

PROTOCOL

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Synthesising the existing evidence for non-pharmacological interventions targeting outcomes relevant to young people with ADHD in the school setting: systematic review protocol

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Abstract

Background: Children and adolescents with attention-deficit/hyperactivity disorder (ADHD) have impairing levels of difficulty paying attention, impulsive behaviour and/or hyperactivity. ADHD causes extensive difficulties for young people at school, and as a result these children are at high risk for a wide range of poor outcomes. We ultimately aim to develop a flexible, modular 'toolkit' of evidence-based strategies that can be delivered by primary school staff to improve the school environment and experience for children with ADHD; the purpose of this review is to identify and quantify the evidence-base for potential intervention components. This protocol sets out our plans to systematically identify non-pharmacological interventions that target outcomes that have been reported to be of importance to key stakeholders (ADHD symptoms, organisation skills, executive-global- and classroom-functioning, quality of life, self-esteem and conflict with teachers and peers). We plan to link promising individual intervention components to measured outcomes, and synthesise the evidence of effectiveness for each outcome.

Methods: A systematic search for studies published from the year 2000 that target the outcomes of interest in children and young people aged 3–12 will be conducted. Titles and abstracts will be screened using prioritisation software, and then full texts of potentially eligible studies will be screened. Systematic reviews, RCTs, non-randomised and case-series studies are eligible designs. Synthesis will vary by the type of evidence available, potentially including a review of reviews, meta-analysis and narrative synthesis. Heterogeneity of studies meta-analysed will be assessed, along with publication bias. Intervention mapping will be applied to understand potential behaviour change mechanisms for promising intervention components.

Discussion: This review will highlight interventions that appear to effectively ameliorate negative outcomes that are of importance for people with ADHD, parents, school staff and experts. Components of intervention design and features that are associated with effective change in the outcome will be delineated and used to inform the development of a 'toolkit' of non-pharmacological strategies that school staff can use to improve the primary school experience for children with ADHD.

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Keywords: Systematic review, ADHD, School, Non-pharmacological interventions, Self-esteem, Executive functioning, School relationships, Intervention mapping, Organisation skills, Quality of life, Global functioning

Background

Children and adolescents with attention deficit/hyperactivity disorder (ADHD) have impairing levels of difficulty paying attention, impulsive behaviour or hyperactivity [1, 2]. The core symptoms of ADHD are dimensional traits, so those with high levels of symptoms not meeting clinical diagnostic thresholds also experience similar difficulties [3, 4]. The prevalence of ADHD in children and adolescents is 2–7% [5]. ADHD causes extensive impairment for young people at school as well as home, and as a result these children are at high risk for poor academic attainment, other physical and mental health conditions and unintentional injuries [6–8]. Unfortunately, many young people with persistent ADHD find themselves in trouble with the police [4], and struggle to maintain friendships and relationships [6]. In spite of these difficulties and impairments, each young person with ADHD is a unique individual with their own strengths. Emerging evidence suggests that individuals with ADHD may be very creative, or able to ‘hyper-focus’ on things that engage their interest [9, 10]. They may think outside the box, and bring energy and fun to group situations. Empirical research into the strengths of children with ADHD is lacking and findings are mixed, although associations have been noted between ADHD and entrepreneurship [11].

The school environment poses some extreme challenges for children with ADHD [12, 13]. Having to stay still and quiet in classroom scenarios can be extremely difficult, focussing on work for long periods of time may be frustrating and tiring, and transitions between lessons or breaks can cause anxiety and exacerbate forgetfulness. Teacher-student relationships are often poorer for children with ADHD than their typically developing peers, which puts children with ADHD at risk for social exclusion [14, 15]. This, alongside perceptions that the young person can control their behaviour, yet is choosing not to, may lead to stigma and low self-esteem [13, 14]. Shouting out in class and negative interactions with teachers, coupled with difficulty expressing emotions in an age-appropriate manner, can lead to repeated exclusions or expulsion from school; children with ADHD experience higher rates of school exclusions [16]. Academic difficulties and co-occurring conditions may lead to placement in special educational provision, or home tutoring [8, 12]. Effective interventions are therefore needed to support these children through school.

