highlights improvements in ADHD-related symptoms, with a focus on inattention and overall executive functioning across multiple studies. Interestingly, Anastopoulos *et al*. (2021) reported a unique statistically significant improvement in hyperactivity-impulsivity (p=0.002). Discrepancies in findings across studies may be attributed to factors such as the diminishing prevalence of hyperactivity-impulsivity with age, as emphasized by Willcutt's (2012) meta-analysis. Anastopoulos *et al*.'s (2021) larger participant pool of 250 participants and the predominance of ADHD-combined type (58.4%) contribute to the observed improvement in hyperactive-impulsive symptoms, unlike other studies with smaller samples with predominantly inattentive types.[7,15,23,24] This indicates that the interventions included within this literature review are particularly effective in mitigating the inattention symptom and enhancing overall executive functions. The suggestion for future research is to adopt larger sample sizes and include more participants with combined or hyperactive-impulsive subtypes to assess intervention effectiveness within these specific diagnostic subtype populations. This suggestion aligns with the overarching aim of analysing the effectiveness of CBT interventions in reducing ADHD-related symptoms among university students with ADHD.

Conclusion

In conclusion, the heightened vulnerability of university students with ADHD to academic and psychosocial challenges necessitates effective interventions. Cognitive-behavioural therapy (CBT), as evidenced in the reviewed studies, shows promise in reducing ADHD-related symptoms, particularly inattention and executive dysfunction. While immediate positive outcomes are apparent, future research should explore the sustainability of these gains over the long term. Moreover, it is recommended that further studies be conducted in the UK to assess the applicability and effectiveness of tailored CBT interventions within the British university environment. Investigating the implementation of CBT by occupational therapists in an occupation-focused context presents an intriguing avenue for further exploration. Such investigations are crucial for enhancing the support systems available to students with ADHD, addressing both immediate and enduring needs.

Conflict of interest

None

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Supplementary Material:
Appendix A: Search Strategy

<table>
<tr><td colspan="2">Research topic:
The effectiveness of cognitive behavioural therapy interventions to reduce ADHD-related symptoms for university students with ADHD.</td></tr>
<tr><td></td><td>List other related words or terms</td></tr>
<tr><td>Search term 1:
Attention deficit-hyperactivity disorder</td><td>ADHD or attention deficit hyperactivity disorder or attention deficit-hyperactivity disorder or ADD or attention deficit or attention deficit disorder</td></tr>
<tr><td>Search term 2:
Cognitive intervention</td><td>Cogniti* intervention or cogniti* therapy or cogniti* treatment or cogniti* strategy or cogniti* program* or cogniti* practic* or cogniti* train*</td></tr>
<tr><td>Search term 3:
University students</td><td>College student* or university student*</td></tr>
<tr><td colspan="2">Results:
209 articles</td></tr>
<tr><td>Peer reviewed:
Yes</td><td>Publication date range:
Published before October 2023</td></tr>
<tr><td>Age range:
18 years old and above</td><td>Languages:
English</td></tr>
<tr><td colspan="2">Research question:
How effective is cognitive behavioural therapy interventions in reducing ADHD-related symptoms or deficits for university students with ADHD.</td></tr>
</table>

Appendix B: Blank McMaster Critical Review Form

Blank McMaster Critical Review Form – Quantitative Studies (Law *et al*. 1998)
Article Title:
Reference:
URL:

<table>
<tr><td>CITATION</td><td colspan="2">Provide the full citation for this article in APA format:</td></tr>
<tr><td>STUDY PURPOSE
Was the purpose stated clearly?
☐ Yes
☐ No</td><td colspan="2">Outline the purpose of the study. How does the study apply to your research question?</td></tr>
<tr><td>LITERATURE
Was relevant background literature reviewed?
☐ Yes
☐ No</td><td colspan="2">Describe the justification of the need for this study:</td></tr>
<tr><td>DESIGN
☐ Randomized (RCT)
☐ cohort
☐ single case design
☐ before and after
☐ case-control
☐ cross-sectional
☐ case study</td><td colspan="2">Describe the study design. Was the design appropriate for the study question? (e.g., for knowledge level about this issue, outcomes, ethical issues, etc.):

