

Case Study 1: An evidence based practice report

Theme: School/setting Based Interventions for Learning.

The effectiveness of mindfulness-based interventions on academic performance for children experiencing ADHD

1.0 Summary

Mindfulness is a long-standing practice that aims to non-judgmentally draw attention to the present moment (Zylowska, et al., 2008). This review evaluates six papers using Harden and Goughs (2012) weight of evidence framework. Due to the variation in the application of mindfulness practice, and the limited scope of research evaluating mindfulness in its original form, this review evaluated mindfulness-based interventions. Mindfulness-based interventions are interventions based on the core premise of mindfulness, which is to pay attention to the present moment without judgement (Kabat-Zinn, 2003). This includes group or individual activities that can be carried out virtually, independently or with a coach, that practice relaxation and breathing (Kabat-Zinn, 2003). The findings of this review suggest that a mindfulness intervention is effective for improving academic performance for children experiencing Attention Deficit Hyperactivity Disorder (ADHD). However, due to the limitations of the research, these findings should be interpreted with caution. For example, the use of ADHD medication was not consistent across participants, potentially inflating some of the results, and the use of academic performance measures varied, with some studies only demonstrating academic ability through a very small snap shot in time. Furthermore, much of the research failed to isolate mindfulness in its original form, and included a variation of mindfulness-based interventions, which creates inconsistency across the research. Randomised Control Trials (RCTs) are needed to evaluate precision of effects before recommending

mindfulness as an effective intervention for improving the academic performance of children experiencing ADHD.

2.0 Introduction

2.1 Mindfulness-based Interventions

Mindfulness has been grounded in ancient Buddhist practice for over 2,000 years (Langer & Moldoveanu, 2000), and more recently it has been used in practice as an intervention for both internalising (Khoury, et al., 2013) and externalising disorders (Cairncross & Miller, 2020). It is defined as the act of non-judgementally drawing your attention to the present moment (Zylowska, et al., 2008). In psychology mindfulness has been used to draw attention to thoughts, feelings and behaviours that are a response to physiological and psychological processes (Bishop, et al., 2004). This is especially relevant to the education context where individuals are required to control their thoughts feelings and behaviours so they can engage in learning. For the purpose of this review, mindfulness-based interventions were the focus, due to the limited scope of research evaluating mindfulness in its original form. Mindfulness-based interventions are activities that incorporate the core principles of mindfulness, and can be defined as any activity that focuses on non-judgementally paying attention to the present moment (Zenner, Herrnleben-Kurz, & Walach, 2014). For example, a mindfulness-based activity may involve; eating, yoga, drawing attention to the breath, scanning the body, untying knots, or feeling objects (Zenner, Herrnleben-Kurz, & Walach, 2014). The flexibility of the application of mindfulness-based interventions makes them suitable to support the diverse needs of the school context. Activities can be adapted at the individual, group or whole class level to meet the needs of the students (Zenner, Herrnleben-Kurz, & Walach, 2014).

2.2 ADHD

ADHD is a wide spread mental disorder affecting 5-20% of children and adolescents worldwide (Polanczyk & Rohdel, 2007). ADHD is often treated with medication, which can affect neurological development and cause unpleasant side effects (World Health Organisation, 2012). This highlights the need for alternative non-pharmacological intervention. According to the diagnostic and statistical manual for mental disorders DSM-5 (American Psychiatric Association, 2013), there are three subtypes of ADHD, inattentive, hyperactive-impulsive, and a combination of inattentive and hyperactive-impulsive. Therefore, the very nature of ADHD makes it difficult to engage in learning activities, putting many individuals who experience ADHD behind in the curriculum having less opportunity to succeed (Berchwood & Daley, 2012; Langberg, et al., 2011). Individuals who experience ADHD have difficulty managing relationships, present poor attainment through school and there after occupationally, have a higher risk of psychiatric comorbidity and drug abuse (World Health Organisation, 2012). Following an extensive review of the literature on the adverse impact of pharmacological intervention for the treatment of ADHD, the World Health Organisation (2012) discussed the need for educational training and intervention as alternative provision. Medication is often a short-term fix; children and adolescents need to be provided with the opportunity to learn how to manage their behaviour through developing self-awareness and skills they can carry with them throughout their lives, alleviating the dependency and harmful effects of medication (World Health Organisation, 2012). The use of mindfulness could allow children to develop skills for life, raising awareness of their behaviour, and being more metacognitive in drawing their attention and behaviour back to the task at hand.

2.3 Psychological Theory

A bio psychological perspective purports mindfulness-based activities release dopamine in the central nervous system (Kjaer, et al., 2002). Subjects with ADHD have been reported to have a decrease in dopamine levels, and ADHD medication is thought to mediate this (Swanson, et al., 2007). Cognitive theory purports mindfulness practice is associated with increased activity in the frontal lobe, which is the area responsible for executive functioning (Dixon, Dillbeck, Travis, & Msemaje, 2005). Executive functioning is the cognitive control system that is in charge of

learning behaviours such as; planning and organising, working memory, cognitive shifting, monitoring, behavioural inhibition and task initiation (Diamond, 2013). Individuals with ADHD are repeatedly reported to have difficulties in these areas (see review: Willcutt, Doyle, Nigg, Faraone, & Pennington, 2005).

2.4 Empirical Evidence

Previous systematic reviews have found positive outcomes for the effectiveness of mindfulness-based interventions on hyperactivity, inattention, impulsivity, executive functioning, emotional control (Chimiklis, et al., 2018; Lee, et al., 2017) and family functioning (Tercelli & Ferreira, 2019) in child populations. Positive outcomes of ADHD symptoms, executive function and emotional regulation have been found amongst adults (Poissant, Mendrek, Talbot, Khoury, & Nolan, 2019). Positive effects were found for the use of a mindfulness intervention on behavioural and social emotional outcomes of typically developing children and adolescents, but no effects were reported for the use of mindfulness as an intervention on academic performance (Maynard, Solis, Miller, & Brendel, 2017). There has been no systematic review to date evaluating the effectiveness of mindfulness-based interventions on academic performance for students who have a diagnosis of ADHD.

2.5 Mindfulness and Educational Psychology

A report produced by the Department For Education and Employment (DFEE) have stressed the importance of Educational Psychologists (EPs) using their specialism to work with specific clinical disorders such as ADHD, and supporting specific emotional and behaviour difficulties (Kelly & Gray, 2000). They have a responsibility to use evidence-based interventions to support children with special educational needs (SEN) (Kelly & Gray, 2000). The evaluation of the effectiveness of mindfulness as an intervention to alleviate ADHD symptoms and aid academic development could be useful to EP practice.