Although there are pharmacological treatments for ADHD, these are not acceptable or tolerable for all children, and tolerance may develop after a few years [17]. Even with medication, children with ADHD do not do as well as those without ADHD in terms of both health- and school-based outcomes [18], and other options for school-based support are required that account for the complexity of successfully managing ADHD. There are often long waits for assessment and diagnosis of ADHD which impacts on the support a child receives in school; a recent survey reported the mean time from parents noticing symptoms to receiving a diagnosis of 31.9 months, with an 18.3 month average wait from first raising concerns with a doctor to receiving a diagnosis [19]. Although medication may acutely alleviate symptoms, support with skill development and other aspects of behaviour are still needed. Many studies have attempted to improve outcomes for children with ADHD in the school setting (e.g. [20–22]). In spite of this, the evidence for which parts of these interventions confer effectiveness is mixed. Non-pharmacological interventions are not always focussed on individual child deficits; they can also address the wider environment around the child to improve support [23]. These interventions may therefore benefit other children beyond the individual with ADHD.

We ultimately aim to develop a flexible, modular ‘toolkit’ of evidence-based strategies that can be delivered by primary (i.e. attended by children ages 5–11 years) school staff to improve the school environment and experience for children with ADHD; the purpose of this review is to identify and quantify the evidence-base for components of non-pharmacological interventions, and explicitly consider theoretical mechanisms of behaviour change within the promising components, in order to select strategies for the toolkit. Many existing school-based interventions for ADHD are complex and multi-component, targeting multiple outcomes in each child regardless of individual strengths or weaknesses [24]. Due to this, it is difficult to disentangle which components of these interventions or characteristics of individual participants are associated with effectiveness and methods such as intervention mapping are needed to understand this. In 2018, a qualitative comparative analysis was conducted to attempt to answer this question; findings indicated interventions targeting self-regulation and those delivered 1:1 may be associated with improvements in academic outcomes [24]. Further work is still needed to

ascertain the best evidence for improving other outcomes for children with ADHD in the school environment given the complexity highlighted in existing reviews. For example, in Richardson et al.'s series of reviews, shorter interventions were more effective which appears paradoxical; however, in qualitative studies, teachers have reported having little time to implement interventions, and in practice report using brief, flexible strategies tailored to the individual child or environment [23, 25, 26]. It may be that longer, complex interventions with many components were implemented with poor fidelity by school staff in existing studies due to busy classrooms and competing demands. There is also currently a poor understanding of mechanisms of change of individual intervention components (and therefore the reasons that intervention components may or may not work), and a lack of explicit consideration of developmental stage and context [27]. Furthermore, existing interventions are poorly implemented (likely due to their complexity) when school staff report using brief varied strategies flexibly in practice [26].

Existing studies of school-based interventions for ADHD have measured over 50 different outcomes [24]. Which of these outcomes were of most importance to people with ADHD and other key stakeholders have been recently identified through a Delphi survey. Consensus was obtained on the outcomes or targets that were considered to be most important to people with ADHD (including children), parents, school staff and ADHD professionals (in the context of developing and delivering a school-based intervention) [28]. These broad categories of outcomes inform and set the parameters of the current review. The current review will also synthesise and extend existing reviews of non-pharmacological and school-based interventions for ADHD (e.g. [27, 29–32]).

In this review, we aim to systematically identify non-pharmacological interventions that target the above outcomes of importance to people with ADHD,

parents, school staff and ADHD experts. The aim is to link individual intervention components to measured outcomes using quantitative synthesis and then to apply methods from intervention mapping to understand hypothesised processes of behaviour change. This review aims to synthesise the evidence of effectiveness of both whole interventions and intervention components (where possible) for each outcome. The review will not be restricted to only those with confirmed ADHD; rather we will seek to identify evidence-based intervention components that may be applicable to those with traits of ADHD and could be translated to the school context. Therefore, the population of primary interest is children and young people age 3–12, the intervention is any non-pharmacological intervention where one of the above outcomes is measured, and the comparator is no intervention or treatment as usual (including within-subject control).