Specify any biases that may have been operating and the direction of their influence on the results:</td></tr>
<tr><td>SAMPLE
N =
Was the sample described in detail?
☐ Yes
☐ No
Was sample size justified?
☐ Yes
☐ No
☐ N/A</td><td colspan="2">Sampling (who; characteristics; how many; how was sampling done?) If more than one group, was there similarity between the groups?:

Describe ethics procedures. Was informed consent obtained?:</td></tr>
<tr><td rowspan="2">OUTCOMES
Were the outcome measures reliable?
☐ Yes
☐ No
☐ Not addressed
Were the outcome measures valid?
☐ Yes
☐ No
☐ Not addressed
Outcome areas:</td><td>Specify the frequency of outcome measurement (i.e., pre, post, follow-up):</td></tr>
<tr><td>List measures used:</td></tr>
<tr><td colspan="2">INTERVENTION
Intervention was described in detail?
☐ Yes
☐ No
☐ Not addressed
Contamination was avoided?
☐ Yes
☐ No
☐ Not addressed
☐ N/A
Cointervention was avoided?
☐ Yes
☐ No
☐ Not addressed
☐ N/A</td><td>Provide a short description of the intervention (focus, who delivered it, how often, setting). Could the intervention be replicated in practice?</td></tr>
</table>

RESULTS Results were reported in terms of statistical significance? ☐ Yes ☐ No ☐ N/A ☐ Not addressed Were the analysis method(s) appropriate? ☐ Yes ☐ No ☐ Not addressed	What were the results? Were they statistically significant (i.e., $p < 0.05$)? If not statistically significant, was study big enough to show an important difference if it should occur? If there were multiple outcomes, was that taken into account for the statistical analysis?
Clinical importance was reported? ☐ Yes ☐ No ☐ Not addressed	What was the clinical importance of the results? Were differences between groups clinically meaningful? (if applicable)
Drop-outs were reported? ☐ Yes ☐ No	Did any participants drop out from the study? Why? (Were reasons given and were drop-outs handled appropriately?)
CONCLUSIONS AND IMPLICATIONS Conclusions were appropriate given study methods and results ☐ Yes ☐ No	What did the study conclude? What are the implications of these results for practice? What were the main limitations or biases in the study?

Appendix C: Overview of McMaster Critical Review Results

Overview of McMaster Critical Review results (Law et al. 1998)

Study	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15
Fleming *et al*., 2015	Y	Y	Y	Y	N	Y	Y	Y	NS	N	Y	Y	Y	Y	Y
Van der Oord *et al*., 2020	Y	Y	Y	Y	Y	Y	Y	Y	NS	N	Y	Y	Y	Y	Y
Anastopoulos *et al*., 2021	Y	Y	Y	Y	Y	Y	Y	Y	NS	N	Y	Y	Y	Y	Y
La Count *et al*., 2015	Y	Y	Y	Y	Y	Y	Y	Y	NS	N	Y	Y	N	Y	Y
Anastopoulos and King, 2015	Y	Y	Y	Y	N	Y	Y	Y	NS	NS	Y	Y	N	Y	Y
Solanto and Scheres, 2021	Y	Y	Y	Y	N	Y	Y	Y	NS	N	Y	Y	Y	Y	Y
Hartung *et al*., 2022	Y	Y	Y	Y	N	Y	Y	Y	NS	NS	Y	Y	Y	N	Y