Being mindful is a fundamental skill to academic development. It facilitates active engagement and the ability to draw attention to the task (Langer & Moldoveanu,

2000). Mindful learning has resulted in higher levels of engagement and enjoyment of the task, improved memory, and the content being more meaningful to the learner (see review: Langer & Moldoveanu, 2000). Therefore, this review aims to evaluate the effectiveness of mindfulness-based interventions on academic performance for students experiencing ADHD.

2.6 Review Question

How effective are mindfulness-based interventions for improving academic performance of children experiencing ADHD?

3.0 Critical Review of the Evidence Base

3.1 Literature Search

Web of Science, ERIC, PubMed, Psych Info, and Scopus were searched on the 13th of January 2019. The search included the following terms (Table 1).

Table 1

Search terms and results of Database search

Database	Search Terms	Number of Results
Web of Science	“mindfulness” OR “meditation” AND “ADHD” Or “Attention Deficit Hyperactivity Disorder” AND "academic performance" OR "school achievement" OR "academic attainment" OR "grade performance" AND "school aged children"	16
ERIC	“effectiveness of mindfulness* as an intervention” AND “school performance” OR “academic performance” “mindfulness-based interventions” AND	6

Database	Search Terms	Number of Results
	“academic performance* OR “academic achievement” OR “GPA” OR “academic engagement” OR “grades” OR “academic success” AND “ADHD*” OR “Attention Deficit Hyperactivity Disorder”	
PubMed	"Mindfulness" OR "Meditation" AND “academic achievement*” AND "ADHD" OR “Attention Deficit Hyperactivity Disorder”	7
Psych Info	"meditation*" AND "academic performance*" AND "ADHD*"	3
Scopus	“Yoga intervention” OR "Mindfulness-based intervention” OR “Mindfulness* AND “ADHD*” AND “Academic performance*”	1

*equals wildcard

Once duplicates were removed, the total relevant papers from the search equalled 33. An ancestral search of articles generated 1 new article for inclusion bringing the total to 34. All 34 articles were screened against the inclusion criteria presented in table 2. The 27 articles excluded are detailed in appendix D. Six articles were deemed appropriate for inclusion in this review (table 3), further details of these articles are mapped in appendix B. A flow chart of the search process can be seen in figure 1.

Table 2

Exclusion and inclusion criteria of studies

Criteria	Exclusion Criteria	Inclusion Criteria	Rationale
1. Publication type	Study was not published in a peer reviewed journal	Study was published in a peer reviewed journal	Academic rigour. Published journals go through the scrutiny of peer review to ensure that the paper reaches the standards required.
2. Type of study	Systematic review, meta-analysis, review, case study, qualitative	Study must be experimental in design, using primary data collected to evaluate the effectiveness of the intervention	To evaluate the impact of mindfulness-based interventions as rigorously as possible.
3. Participants	The study does not include participants age 0-5 (due to the skill required to engage in a mindfulness-based activity), individuals who do not attend school or who are over the age of 18.	Participants attending school aged between 5 and 18.	Required to evaluate the effectiveness of a school-based mindfulness-based intervention on academic performance.
4. Outcome measures	Studies that did not include a measure of academic performance	Studies that included measure relevant to academic performance	Required to evaluate the relationship between mindfulness and academic performance
5. Language	Studies not published in English	The literature search was open to studies published in English	This ensures the paper can be read and critiqued by the researcher.
6. Region	Research in schools that are not representative of the United Kingdom (UK) education system.	Research in schools that are representative of the UK education system.	This ensures that the findings of this review can be used to inform practice in schools in the UK.

7. Mindfulness-based intervention	Studies that do not have a mindfulness-based intervention	Studies that included a mindfulness-based intervention, e.g yoga, breathing, mindfulness programme, meditation, any intervention grounded in the principles of paying attention to the present moment.	Required to evaluate the relationship between mindfulness-based interventions and academic performance
8. Clinical diagnosis of ADHD	Study participants that do not have a clinical diagnosis of ADHD screened by a medical professional.	All study participants must have a clinical diagnosis of ADHD, screened by a medical professional.	Required to evaluate the effectiveness of this intervention on the ADHD population

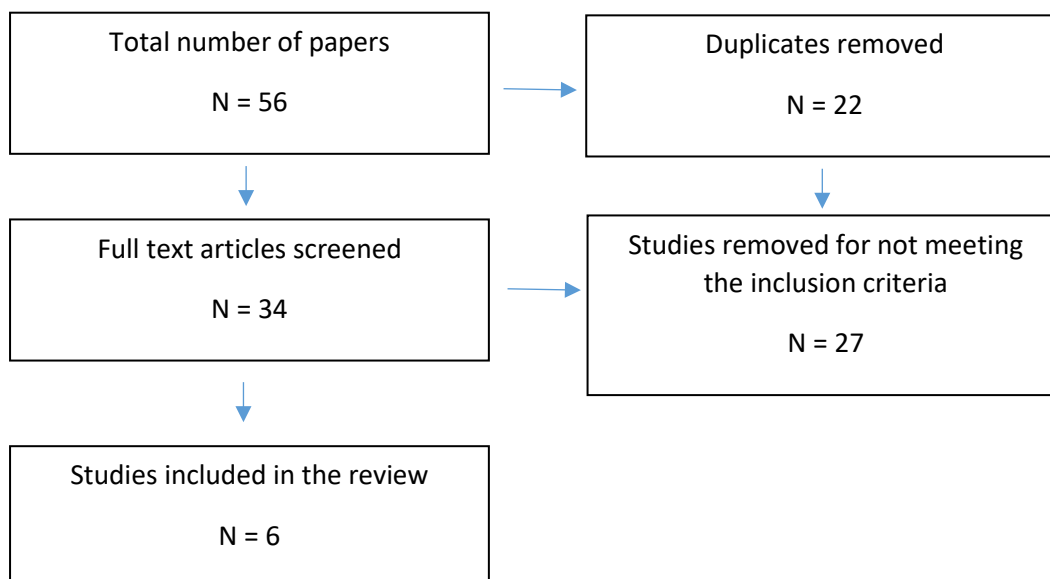


Figure 1. Study search process

Table 3

Studies included in the review

Grosswald, S. J., Stixrud, W. R., Travis, F., & Bateh, M. A. (2008). Use of the transcendental meditation technique to reduce symptoms of attention deficit hyperactivity disorder (ADHD) by reducing stress and anxiety: an exploratory study. *Current Issues in Education, 10*, 1-11.