Aims and research questions

The aim of this review is to systematically identify non-pharmacological interventions that target outcomes of importance to people with ADHD, parents, school staff and ADHD experts (listed in Table 1). We further aim to synthesise the evidence regarding which interventions and components of interventions are associated with improvements in the target outcomes. Therefore there are two main research questions that will be answered with different evidence synthesis strategies:

Research question 1

To what extent do non-pharmacological interventions for children and adolescents improve outcomes that have been established as being important to people with ADHD, parents and school staff, and what components of interventions appear to be associated with effectiveness?

Table 1 The most important outcomes for a school-based ADHD intervention to target, consensus reached by Delphi survey

Outcome
Inattention
Hyperactivity
Impulsivity
Conflict with teachers and peers
Organisational skills
Self-esteem
Classroom functioning
Executive functioning
Global functioning/quality of life

Research question 2

Why are the components identified in research question 1 effective at ameliorating ADHD symptoms or associated outcomes and what are the mechanisms of behaviour change involved?

Methods

A PRISMA-P checklist is included in the Additional file 1, and this protocol is registered on Prospero (ref CRD42021233924).

Eligibility criteria**Population**

Children and young people age 3–12 where ADHD or any of the core symptoms (impulsivity, inattention or hyperactivity) are mentioned in the title or abstract. Studies solely including “typically developing” populations will be excluded, as will studies of populations with acquired brain injury.

Intervention

Any non-pharmacological intervention or strategy, for example interventions or strategies may be psychological, cognitive, behavioural, or aim to change the learning environment. Interventions that intervene with diet or nutrition (including dietary supplements) will be excluded. Interventions requiring specialist equipment not commonly available to schools (e.g. EEG or specialist animals such as horses) will be excluded. Studies will be excluded if the intervention clearly requires a trained therapist to deliver it. Studies will not be excluded if young people are taking medication (for ADHD or other conditions). Studies that report solely on parent training, with no child-delivered component or school-relevant outcomes will be excluded, as will studies of the overarching effect of “summer treatment programmes” as these are intensive extended intervention programmes. A separate review of summer treatment programmes for ADHD is planned.

Comparator

For group designs, the comparator will be no intervention or treatment as usual (including medication). For within-subject designs, the comparator will be each participants’ baseline data.

Outcomes

Eligible studies will provide pre- and post- measures that capture a facet of at least one of the following child-focussed outcomes. Some outcomes may overlap, for example planning is an executive function, but also an organisational skill. Outcome measures may

be recorded by parents, teachers, the young person or through observational measures or computer-assisted technology. We will include studies of both (i) interventions that directly target the outcomes, and (ii) studies that measure any of these outcomes although they were not the explicit focus of the intervention.

1. Hyperactivity
2. Inattention (and attention but not “joint attention” referring to eye-gaze in autism studies)
3. Impulsivity
4. Organisational skills, including organised actions, time management and task planning [33]
5. Teacher conflict—or relationships with teachers
6. Peer conflict—or relationships with peers, and other indicators of social impairment such as friendships, peer relationships and bullying
7. Self-esteem
8. Executive functioning, including working memory, inhibitory control, shifting between tasks or cognitive flexibility, emotional self-regulation, initiating, planning and problem solving, self-monitoring [34]
9. Classroom functioning, e.g. task-relevant behaviours, communication, engagement, social skills, leadership skills, learning problems, problem behaviours, academic competence, classroom physical environment [35, 36]
10. Global functioning and quality of life