Note: *Q1: was the purpose stated clearly?, Q2: was relevant background literature reviewed?, Q3: was the design appropriate for the study question?, Q4: was the sample described in detail?, Q5: was sample size justified?, Q6: were the outcome measures reliable?, Q7: were the outcome measures valid?, Q8: was the intervention described in detail?, Q9: was contamination avoided?, Q10: was cointervention avoided?, Q11: were results reported in terms of statistical significance?, Q12: were the analysis methods appropriate?, Q13: was clinical importance reported?, Q14: were drop-outs reported?, Q15: were conclusions appropriate given study methods and results?, Y: yes, N: no, NS: not Specified.*

Appendix D: Data Extraction Table

Author, year, country	Aims	Design	Participants	Intervention	Outcome measures	Findings and conclusion
Fleming *et al.* (2015), USA	Evaluating dialectical behaviour therapy (DBT) group skills training adapted for college students with Attention Deficit-Hyperactivity Disorder (ADHD)	Pilot Randomised Control Trial (RCT) The study was approved by the University of Washington Institutional Review Board.	33 students 18-24 years old 17 participants in DBT group (1 drop out) 16 participants in self-guided skills handout (SH) group Students were still eligible if they were on stable medication and dose for 1 month prior to enrolment. Intent-to-treat sample	DBT group skills training format 8 weeks - 8 weekly 90-minute group sessions focused on skills acquisition and strengthening - 7 weekly 10/15-minute individual coaching call focused on skills generalisation Booster - 90 min group session - First week follow up Setting - On campus outpatient psychology clinic Skills handout (SH) group (comparison group): - 34 pages of skills handouts and self-help materials drawn from a manual for treatment of adults with ADHD	- Barkley Adult ADHD Rating Scale – IV (BAARS-IV) - Brown ADD Rating Scale (BADDS) - ADHD quality of life questionnaire (AAQoL) - Beck Anxiety Inventory (BAI) - Beck Depression inventory (BDI) - Grade Point Average (GPA) - Five facet Mindfulness Questionnaire (FFMQ) - Conners Continuous Performance Test – 2nd edition (CPT-2)	Statistically significant: - Improvement in ADHD inattentive symptoms of DBT group compared to SH group at follow-up (p=0.02) - Improvement in executive functioning in DBT group compared to SH group (p=0.007) on BADDS total scores. - Improvement in quality of life of DBT group at post-treatment compared to SH group (p=0.038) - Improvement in overall mindfulness in DBT group at post-treatment and follow-up on FFMQ Not statistically significant: - No significant change in anxiety symptoms, depressive symptoms or GPA of DBT group compared to SH group. - A trend towards greater Improvement in CPT-2 omission errors in DBT group compared to SH group (p=0.066). - No significant improvement of CPT-2 commission errors (p=0.247) or response time (p=0.243) in DBT group when compared to SH group. The authors report that the sample size does not provide enough statistical power to detect small-to-moderate effect sizes or to assess mediators and moderates of treatment response.