Mehta, S., Mehta, V., Mehta, S., Shah, D., Motiwala, A., Vardhan, J., & Mehta, D. (2011). Multimodal behavior program for ADHD incorporating yoga and implemented by high school volunteers: a pilot study. *ISRN pediatrics, 2011*, 1-5.

Mehta, S., Shah, D., Shah, K., Mehta, S., Mehta, N., Mehta, V., & Mehta, D. (2012). Peer-mediated multimodal intervention program for the treatment of children with ADHD in India: one-year followup. *ISRN pediatrics, 2012*, 1-7.

Singh, N. N., Lancioni, G. E., Karazsia, B. T., Felver, J. C., Myers, R. E., & Nugent, K. (2016). Effects of samatha meditation on active academic engagement and math performance of students with attention deficit/hyperactivity disorder. *Mindfulness, 7*(1), 68-75.

Singh, N. N., Lancioni, G. E., Nabors, L., Myers, R. E., Felver, J. C., & Manikam, R. (2018). Samatha Meditation Training for Students with Attention Deficit/Hyperactivity Disorder: Effects on Active Academic Engagement and Math Performance. *Mindfulness, 9*(6), 1867-1876.

Zylowska, L., Ackerman, D. L., Yang, M. H., Futrell, J. L., Horton, N. L., Hale, T. S., & Smalley, S. L. (2008). Mindfulness meditation training in adults and

adolescents with ADHD: A feasibility study. *Journal of Attention Disorders*, 11(6), 737-746.

3.2 Weight of Evidence

Harden and Gough’s (2012) weight of evidence (WoE) framework was used to evaluate the studies in this review through WoE A, B, C and D (see table 4 and appendix C). WoE A evaluates and compares the methodological quality of each study using a coding protocol. Gersten and colleague’s (2005) coding protocol was deemed appropriate for the six studies here as it applies to both group designs and clinical populations (appendix A). The six studies use either a quasi-experimental design or single arm, drawing comparison across groups. WoE B evaluates the extent to which the methodology of each review question answers the question of this review. WoE C evaluates the relevance of the studies topic and general characteristics of the study to the question in this review. WoE D calculates an overall rating through summing the mean score and coding it into a tercile range (table 4). Low was 1 to 1.6, medium was 1.7 to 2.3, and high 2.4 to 3.

Table 4

WoE A, B, C, D summarised for each study, mean score presented in brackets.

Study	WoE A	WoE B	WoE C	WoE D
Grosswald, <i>et al.</i> (2008)	Medium (2)	Medium (2)	High (2.7)	Medium (2.2)
Mehta, <i>et al.</i> (2011).	Low (1)	Medium (2)	Medium (2)	Medium (1.7)
Mehta, <i>et al.</i> (2012)	Low (1)	Medium (2)	Medium (2)	Medium (1.7)
Singh, <i>et al.</i> (2016)	High (3)	Medium (2.3)	High (2.7)	High (2.7)
Singh, <i>et al.</i> (2018)	High (3)	Medium (2.3)	High (2.7)	High (2.7)
Zylowska, <i>et al.</i> (2008)	Low (1)	Medium (2)	High (2.7)	Medium (1.9)

3.3 Participants

Five of the six studies adhered to the inclusion criteria of school age students only, with an age range of 6-14 years (Grosswald, *et al.*, 2008; Mehta, *et al.*, 2011; Mehta,

et al. 2012; Singh, et al., 2016; Singh, et al., 2018). One of the studies (Zylowska, et al., 2008) included both adolescent and adult participants; the mean age of the adolescent participants was 15.6. However, due to the limited scope of studies in this area of research, it was still included in this review.

All of the studies used opportunity sampling, advertising for involvement in the study at local schools. As convenient and cost effective this level of sampling is there is a risk the sample is only representative of the organisation the participants were sampled from (Cohen, Manion, & Morrison, 2011). The educational establishment may possess characteristics unrepresentative to the wider target population (Cohen, Manion, & Morrison, 2011).

Two of the studies took place in a small town in India (Mehta, et al., 2011; Mehta, et al. 2012), which due to cultural and economic differences was deemed less applicable to the UK education context as evaluated in WoE C (see appendix C). Four were carried out in America (Grosswald, et al., 2008; Singh, et al., 2016; Singh, et al., 2018; Zylowska, et al., 2008), these were deemed more applicable to the UK education system (see WoE C appendix C).

Four of the studies participants had a long-standing diagnosis of ADHD diagnosed by a medical professional prior to the commencement of the study (Grosswald, et al., 2008; Singh, et al., 2016; Singh, et al., 2018; Zylowska, et al., 2008). All of which followed the criteria for ADHD outlined in the DSM-5 (American Psychiatric Association, 2013). This contributed to the high WoE C score evaluated for these four studies. In comparison, Mehta, et al. (2011) and Mehta, et al. (2012) scored low for WoE C in this area (see WoE C appendix C), as students were diagnosed with ADHD as part of the screening process using the Vanderbilt questionnaire and a medical professional. The Vanderbilt questionnaire was developed and standardised on a western population, therefore, the credibility of this tool to diagnose ADHD on an Indian population should be considered. Furthermore, the participants of Grosswald, et al. (2008), Singh, et al. (2016), Singh, et al. (2018), Zylowska, et al. (2008), were all taking medication for ADHD as part of their daily lives prior to and throughout the study period. The participants in Mehta, et al. (2011), and Mehta, et al. (2012) study were not taking any medication. The effects of medication on

successful meditation practice and academic performance should be considered when interpreting the results.

The number of participants included in the analysis of each of the six studies ranged from 4-63. Attrition rates varied across the papers, from no drop out (Singh, et al., 2016; Singh, et al., 2018), to 27% (Mehta, et al., 2012), 17% (Mehta, et al., 2011), 22% (Zylowska, et al., 2008) and 9% (Grosswald, et al., 2008). An attrition rate of 20% or more may impose a risk of bias (Schulz & Grimes, 2002). None of the studies with drop out reported omitting that data in their analysis using pairwise or listwise deletion, potentially inflating the power of the results (Kang, 2013). Mehta, et al. (2012) reported two participants were lost due to incomplete data collection, five moved out of the study region and 14 had a co-morbid diagnosis of oppositional defiance disorder (ODD). As recently reported by Bhat, Sengupta, Grizenko and Joobar (2020), there is high rate of co-morbidity with ADHD, and ODD is the most common co-morbidity amongst individuals experiencing ADHD. Thus drawing into question the generalisability of these findings to individuals experiencing ADHD. Mehta, et al. (2011) did not report any information on the participants who dropped out. Zylowska, et al. (2008) found no statistical difference of ADHD pathology between dropouts and completers. Grosswald, et al. (2008) reported their drop out participant opted out as they preferred to meditate at home.