Types of study to be included

For research question 1, eligible studies will report changes in any of the outcomes listed above following non-pharmacological intervention and include control or comparison data. Systematic reviews that include studies meeting the above criteria, randomised and non-randomised controlled trials will be included for the quantitative synthesis. In addition to these study designs, controlled before and after studies, case-control studies or case series (including multiple baseline designs) are eligible study designs for research question 2. Individual study participants can be their own controls, e.g. using pre-intervention baseline data. Studies that include one intervention group that has the same measure pre- and post-treatment will be eligible for inclusion, as long as there are data available for a comparative ‘control’ period pre-treatment. Qualitative studies and individual case studies will be excluded from the synthesis, although they may inform the intervention mapping analysis. Process evaluations will be eligible study designs for research question 2 where they report on an intervention study that meets inclusion criteria. Where there are existing

high quality systematic reviews that match our inclusion criteria, we will include these reviews and only synthesise primary research studies published since the review search dates. It is anticipated that most existing systematic reviews will not match our aims precisely, in this case individual eligible studies within reviews will be included.

Given the ultimate aim of extracting detailed intervention information and plans to request intervention manuals from authors, we have made the pragmatic decision to include only studies published in English from 2000 to the search date (late 2020). This is based on experience from prior efforts to contact authors of school-based ADHD interventions; authors publishing more than two decades ago were often not traceable, or reported no longer having intervention manuals or further information. Prior to final analysis, searches will be re-run to identify any further recent publications. Conference abstracts will be excluded, and dissertations will be included. Forward and backward citation searching of included articles will also be conducted.

Context

Although the ultimate aim is to translate evidence to a school setting, eligible studies can be in any setting (home, school, after-school, hospital school, or clinical settings). As part of the scoping of literature, searches and title and abstract screening will include children and adolescents up to the age of 18; however, given the volume of eligible literature and that studies conducted with older age groups may have limited translatability to primary school settings, full-text screening will include only studies of children aged 3–12 years as the eligible study population. Following full-text screening, if there are insufficient studies in this younger population ($n < 3$ for any of the outcomes listed above), full texts will be re-screened and studies of secondary school pupils (age 12–18 years) will be included. Depending on the volume of evidence available for each outcome, studies based in the school setting will be prioritised over those in other settings.

Search strategy

The following databases and registries will be searched: Medline, PsycINFO, Australian Education Index, ERIC, Education research complete, British Education Index, Embase, Health Management Information Consortium, Social Policy and Practice (via OvidSP); ASSIA, Social Sciences Citation Index, Conference Proceedings Citation Index; Conference Proceedings Citation Index–Social Science and Humanities.

In addition, the following databases will be screened for relevant studies: The Cochrane Library, Cochrane Database of Systematic Reviews (CDSR), Database of

Abstracts of Reviews of Effects (DARE), Cochrane Central Register of Controlled Trials (CEN-TRAL), Cochrane Methodology Register (CMR), Health Technology Assessment (HTA) and The Campbell Library ISRCTN Registry. An example draft search strategy for PsycINFO can be seen in Table 2. Searches will have two steps, the first step will include *ADHD terms*, AND *at least one of the other outcome terms* (combined with OR), AND *intervention terms*. The second search will include *ADHD terms* AND *intervention terms* and exclude those results already present from step 1. This second step will capture studies that measure only the ADHD-specific symptom outcomes but none of our other outcomes of interest. Records from the two steps will be combined to form the search results. Scoping searches revealed that these terms are very broad: to focus the screening, additional NOT terms were applied to the records following all database searches (see Table 3).

Additional search strategies include forward and back citation chasing, contacting experts and searching through key journals (where journals or authors are highly recurrent in included studies). Potentially eligible trials identified through trial registrations will be followed-up to identify relevant publications, and where trials appear ongoing authors will be contacted to enquire if they have relevant data to contribute.