Author, year, country	Aims	Design	Participants	Intervention	Outcome measures	Findings and conclusion
Solanto and Scheres (2021), Netherlands	To assess the feasibility, acceptability, and effectiveness of a new group cognitive-behavioural treatment (CBT) to enhance executive function (EF) in college students with ADHD.	Pilot RCT The study was approved by the Institutional Review Board at the University where it was conducted. Reported all participants provided signed informed consent	ADHD group: 18 students 19-31 y/o (23.61 y/o) 56% female Typical comparison group: - 20 students - 18-22 y/o (19.85 y/o) - 95% female - Recruited from first-year psychology students Students who were taking medication for ADHD must be stable for 2 months.	Intervention aimed to impart both cognitive and behavioural strategies to facilitate development of the executive self-management skills in such a way that they would become habitual. 12 weeks - 12 weekly 2 hour group sessions - Weekly home exercises	Diagnostic assessments: - Conners Adult ADHD Rating Scale (CAARS-S) - Adult ADHD Self-report Scale (ASRS) - Conners adult ADHD rating scale - Adult ADHD Clinical Diagnostic Scale (ACDS) - Childhood ADHD Symptoms Scale (CSS) - Self-Report - DSM-5 - MINI International Neuropsychiatric Interview - AUDIT (alcohol) questionnaire - DUDIT (drugs) questionnaire Clinical outcomes: - Adult Investigator Symptoms Rating Scale (AISRS) - CAARS-Self-DSM Inattentive Symptoms sub- scale - CAARS-Self-Inattention/ Memory subscale - Beck Depression Inventory (BDI) - State-Trait Anxiety Inventory (STAI) - Penn state worry questionnaire Executive function outcomes: - Barkley Deficits in Executive Function Scale (BDEFS) - Learning And Study Skills Inventory (LASSI -3rd edition) Educational outcome: - Grade point average (GPA) Participant evaluations: - Participants evaluation rating scale	Statistically significant: - Reduction in number of DSM-5 inattentive symptoms on clinician-rated AISRS (p=0.001) - Reduction of total score on AISRS (p=0.000) - Improvement for CAARS DSM-inattentive symptoms (p=0.000) - Decrease in CAARS-Self-Inattention/Memory subscale (p=0.001) - Reduction of self-management on BDEFS (p=0.000) - Improvements in organisation and total executive function - Improvement of motivation on LASSI (p=0.012) - Improvement of time-management on LASSI (p=0.008) - Improvement of concentration on LASSI (p=0.002) - Improvement of anxiety on LASSI (p=0.005) - Reduction of anxiety and depression symptoms on the Penn State Worry Questionnaire (p=0.018) Not statistically significant: - Improvement of motivation on BDEFS - Changes in GPA

Author, year, country	Aims	Design	Participants	Intervention	Outcome measures	Findings and conclusion
Van der Oord *et al*. (2020), Belgium	The effectiveness of a short individual cognitive behavioural planning intervention for college students with attention-deficit/ hyperactivity disorder (ADHD)	RCT Reported clinical trial registration link. Reported all participants provided informed written consent.	59 students (1 excluded) 18 F; 41 M	Planning and organisation intervention adapted from the Dutch manual for adolescents with ADHD "Plan my Life" 6 week program - 6 weekly 1 hour individual sessions focused on enhancing planning and organisation of daily academic life Booster - 4 months after intervention focused on creating a relapse prevention plan Setting - College psychological services - At one site, individuals paid €15 per session	Selection measures: - Diagnostic Interview for Adult ADHD 2nd edition (DIVA 2.0) - MINI Plus - MSI-BPD - Structured clinical interview for DSM-IV Axis II personality disorders (SCID-II) Primary outcomes: - ADHD Rating Scale (ADHD-RS) - Learning And Study Skills Inventory (LASSI) Secondary outcomes: - Beck Depression Inventory II (BDI-II) - Delis-Kaplan Executive Function System (D-KEFS) - The Adult Self-Report (ASR)	Significant: - Reduction of inattention symptoms in ADHD group on ADHD rating scale - Overall change in ADHD symptoms over time on ADHD rating scale Both groups showed significant improvements in the following outcome measures, however there was no differential impact between the intervention group and wait list group: - Improvement in attitude, motivation, time management and test strategies on LASSI - Improvement of depressive symptoms on BDI - Improvement of executive functions on Tower Test - Improvement on attention problem subscale of the ASR Not statistically significant: - Reduction of hyperactivity symptoms on ADHD Rating Scale (p=0.695) Authors did not report data for the follow-up