Power analysis revealed three of the studies samples were appropriate to measure effect at the $p < .05$ level (Mehta, et al., 2011; Singh, et al., 2016; Singh, et al., 2018). Zylowska, et al. (2008) included a sample of 25 in their analysis, due to the small effect size, a minimum sample of 216 would be required to determine a true effect. Similarly, Grosswald, et al. (2008) analytic sample did not meet the criteria ($n = 10$), requiring a minimum sample of 12. Mehta, et al. (2012) had a total sample of 55. However, there was not sufficient information to conduct a power analysis.

3.4 Measures

Overall, Singh, et al. (2016) and Singh, et al. (2018) had the most robust measure relevant to academic performance (math quiz). As these studies were conducted in the USA, and the measure of academic performance can be directly related to

learning activities in a UK classroom, these studies were rated as high on WoE B and C (see appendix C). Furthermore, these studies collected math quiz data for up to 75 math lessons. This contributed to an overall high WoE A rating (see appendix C).

Mehta, et al. (2011) and Mehta, et al. (2012) used the Vanderbilt assessment to both screen for ADHD and measure academic performance, using multisource data collection (parent and teacher report) across multiple academic domains (reading, mathematics and written expression). Even though these variables directly relate to learning in the classroom, this questionnaire was initially developed and normed on western populations. Therefore, the appropriateness of this scale to an Indian population should be considered when interpreting the results, as this population may have different statistical norms due to cultural differences. Therefore, these studies were rated as low for the factor on WoE B pertaining to the quality of the academic performance measure, and low for the factor on WoE C pertaining to the relevance of the study to the UK education system. This contributed to their overall medium score for WoE B and C (see appendix C).

Grosswald, et al. (2008) and Zylowska, et al. (2008) both used a verbal fluency subtest from a psychological test battery, yielding a weaker probability of effect (Grosswald, et al., 2008), and a non-significant result (Zylowska, et al., 2008). As this is one subtest of a psychological test battery, collected at only two points in time, it is questionable as to whether there was enough data to evidence effect. As such, these studies received a medium score for this factor on WoE B (see appendix C). Furthermore, due to the very nature of the study question not being on academic performance, participants had minimal opportunity to demonstrate this following the mindfulness intervention. This contributed to an overall medium score on WoE B. Nonetheless, research has evidenced verbal fluency as a strong predictor of academic performance (Aksamovie, et al., 2019), deeming it an appropriate measure for the question in this review.

3.5 Research Design

Singh, et al. (2016) and Singh, et al. (2018) both used a quasi-experimental design, which contributed to their overall high WoE A score (see appendix C). Whilst RCTs are considered the gold standard in research design, they can be impractical to

administer (Hudson, Fielding & Ramsay, 2019). Quasi-experimental designs are a strong alternative, but do not use randomisation of participants (Hudson, Fielding & Ramsay, 2019). They do include both pre and post intervention data, and collect data at multiple time points. Therefore, it can be assumed with greater confidence that the independent variable mindfulness had an effect, as the target behaviour is measured at different time points in which the intervention is being delivered (Biglan, Ary & Wagenaar, 2000). However, quasi-experimental designs do not account for removal of intervention effects, limiting the extent to which causation can be inferred (Zheng, RosenKranz, & Hughs, 2013).

Grosswald, et al. (2008), Mehta, et al. (2011), Mehta, et al. (2012) and Zylowska, et al. (2008), all used a single arm experimental design in which all participants received the intervention condition with no control group and only baseline and outcome data. Mehta, et al. (2012) collected data at an additional 1 year follow up. As a result, Mehta, et al. (2011), Mehta, et al. (2012) and Zylowska, et al. (2008) had a low WoE A rating, and this contributed to Grosswald, et al. (2008) receiving a medium WoE A rating (see appendix C). Due to none of the studies implementing randomisation into control and experimental groups, they were all rated as low on WoE B point 1 (Grosswald, et al., 2008; Mehta, et al., 2011; Mehta, et al., 2012; Singh, et al., 2016; Singh, et al., 2018; Zylowska, et al., 2008).

3.6 Intervention

All of the six studies included students who had no prior engagement in mindfulness practice, which is a necessary exclusion criteria for this type of intervention as mindfulness is a within person skill of self-awareness. Singh, et al. (2016) and Singh, et al. (2018) used Samatha meditation. This is a widely used and recognised form of mindfulness practice, used throughout history focussing on techniques that calm the mind and focus attention on a specific point (Singh, et al., 2016; Singh, et al., 2018). As such, these studies received a high score for this factor on WoE B (see appendix C). Mehta, et al. (2011), and Mehta, et al. (2012) implemented a combined intervention of yoga, meditation, and play therapy. They did not specify the origins of the mindfulness meditation practice. Therefore, as they did not use meditation in its purist form, we cannot conclude that mindfulness was accountable for the improved

academic achievement scores. As such, these studies received a low score on this factor of WoE B (see appendix C). Zylowska, et al. (2008) adapted a mindful awareness programme tailored to the needs of individuals with ADHD. The origins of this programme were around drawing your attention to the present moment. Grosswald, et al. (2008) used transcendental meditation practice, which was not about controlling the mind, but about being in a restful state of consciousness for up to 20 minutes twice daily. These studies received a high score for this factor on WoE B (see appendix C).

3.7 Findings and Effect Sizes

A summary of each of the study’s findings and effect sizes can be seen in table 6. Table 5 reports effect size descriptors to support interpretation of these values.

Table 5

Effect size descriptors for Cohen’s d (1998)

Cohen’s d	Descriptor
.8	Large
.5	Medium
.2	Small

Table 6

Study findings (level of significance, $p < 0.05^*$, $p < .001^{}$), effect size of mindfulness on the measure of academic performance scored using Cohens d , and WoE D.**

Author	Sample size	Key outcome measure	Significance (between baseline and outcome measure)	Effect size	Overall WoE D
Singh, <i>et al.</i> (2018)	20	Math Quiz (2-3 times per week)	$p < .001^{**}$	$d = .7$ (medium)	High (2.7)
Singh, <i>et al.</i> (2016)	4	Math Quiz (2-3 times per week)	$p < .001^{**}$	$d = .9$ (large)	High (2.7)
Mehta, <i>et al.</i> (2012)	69	Teacher and Parent Vanderbilt questionnaire: reading, mathematics, written expression	$p < .001^{**}$	NA	Medium (1.7)
Mehta, <i>et al.</i> (2011).	76	Teacher and Parent Vanderbilt questionnaire: reading, mathematics, written expression	$p < .001^{**}$	$d = .2$ (small)	Medium (1.7)
Zylowska, <i>et al.</i> (2008)	24	Verbal IQ: Vocabulary subtest of the WISC	$p = .08$	$d = .1$ (small)	Medium (1.9)
Grosswald, <i>et al.</i> (2008)	10	D-KEFS Verbal Fluency Test.	$p < .05^*$	$d = .5$ (medium)	Medium (2.2)