Study selection

Two reviewers will screen titles and abstracts, and then full-text records to assess study eligibility. Disagreements will be resolved through discussion, with a third reviewer (DM) if necessary. Screening and search records will be kept following a PRISMA diagram, with reasons recorded for studies that are excluded at full-text screening. Because scoping searches indicated a very high number of records would be retrieved from database searches (i.e. > 130,000), title and abstract screening will utilise *Swift-Review* software to minimise burden and facilitate the screening process [37]. This uses a ‘literature prioritisation’ algorithm, text mining and machine learning in order to prioritise screening for abstracts that appear eligible based on decisions made thus far. Piloting will involve reviewers independently making decisions on 100 titles and abstracts (that include eligible studies measuring the full range of outcomes of interest and studies that are ineligible). Reviewers will then screen from the top of the prioritised list, and the library will be re-prioritised frequently throughout screening to enhance the prioritisation algorithm (approximately every 100 records). Title and abstract screening will continue until 100 consecutive records are ineligible, and then after reprioritisation, a further 100 are not eligible. A random 100 records from those

Table 2 Example search strategy, PsyclINFO**ADHD terms**

attention deficit disorder with hyperactivity
 ADHD
 attention deficit/hyperactivity disorder
 ADD
 attention deficit
 hyperactiv*
 hyperk*
 inattent*
 impulsiv*
 restless*
 overactiv*
 (attention (problem or difficult* or disorder* or issue))

Organisation skills terms

organi?ation* skill*
 time management
 planning
 preparing material*
 task management
 homework
 ((self or personal) adj2 organis*)

Teacher and peer relationship terms

teacher relationship*
 peer relationship*
 friend*
 teacher conflict
 peer conflict
 classroom conflict
 pupil relationship*
 student-teacher
 pupil-teacher
 peer-peer
 teacher pupil relationship*
 teacher student relationship*
 (Family adj2 school adj (partnership* or relationship* or involvement))
 (Parent adj2 school adj (partnership* or relationship* or involvement))
 (school adj2 parent adj (partnership* or relationship* or involvement))
 (home adj2 school adj (partnership* or relationship* or involvement))

Self-esteem terms

self esteem
 self-esteem
 self-worth
 self worth
 value
 self-respect
 self respect
 Self-confiden*

Table 2 (continued)**Executive functioning terms**

working memory
 inhibit*
 task shift*
 cognitive flexib*
 emotional regulat*
 self-regulat*
 planning
 problem solving
 self-monitor*

Classroom functioning terms

engagement*
 classroom funct*
 social skill*
 leadership*
 academic*
 attainment
 classroom environment*
 learning environment
 learning establishment
 teaching environment

Global functioning and quality of life terms

global function*
 quality of life
 QoL
 happiness
 satisfaction
 assessment of function*
 social function*
 psychological function*
 global impairment*

Intervention terms

intervention*
 strateg*
 program*
 project*
 train*
 support*
 therap*
 treatment
 (Behavio?r* adj2 (management or modification* or medicine or treatment*))
 (education* adj2 (management or modification* or treatment*))
 (classroom adj2 (management or modification* or treatment*))
 (playground adj2 (management or modification*))
 (psychosocial adj2 (management or modification* or treatment*))
 (cognitive adj2 (management or modification* or treatment*))
 behavio?r change technique*
 mentor*
 counsell*

Table 2 (continued)

coach*
social skills
social problem solving
life skills
CBT
cognitive behavior?r*
cognitive therap*
Not terms
TBI or (traumatic brain injury)
University*
higher education*

Each category of terms combined with 'or'; then final search is:

Search 1; (ADHD terms) AND (organisation skills terms) OR (teacher and peer relationship terms) OR (self-esteem terms) OR (executive functioning terms) OR (classroom functioning terms) OR (global functioning and QoL terms) AND (intervention terms) NOT (not terms), restricted to year=2000/2020; Search 2; (ADHD terms) and (intervention terms) not (not terms or results from search 1), restricted to year=2000/2020 * is a wildcard symbol used to denote any characters following the word stem

remaining will then be screened to ensure all are ineligible prior to concluding title and abstract screening.

Full-text screening will be conducted by three reviewers. All reviewers will screen 10% of the records to assess concordance. Providing reviewers have a high level of agreement (> 95%) on studies meeting inclusion criteria, the remaining full texts will be each screened by one individual. If not, double-screening will continue until concordance is reached. Screening will result in a series of studies meeting inclusion criteria across all outcomes.