Author, year, country	Aims	Design	Participants	Intervention	Outcome measures	Findings and conclusion
Anastopoulos *et al*. (2021), USA	Reports findings from a large, multisite randomized controlled trial examining the efficacy of a treatment for this population, known as ACCESS—Accessing Campus Connections and Empowering Student Success	RCT Multisite All study procedures were approved annually by each university's Institutional Review Board. Reported participants provided consent.	250 students 165 F; 85 M 18-30 y/o (19.7 y/o)	ACCESS CBT program Intensive active phase (8 weeks) - 8 weekly 90 minute group sessions focused on improving ADHD knowledge, behavioural strategies and adaptive thinking - 8 weekly 30 minute individual mentoring session focused on reinforcing what was learnt in CBT group, support student in establishing personal goals and signposting to appropriate resources Maintenance phase - One 90 minute booster group session at the start of the following semester - 6 flexible 30 minute individual mentoring sessions	Diagnostic measures: - Semi-Structured Interview for Adult ADHD - ADHD Rating Scale-5 (ARS-5) - Structured clinical interview for DSM-IV: Research Version (SCID-5-RV) Primary outcome measures: - Conners Adult ADHD Rating Scale, Self-Report, Long Version (CAARS-S:L) - Behavior Rating Inventory of Executive Function–Adult Version (BRIEF-A) - Beck Depression Inventory II (BDI-II) - Beck Anxiety Inventory (BAI) Secondary outcome measures: - Test of ADHD Knowledge (TOAK) - Strategies For Success (SFS) - ADHD Cognition Scale-College Version (ACS-CV) - Services for College Students Questionnaires (SCSQ)	Statistically significant: - Decline in overall ADHD symptomatology on CAARS Total ADHD scores (p<0.001) in both groups but greater in the ACCESS participants - Decline in inattention symptoms on CAARS IN scores (p<0.001) in both groups but greater in the ACCESS participants - Decline in hyperactive-impulsive symptoms on CAARS HI scores (p=0.002) in both groups but greater in the ACCESS participants. - Decline in overall EF deficits on BRIEF-A GEC scores (p<0.001) in both groups but significantly greater in the ACCESS participants. - Decline in behavioural regulation deficits on BRIEF-A BRI scores (p<0.001) - Decline in metacognition deficits on BREIF-A MCI scores (p<0.001) in both groups but significantly greater in the ACCESS participants.

Author, year, country	Aims	Design	Participants	Intervention	Outcome measures	Findings and conclusion
						- Improvement in ADHD knowledge on TOAK (p<0.001) in both groups but significantly greater in the ACCESS participants. - Improvement in use of behavioural strategies on SFS scores (p<0.001) in both groups but significantly greater in the ACCESS participants. - Decline in maladaptive thinking on ACS-CV (p<0.001) - Increase use of disability services (p=0.001) of ACCESS participants. Not statistically significant: - Reduction of depression symptoms on BDI-II (p=2.97) in both groups - Overall increase of ADHD medication (p=0.513) ADHD symptoms, EF and changes in clinical mechanisms were evident at the end of the active phase and remained stable throughout the maintenance phase of the intervention.
LaCount *et al*. (2015), USA	To investigate the preliminary effects of a CBT intervention, designed for adults with ADHD adapted to a combined group and individual format for college students with ADHD.	Open trial – before and after (no control group) The study was approved by the University Institutional Review Board where the study was conducted. Reported all participants provided informed consent.	17 students (12 students completed post intervention) 18-38 y/o (25.41 y/o) 11 Female 6 Male Students were still eligible if they were on a stable course of medication.	Condensed adaptation a treatment protocol as a goal-directed intervention designed to help adults cope with ADHD. 10 weeks - 10 weekly 1 hour group sessions - 10 weekly 1 hour individual sessions Main modules: Psychoeducation, Organisation, and Planning; Reducing Distractibility; Adaptative Thinking and Additional Skills.	- Barkley Current Symptom Scale – Self-Report Form (CSS-SR) - Weiss Functional Impairment Rating Scale (WFIRS)	Statistically significant: - Reduction in inattention symptoms on CSS-SR measure (p=0.045) (large effect size) - Improvement in School (p=0.047) and Work (p=0.033) domains on WFIRS measure (medium effect size) Not statistically significant: - Reduction in hyperactivity/ impulsivity symptoms on CSS-SR measure (p=0.139) (approached standards for large effect) - Improvement in Self-Concept and Life Skills on WFIRS measure (approached standards for small effect)