Five of the studies reported a significant increase in academic performance following the meditation intervention (Grosswald, et al., 2008; Mehta, et al., 2011; Mehta, et al., 2012; Singh, et al., 2016; Singh, et al., 2018). One of the studies found no difference in academic performance scores from baseline to follow up (Zylowska, et al., 2008). One study reported a large effect size (Singh, et al., 2016), two of the studies reported a medium effect size (Grosswald, et al., 2008; Singh, et al., 2018), and two reported small effect sizes (Mehta, et al., 2011; Zylowska, et al., 2008). One of the studies did not provide sufficient information to calculate an effect size, contributing to its overall low WoE A rating (see appendix C Mehta, et al., 2012).

Mehta, et al. (2012) calculated medium scores from the teacher and parent report Vanderbilt questionnaires. These measured students' reading, maths and written expression. Medium scores improved from baseline (medium impairment score of 6) to one year follow-up (medium impairment score of 0). There was a statistically significant increase in performance on the Vanderbilt questionnaire from baseline to follow up ($p < .001$). There was not enough information to calculate effect sizes.

Mehta, et al. (2011) calculated mean scores of teacher and parent report Vanderbilt questionnaire that included a measure of students reading, maths and written expression. There was a statistically significant increase in performance pre and post intervention ($p < .001$), with a small effect size (Cohen's $d = .2$).

Singh, et al. (2018) calculated the percentage of maths problems solved correctly, before the meditation condition took place and after the meditation condition across the three sub types of ADHD: hyperactive, inattentive and combined. An overall mean score was calculated from the three subtype mean scores at pre and post-test, and standard deviation at pre-test. There was a statistically significant increase of maths problems solved correctly between baseline and follow up for all three subtypes of ADHD ($p < .001$), with a medium effect size (Cohen's $d = .7$).

Singh, et al. (2016) conducted a three-stage study, collecting data of percentage of math problems solved correctly at baseline, during meditation training and meditation practice. This contributed to the overall high WoE A score (see appendix C). As the standard deviation at baseline was not reported, effect sizes were calculated between stages two and three: meditation training and meditation practice. Mean scores were calculated for each of the four participants overall percentage score of

math problems solved correctly at meditation practice and at meditation training. A mean score was calculated for the four participants standard deviation score at meditation practice. There was a statistically significant increase of maths problems solved correctly across all four participants from baseline to meditation practice ($p < .001$), with a large effect size (Cohen's $d = .9$).

Zylowska, et al. (2008) analysed verbal IQ scores on the Wechsler Adult Intelligence Scale – Revised and the Wechsler Intelligence scale for children-Third Edition (Wechsler, 1981, 1991). Data was collected at pre and post meditation intervention. This contributed to the low overall WOE A score on items measuring the quality of the outcome measure and points of data collection (see appendix C). There was not a statistically significant difference between verbal IQ scores at pre and post-test. The effect size was small (Cohen's $d = .1$).

Grosswald, et al. (2008) measured performance using the Delis-Kaplan Executive Function System (D-KEFS) verbal fluency test, contributing to the low overall WoE A score, scoring low on items measuring the quality of the outcome measure (see appendix C). There was a significant improvement in verbal fluency scores over a three month study period from pre the meditation intervention to post ($p < .05$), with a medium effect size ($d = .5$).

Overall, synthesis of the study findings would suggest that the studies with the most robust methodological design (see WoA appendix C) also had the largest effect sizes (Singh, et al., 2016 & Singh, et al., 2018). Singh, et al., (2016) and Singh, et al., (2018). Both studies incorporated a quasi-experimental design collecting maths data 2-3 times a week for the duration of the study with careful consideration given to the purity of the intervention. This is a promising evaluation for the effectiveness of mindfulness-based interventions in schools, as with a strong design, strong effect sizes emerge. It is reasonable to assume that the smaller effects found in other studies could be due to the limitations evaluated in WoE A (see appendix C).

4.0 Conclusions and Recommendations

4.1 Conclusion

Overall, the papers in this review support the notion that mindfulness-based interventions have a positive effect on academic performance for students experiencing ADHD. This supports current theory and previous systematic reviews that suggest mindfulness-based practice can positively affect ADHD symptoms (Chimiklis, et al., 2018; Dixon, et al., 2005; Lee, et al., 2017; Poissant, et al., 2019; Tercelli and Ferreira, 2019). The significant effects reported lend support to the fact that mindfulness does not have to be administered in its purest form, as it is still effective in the more malleable form of a mindfulness-based intervention. This makes it an especially valuable intervention for schools, young people exercising their first experience of mindfulness practice, and people with SEN. The very nature of mindfulness-based interventions mean they can be used at the whole class, group and individual level, with the addition of props or exercises to support engagement.

Furthermore, the evaluation presented here is informative to EP practice, as EPs have a duty to recommend support and intervention to individuals experiencing SEN, and share this knowledge and information with other professionals (Kelly & Gray, 2000). However, there are a number of methodolgcal limitations to be taken into to consideration, due to this research being in the preliminary stages.

4.2 Recommendations

Practitioners should consider the potential effects of ADHD medication across these papers. The significant and strong effect sizes (see table 6) were calculated from participants taking ADHD medication (Grosswald, et al., 2008; Singh, et al., 2016; Singh, et al., 2018). The significant but small effect sizes (see table 6), were calculated from participants who were not taking ADHD medication (Mehta, et al., 2011; Mehta, et al., 2012). Therefore, it is reasonable to assume that a combined intervention of medication and meditation had a greater impact on academic performance than meditation alone.

Of the six studies discussed in this review, two were quasi-experimental (Singh, et al., 2016; Singh, et al., 2018) and the remaining four were single arm in design (Grosswald, et al., 2008; Mehta, et al., 2011; Mehta, et al., 2012; Zylowska, et al., 2008). This meant that comparison across experimental and non-experimental groups was not possible, restricting a more thorough analysis of effects. Without a separate control group that is matched equally on demographic characteristics, there is a risk that the positive effects of mindfulness on academic performance may have been due to chance or due to potential interacting variables. Furthermore, analysis of attrition is limited, and appropriate statistical procedures such as listwise or pairwise deletion to correct for missing data was not reported, potentially inflating the power of the results (Kang, 2013). Future studies employing a RCT design would allow for this level of analysis, and require missing data to be corrected appropriately. As to receive status as an RCT, the Consolidated Standards of Reporting Trials (CONSORT: Moher, Schulz, and Altman, 2001) must be adhered to.