Following screening, additional searches will be conducted and authors contacted in order to identify additional data relating to the implementation of included interventions, for example process evaluations, intervention manuals and qualitative analyses.

Data extraction

A data extraction form will be developed and piloted with 10 studies from a range of designs. A separate data extraction form will be used for systematic reviews. Data will be extracted by one reviewer, with data from the first 10% of included studies extracted and checked by a second reviewer. The second reviewer will also scrutinise extraction of data used for calculating effect sizes, intervention descriptions, and categorisation of outcome measures for at least an additional 10% of studies, as these are considered aspects of data extraction where accuracy is critical. If discrepancies are identified, further studies will be double-extracted until consistency is reached.

For individual intervention studies (including eligible studies within systematic reviews), descriptive data on the study sample will be extracted (number of participants, age, sex, clinical characteristics), along with

detail of the study year, author, funding source, country, study design, setting, intervention and control group conditions. As much detail as possible will be extracted regarding the nature, content and implementation of the intervention, following the *template for intervention description and replication* (TIDieR) for describing interventions, which include items on reporting fidelity and implementation [38]. Information will be extracted regarding who delivers the intervention and formats of delivery, dosage and duration of baseline, intervention and follow-up periods. As much detail as possible will be extracted relating to theoretical approaches used, implied or explicitly referred to. Where participants represent a selected group (e.g. those with ADHD), information on diagnostic assessment and current treatments will be extracted where these data are available.

Components of interventions in each study will be paired with the estimate of effect on the outcomes of interest. These are likely to be challenging to disentangle, and for this aspect of the analysis the identified intervention components will be paired with any pertinent outcomes measured. For example, if an intervention includes four components and two relevant outcomes, the effect size estimate will be recorded for each pairing of component and outcome; eight effect sizes in this example (of which the four effect estimates for each outcome will be the same). It is acknowledged that this approach will be somewhat reductionist where interventions are poorly described; however, synthesising these effects across studies should allow for identification of promising components of interventions, to be further evaluated through intervention mapping.

For each intervention-outcome pairing, participant numbers, means and standard deviations (SDs) for

Table 3 List of additional “not” terms

Term
Cell induced
Protein
Rat
Cancer
Tumor
Inhibitor
Cocaine
Immune
Covid
Infection
Autoimmune
Inflammatory
Gene
Mutat*
Genetic variants
Bladder
Oab
Mirabegron
Solifenacin
Incontinen*
Kinase
Alpha
Phosphorylate*
Receptor
Binding
Nucleus
Stroke
Renal
Hyperalaemia
Kidney
Ckd
Platelet
Complement
Serum
Blood
Biomarker
Plasma
Lesion
Hyperkerat*
Psoriasis
Cutaneous
Keratosis
Aky
Mapk
Phosphor*
Diabet*

Table 3 (continued)

Term
Insulin
Metabolic
Glucose
Mellitus
Neuronal
Alzheimer*
Neuron
Microglia
Urinary
Detrusor
Voiding
Urodynamic
Calcium
Hypertension
Cardiovascular
Carotid
Arterial
Myocardial
Oxidative
Autophagy*
Botulinum
Intravesical
Neurogenic
Postoperative
Surgical
Preoperative
Prolapse
Hyperkyphosis
Kyphosis
Thoracic
Delirium
Dementia
Icu
Methylation
Epigenetic
Histone
Hepatic
Thyroid
Testosterone
Adrenal
Antibodies
Ovarian
Serum
Hypothyroidism
Prostate
Prostatic

Table 3 (continued)

Term
Osteoclast*
Enzyme
Sperm
Progesterone
Fertility
Semen
"Adults with ADHD"
"Adult ADHD"

outcome measures will be extracted, or a measure of intervention effect with an estimate of precision such as confidence intervals. These will be converted to *Hedge's g*, a standardised measure of study effect size that corrects for overestimation of the true population effect [39]. For non-randomised studies of interventions, we will follow Cochrane guidance and extract estimates of effect and precision as well as information about how the effect estimate was derived (e.g. the confounders controlled for) [40]. For high-quality systematic reviews that fully meet our inclusion criteria, similar data will be extracted including intervention descriptions in included studies, as well as lists of included studies.