Author, year, country	Aims	Design	Participants	Intervention	Outcome measures	Findings and conclusion
Anastopoulos and King (2015), USA	To identify the effectiveness of the ACCESS program for college students with ADHD.	Open trial -before and after study Foundation-funded project awarded to the University of North Carolina system. Participants providing informed consent was not reported.	43 students (3 drop-outs) 27 F; 16 M 17-27 y/o (20.3 y/o)	ACCESS CBT program Active treatment phase - 8 weekly 90 minute group CBT sessions - 8 weekly 30 minute individual mentoring sessions Maintenance phase - 2 booster CBT sessions at the start and midpoint of the semester - 5-6 30 min individual mentoring (occurring every 2-3 weeks) Main modules: ADHD knowledge, behavioural strategies, cognitive therapy	Clinical change mechanism: - 50-item test of ADHD Knowledge - Strategies For Success (SFS) - ADHD Cognitions Test (ACT) - Cognitive Response Test for ADHD (CRT-A) Functional Outcomes: - Conners Adult ADHD Rating Scale (CAARS-S:L) DSM-IV inattentive symptoms, DSM-IV hyperactive–impulsive symptoms, and DSM-IV ADHD symptoms total scores - Behavior Rating Inventory of Executive Function–Adult Version (BRIEF-A) - Beck Depression Inventory -II (BDI-II) - Beck Anxiety Inventory (BAI) - Grade Point Average (GPA)	Statistically significant: - Increased knowledge of ADHD (p<0.001) - Increased use of organisational and other behavioural strategies (p<0.001) - Reduced levels of maladaptive thinking on CRT-A (p<0.001) - Reduced inattentive symptoms on CAARS-S:L (p<0.001) (moderate to large effect) - Reduction of total ADHD symptom on CAARS-S:L DSM-IV ADHD symptoms (p<0.001) (moderate to large effect) - Improvement across all executive function domains on BRIEF-A (p<0.001) (large effects) Not statistically significant: - Reduction of hyperactivity-impulsivity symptoms on CAARS-S:L DSM-IV hyperactive-impulsive symptoms (p=0.054) - Reduced levels of anxiety (p=0.055) - Reduced levels of depression (p=0.134) - Change in GPA

Author, year, country	Aims	Design	Participants	Intervention	Outcome measures	Findings and conclusion
Hartung *et al*. (2022), USA	To identify the effectiveness of a CBT intervention tailored specifically for college students with ADHD.	Open trial – before and after study (no comparison group) Authors do not report on registration nor Institutional Review Board approval. Participants providing informed consent was not reported.	30 students 20 UG; 8 GD; 2 PG 18-32 years old (M = 22.63 years old) 56.7% male 83.3% White/Non-Hispanic	New CBT intervention tailored specifically for college student with ADHD. 6 weeks - 6 group sessions - 3-6 individual sessions Main modules: - OTMP skills - Psychoeducation - Academic skills Setting - University-based psychology training clinics	- Social and Developmental History Form - DSM-5 Current Checklist, Self-Report - Weiss Functional Impairment Rating Scale, Self-Report (WFIRS) - Conners Adult ADHD Rating Scale, Self-Report, Long Version (CAARS-S:L) - Organizational, Time Management and Planning (OTMP), Self-Report	Adequate sample size to detect medium effect size. Statistically significant: - Reduction of inattentive ADHD symptoms on DSM-5 ADHD Symptoms Checklist (p=0.006) (small to medium effect) - Reduction of total ADHD symptoms on the CAARS DSM-IV ADHD Total Symptoms (p=0.002) (small to medium effect) - Decrease of impairment on the total WFIRS average score (p=0.049) and Self-Concept (p=0.031) domain (small to medium effect) - Increase in OTMP skill usage on the OTMP measure (p=0.011) (medium to large effect) Not statistically significant: - Reduction of hyperactive-impulsive symptoms on ADHD Symptoms Checklist.