Future research should consider more robust multi-source measures of academic performance, collected at multiple time points. This would provide sufficient opportunity for participants to demonstrate their academic ability. The studies presented here only used one measure of academic ability, and four of the studies only collected data at two time points (Grosswald, et al., 2008; Mehta, et al., 2011; Mehta, et al., 2012; Zylowska, et al., 2008), limiting the extent to which true academic potential can be recorded.

Furthermore, to be sure that it is mindfulness being evaluated more studies are required that evaluate mindfulness grounded in a specific domain such as Samatha or Vipassana. Only three of the studies in this review documented the origins of the meditation practice (Grosswald, et al., 2008; Singh, et al., 2016; Singh, et al., 2018). Within this, a comparison of the different mindfulness interventions would be useful for schools to weigh cost against effectiveness prior to implementation.

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Appendix A Study Coding Protocol

Coding protocol: Gersten, R., Fuchs, L. S., Compton, D., Coyne, M., Greenwood, C, & Innocenti, M. (2005). Quality indicators for group experimental and quasi-experimental research in special education. *Exceptional Children*, 71,149-164.

Study: Singh, et al. (2016)

Essential Quality Indicators - Quality indicators for describing participants

Was sufficient information provided to determine/confirm whether the participants demonstrated the disability(ies) or difficulties presented?

Yes

No

N/A

Unknown/Unable to Code

Were appropriate procedures used to increase the likelihood that relevant characteristics of participants in the sample were comparable across conditions?

Yes

No

N/A

Unknown/Unable to Code

Was sufficient information given characterizing the interventionists or teachers provided? Did it indicate whether they were comparable across conditions?

Yes

No

N/A

Unknown/Unable to Code

Essential Quality Indicators - Quality indicators for Implementation of the Intervention and Description of Comparison Conditions

Was the intervention clearly described and specified?

Yes

No

N/A

Unknown/Unable to Code

Was the fidelity of implementation described and assessed?

Yes

No

N/A

Unknown/Unable to Code

Was the nature of services provided in comparison conditions described?

Yes

No

N/A

Unknown/Unable to Code

Essential Quality Indicators – Quality Indicators for Outcome Measures

Were multiple measures used to provide an appropriate balance between measures closely aligned with the intervention and measures of generalised performance?

Yes

No

N/A

Unknown/Unable to Code

Were outcomes for capturing the intervention's effect measured at the appropriate times?

Yes

No

N/A

Unknown/Unable to Code

Essential Quality Indicators – Quality Indicators for Data Analysis

Were the data analysis techniques appropriately linked to key research questions and hypotheses? Were they appropriately linked to the limit of analysis in the study?

Yes

No

N/A

Unknown/Unable to Code

Did the research report include not only inferential statistics but also effect size calculations?

Yes

No

N/A

Unknown/Unable to Code

Essential Quality Indicators Total Score: 10

Desirable Quality Indicators

Was data available on attrition rates among intervention samples? Was severe overall attrition documented? If so, is attrition comparable across samples? Is overall attrition less than 30%?

Yes

No

N/A

Unknown/Unable to Code

Did the study provide not only internal consistency reliability but also test-retest reliability and interrater reliability (when appropriate) for outcome measures? Were data collectors and/or scorers blind to study conditions and equally (un)familiar to examinees across study conditions?

Yes

No

N/A

Unknown/Unable to Code

Were outcomes for capturing the intervention's effect measured beyond an immediate post-test?

Yes

No

N/A

Unknown/Unable to Code

Was evidence of the criterion-related validity and construct validity of the measures provided?

Yes

No

N/A

Unknown/Unable to Code

Did the research team assess not only surface features of fidelity implementation (e.g. number of minutes allocated to the intervention or teacher/interventionist following procedures specified), but also examine quality of implementation?

Yes

No

N/A

Unknown/Unable to Code

Was any documentation of the nature of instruction or series provided in comparison conditions?

- Yes
- No
- N/A
- Unknown/Unable to Code

Did the research report include actual audio or videotape excerpts that capture the nature of the intervention?

- Yes
- No
- N/A
- Unknown/Unable to Code

Were results presented in a clear, coherent fashion?

- Yes
- No
- N/A
- Unknown/Unable to Code

Desirable Quality Indicators Total Score: 6

	Total	Score
Essential Quality Indicators Total of >9 = Score 1 Total of <9 = Score 0	10	1
Desirable Quality Indicators Total of ≥4 = Score 2 Total of <4 = Score 1 Total 0 = Score 0	6	2
Total Score (3 = High Quality; 2 = Acceptable Quality; <2 = Poor Quality)		3

Study Rating: High Quality

Appendix B Mapping of the Field

Author and Date	Title	Participant details/ Number of Participants (N)	Type of Study	Control group	Mindfulness-Based Intervention	Baseline	Pre and Post-test measures	Study duration
Singh., et al. (2018)	Samatha Meditation Training for students with Attention Deficit/Hyperactivity Disorder: Effects on active Academic Engagement and Math Performance.	20 (N), age 10-12, 3 state schools in America, diagnosis of ADHD.	Quasi experimental design	10 lesson pre-intervention	Samantha Meditation Training	Pre-test measures, during the 10 lesson pre-intervention period.	Maths ability: Math Quiz (2-3 per week).	75 Maths lessons
Singh., et al. (2016)	Effects of Samatha Meditation on Active Academic Engagement and Math Performance of Students with Attention Deficit/ Hyperactivity Disorder	4 (N) 5 th grade student from a state school in America, diagnosis of ADHD	Quasi experimental design	Pre-intervention group (10 Math lessons)	Samantha Meditation Training	Pre-test measures, during the 10 lesson pre-intervention period.	Maths ability: Math Quiz (2-3 per week).	75 Maths lessons
Mehta., et al. (2011).	Multimodal Behaviour Program for ADHD Incorporating Yoga and Implemented by High School Volunteers: A Pilot Study	76 (N) diagnosed with ADHD, aged 6-11 years in India.	Single arm	No control	Multimodal programme called climb up, incorporating yoga, meditation, and play therapy.	Pre-test measures	Teacher and Parent Vanderbilt questionnaire: reading, mathematics, written expression.	6 weeks

Appendix B Mapping of the Field

Author and Date	Title	Participant details/ Number of Participants (N)	Type of Study	Control group	Mindfulness-Based Intervention	Baseline	Pre and Post-test measures	Study duration
Mehta., et al. (2012)	Peer-Mediated Multimodal Intervention Program for the Treatment of Children with ADHD in India: One-Year Follow-up	69 (N) aged 6-11, ADHD, attending a school in India	Single-arm	No control	Multimodal programme called climb up, incorporating yoga, meditation, and play therapy.	Pre-test measures	Teacher and Parent Vanderbilt questionnaire: reading, mathematics, written expression.	6 weeks. 1 year follow up
Zylowska., et al. (2008).	Mindfulness Meditation Training in Adults and Adolescents with ADHD.	24 adults and 8 adolescents diagnosed with ADHD, participants had to be 15 years of age or older, based in California	Single arm	No control	8 week meditation programme	Pre-test measures	Verbal IQ: Vocabulary subtest of the WISC	8 weeks
Grosswald., et al. (2008).	Use of the Transcendental Meditation Technique to reduce symptoms of Attention Deficit Hyperactivity Disorder (ADHD) by reducing Stress and Anxiety: An exploratory Study	10 (N), aged 11-14 with a pre-existing diagnosis of ADHD, based in Columbia.	Single arm	No control	Transcendental Meditation technique	Pre-test measures.	D-KEFS Verbal Fluency Test.	Three months.

Appendix C WOE A, B and C

WoE A Methodological Quality

The Gersten, et al. (2005) protocol was used to evaluate the methodological quality of the studies in this review. This protocol was deemed appropriate as the six studies evaluated used a group-based design and a clinical population. This protocol has a set of ten questions titled essential criteria, and eight questions titled desirable criteria. The essential criteria covered information about the participants, implementation of the interventions, comparison conditions, quality of the outcome measures, details on the data analysis process and reporting. The desirable criteria covered attrition, evidence of reliability and validity, follow up, the fidelity of the intervention and implementation. Each question receives a score of 1, a total equal to or more than 9 on the essential criteria receives a score of 1, a total of less than 9 receives a score of 0. A total of equal to or more than four on the desirable criteria receives a score of 2, and total of less than 4 receives a score of 1, a total of 0 receives a score of 0. Total scores are graded 1-3 where 3 equals high quality, 2 equals acceptable quality and less than 2 equals poor quality.

WoE A overall quality rating of the Gersten, et al. (2004) methodological quality coding protocol

Author	Essential quality total (score)	Desirable quality total (score)	Overall quality rating
Grosswald, et al. (2008)	7 (0)	4 (2)	2 (medium)
Mehta, et al. (2011)	5 (0)	2 (1)	1 (poor)
Mehta, et al. (2012)	5 (0)	3 (1)	1 (poor)
Singh, et al. (2016)	10 (1)	6 (2)	3 (high)
Singh, et al. (2018)	9 (1)	6(2)	3 (high)
Zylowska, et al. (2008)	8 (0)	3 (1)	1 (poor)

WoE B Methodological evidence to the review question

WoE B was evaluated by judging the appropriateness of the study's methodology to the question of this review. This was evaluated on the following three elements:

1. Quality of the control group

2. Quality of the academic performance outcome measure
3. The fidelity of the intervention to mindfulness practice

Criteria for evaluating WoE B

Rating	Description
3 points (High)	<ol style="list-style-type: none"> 1. Randomly assigned matched comparison group based on demographic characteristics. 2. Academic performance measure that relates directly to classroom performance. 3. A recognised programme, that is a purely mindfulness intervention only and implemented by a trained professional well rehearsed in teaching mindfulness practice and principles.
2points (Medium)	<ol style="list-style-type: none"> 1. Groups derived from non-random assignment to experimental or control condition and participants are not matched on demographic characteristics. 2. Academic performance measure that is relevant to learning. 3. Mindfulness-based intervention on its own, implemented by an experienced professional.
1 point (low)	<ol style="list-style-type: none"> 1. No control condition, just baseline and outcome measures. 2. Observation based performance measures only. 3. Mindfulness-based intervention, in amongst other practices.

WOE B was calculated by summing the mean score for each paper. Mean scores were evaluated by terciles range, for example; low was equal to 1 to 1.6, medium was equal to 1.7 to 2.3, and high was equal to 2.4 to 3.

Table displaying scores for WoE B, and tercile range presented in brackets to represent overall WoE B quality.

Author	WoE B Score	Mean Score
Grosswald, et al. (2008)	1 = 1 2 = 2 3 = 3	2 (medium)
Mehta, et al. (2011).	1 = 1 2 = 2 3 = 3	1.7 (medium)
Mehta, et al. (2012)	1 = 1 2 = 2 3 = 3	1.7 (medium)
Singh, et al. (2016)	1 = 1 2 = 3 3 = 3	2.3 (medium)
Singh, et al. (2018)	1 = 1 2 = 3 3 = 3	2.3 (medium)
Zylowska, et al. (2008)	1 = 1 2 = 2 3 = 3	2 (medium)

WoE C. Topic relevance to the review question

The following three criteria evaluated whether the overall topic of the studies related to the review question here.

1. Participants were recruited having a pre-existing diagnosis of ADHD
2. The relevance of the study to the UK education system
3. Participants were school aged

Criteria for evaluating WoE C

Rating	Description
3points (High)	<ol style="list-style-type: none"> 1. Participants recruited having a pre-existing diagnosis of ADHD by a medical professional using the DSM criteria. 2. Study was carried out in the UK 3. All study participants were school age, attending full time education
2 points (Medium)	<ol style="list-style-type: none"> 1. Participants were referred by the community as having a pre-existing diagnosis of ADHD, and were screened as part of the study. 2. The study was carried out in a country that is culturally similar to

Rating	Description
1 point (Low)	<p>the UK where some continuity of education can be assumed.</p> <ol style="list-style-type: none"> 3. School age and adult participants 1. Participants do not have a pre-existing condition of ADHD, but were screened for similar behaviour presentation as part of the study. 2. The study was carried out in a country that is not culturally relevant to the UK, and continuity of education cannot be assumed. 3. All adult participants

An overall mean score was calculated for each study from the ratings. Score were evaluated through a tercile range for example; low was equal to 1 to 1.6, medium was equal to 1.7 to 2.3, and high was equal to 2.4-3.

Table displaying scores for WoE C, and tercile range presented in brackets to represent overall WoE C quality.

Author	WoE C Score	Mean Score
Grosswald, et al. (2008)	1 = 3 2 = 2 3 = 3	2.7 (high)
Mehta, et al. (2011).	1 = 2 2 = 1 3 = 3	2 (medium)
Mehta, et al. (2012)	1 = 2 2 = 1 3 = 3	2 (medium)
Singh, et al. (2016)	1 = 3 2 = 2 3 = 3	2.7 (high)
Singh, et al. (2018)	1 = 3 2 = 2 3 = 3	2.7 (high)
Zylowska, et al. (2008)	1 = 3 2 = 2 3 = 2	2.7 (high)

Appendix D Excluded Studies

<i>Studies excluded from review</i>	<i>Reason for exclusion</i>
1. Bakosh, L. S., Mortlock, J. M. T., Querstret, D., & Morison, L. (2018). Audio-guided mindfulness training in schools and its effect on academic attainment: Contributing to theory and practice. <i>Learning and Instruction, 58</i> , 34-41.	Non-ADHD population
2. Bakosh, L. S., Snow, R. M., Tobias, J. M., Houlihan, J. L., & Barbosa-Leiker, C. (2016). Maximizing mindful learning: Mindful awareness intervention improves elementary school students' quarterly grades. <i>Mindfulness, 7</i> (1), 59-67.	Non-ADHD population
3. Beauchemin, J., Hutchins, T. L., & Patterson, F. (2008). Mindfulness meditation may lessen anxiety, promote social skills, and improve academic performance among adolescents with learning disabilities. <i>Complementary Health Practice Review, 13</i> (1), 34-45.	Non-ADHD population
4. Bóo, S. J., Childs-Fegredo, J., Cooney, S., Datta, B., Dufour, G., Jones, P. B., & Galante, J. (2019). A follow-up study to a randomised control trial to investigate the perceived impact of mindfulness on academic performance in university students. <i>Counselling and Psychotherapy Research, 2020</i> , 286-301.	Adult population
5. Caballero, C., Scherer, E., West, M. R., Mrazek, M. D., Gabrieli, C. F., & Gabrieli, J. D. (2019). Greater Mindfulness is Associated With Better Academic Achievement in Middle School. <i>Mind, Brain, and Education, 13</i> (3), 157-166.	Non-ADHD population
6. Cooper, P. (2011). Teacher strategies for effective intervention with students presenting social, emotional and behavioural difficulties: An international review. <i>European Journal of Special Needs Education, 26</i> (1), 71-86.	Review

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| 7. Crescentini, C., Capurso, V., Furlan, S., & Fabbro, F. (2016). Mindfulness-oriented meditation for primary school children: Effects on attention and psychological well-being. <i>Frontiers in psychology</i> , 7, 1-12. | Non-ADHD population |
| 8. Hagins, M., & Rundle, A. (2016). Yoga improves academic performance in urban high school students compared to physical education: a randomized controlled trial. <i>Mind, Brain, and Education</i> , 10(2), 105-116. | Non-ADHD population |
| 9. Huguet, A., Ruiz, D. M., Haro, J. M., & Alda, J. A. (2017). A pilot study of the efficacy of a mindfulness program for children newly diagnosed with Attention-Deficit Hyperactivity Disorder: Impact on core symptoms and executive functions. <i>International Journal of Psychology and Psychological Therapy</i> , 17(3), 305-316. | No academic performance measure |
| 10. Humphrey, N., Kalambouka, A., Wigelsworth, M., Lendrum, A., Lennie, C., & Farrell, P. (2010). New Beginnings: Evaluation of a short social–Emotional intervention for primary-aged children. <i>Educational Psychology</i> , 30(5), 513-532. | No mindfulness intervention |
| 11. Jha, A. P., Denkova, E., Zanesco, A. P., Witkin, J. E., Rooks, J., & Rogers, S. L. (2019). Does mindfulness training help working memory ‘work’better?. <i>Current Opinion in Psychology</i> , 28, 273-278 | No academic performance measure |
| 12. Lam, K., & Seiden, D. (2019). Effects of a Brief Mindfulness Curriculum on Self-reported Executive Functioning and Emotion Regulation in Hong Kong Adolescents. <i>Mindfulness</i> , 2020, 627-642. | No academic performance measure |
| 13. Lee, C. S., Ma, M. T., Ho, H. Y., Tsang, K. K., Zheng, Y. Y., & Wu, Z. Y. (2017). The effectiveness of mindfulness-based intervention in attention on individuals with ADHD: A systematic review. <i>Hong Kong Journal of Occupational Therapy</i> , 30, 33-41. | Review |

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| <p>14. Lo, H. H., Wong, S. Y., Wong, J. Y., Wong, S. W., & Yeung, J. W. (2016). The effect of a family-based mindfulness intervention on children with attention deficit and hyperactivity symptoms and their parents: design and rationale for a randomized, controlled clinical trial (Study protocol). <i>BMC Psychiatry</i>, <i>16</i>(1), 1-9.</p> | <p>No academic performance measure</p> |
| <p>15. Lu, S., Huang, C. C., & Rios, J. (2017). Mindfulness and academic performance: An example of migrant children in China. <i>Children and Youth Services Review</i>, <i>82</i>, 53-59.</p> | <p>Non-ADHD population</p> |
| <p>16. Mak, C., Whittingham, K., Cunnington, R., & Boyd, R. N. (2018). Efficacy of mindfulness-based interventions for attention and executive function in children and adolescents—A systematic review. <i>Mindfulness</i>, <i>9</i>(1), 59-78.</p> | <p>Review</p> |
| <p>17. McCloskey, L. E. (2015). Mindfulness as an intervention for improving academic success among students with executive functioning disorders. <i>Procedia-Social and Behavioral Sciences</i>, <i>174</i>, 221-226.</p> | <p>Non-ADHD population</p> |
| <p>18. Mendelson, T., Greenberg, M. T., Dariotis, J. K., Gould, L. F., Rhoades, B. L., & Leaf, P. J. (2010). Feasibility and preliminary outcomes of a school-based mindfulness intervention for urban youth. <i>Journal of Abnormal Child Psychology</i>, <i>38</i>(7), 985-994.</p> | <p>Non-ADHD population</p> |
| <p>19. Meppelink, R., de Bruin, E. I., & Bögels, S. M. (2016). Meditation or Medication? Mindfulness training versus medication in the treatment of childhood ADHD: a randomized controlled trial. <i>BMC Psychiatry</i>, <i>16</i>(1), 267-275.</p> | <p>No academic performance measure</p> |
| <p>20. Miles, S. B., & Stipek, D. (2006). Contemporaneous and longitudinal associations between social behavior and literacy achievement in a sample of low-income elementary school children. <i>Child Development</i>, <i>77</i>(1), 103-117.</p> | <p>No mindfulness intervention</p> |

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