Risk of bias (quality assessment)

There are multiple tools that can be used to assess risk of bias. The Joanna Brigg's Institute tools for critical appraisal will be utilised because it has separate quality appraisal tools available for appraisal of systematic reviews, RCTs and non-randomised experimental studies [41]. There are no guidelines of which we are aware to appraise the quality of interventions and implementation, so to appraise the quality of interventions, and the quality of implementation of the intervention, we will develop an appraisal tool that reflects the components of the TiDieR checklist and best-practice recommendations on assessing implementation and fidelity [38].

Strategy for data synthesis

Data will be synthesised separately for the two research questions. For research question 1, eligible study designs will be systematic reviews, randomised and non-randomised trials (i.e. between-group studies). For research question 2, within-group studies such as case-series and multiple baseline studies will also be eligible for inclusion, along with process evaluations and intervention manuals.

Screening will result in a series of studies meeting inclusion criteria for each of the outcomes. The evidence for each outcome will be synthesised separately, where constructs overlap substantially these will be merged and discussed as pertinent to both outcomes.

Depending on the level of evidence and volume of research available for each outcome, data synthesis will vary. Should there be a large number of eligible systematic reviews, research question 1 may include a synthesis of reviews or a 'review of reviews' in addition to the analysis linking components of primary studies to intervention effect estimates; we will use the AMSTAR tool to assess review quality and follow best-practice guidance [42]. For systematic reviews that meet inclusion criteria, we will conduct a separate synthesis to explore whether primary research that has been published since the review date fits the reported findings. Data from interventions included within systematic reviews will be extracted and synthesised in addition. Where it is not possible to include a systematic review, for example if many of the studies in the review are not pertinent to the research questions, individual study details will be extracted from reviews and checked for eligibility.

Where included studies are sufficiently homogeneous, random-effects meta-analysis will be used to assess the cumulative evidence for intervention effectiveness. Heterogeneity will be assessed using the I^2 statistic [43], and funnel plots and Egger's regression will be used to investigate potential effects of publication bias [44]. We will prioritise quantitative analysis of existing meta-analyses and randomised controlled trials for each outcome, and conduct meta-analysis or quantitative synthesis of other study designs where appropriate, when sufficient systematic reviews (at least 1) or RCTs (at least 5 without a high heterogeneity estimate) are unavailable. Moving beyond the component-outcome analysis, subgroup analyses and meta-regression will be used to examine the influence of specific intervention

or study features associated with effectiveness, for example by examining the impact of setting, duration, delivery agent, or type of intervention, the population studied, the country and region of the study setting and the gender of participants on outcomes. The composition and nature of control conditions such as “treatment as usual” will vary depending on the location and design of included studies, and we intend to report a descriptive table detailing clinical guidance for treatment of ADHD for the countries in which included studies are set.

Given that interventions and measures for the pre-school aged population may differ from those who are of school age, we will also assess whether the effectiveness of non-pharmacological interventions varies by the age of the study population. The strength of the body of evidence for each outcome in research question 1 will be assessed using GRADE [45].

Synthesis of non-randomised group-based study designs can be complex; these studies are subject to a higher risk of bias than randomised designs [46], and the direction of bias between studies may vary due to different features of study design [40]. However, evidence from non-randomised studies will complement evidence from RCTs and may be the best available evidence for some outcomes, and so if the study designs and measures are sufficiently homogeneous, meta-analyses and meta-regression will be undertaken. Findings from within-subject study designs where each participant provides their own control data will be used to inform the intervention mapping analysis for research question 2.

The findings from the data synthesis will identify and quantify the current evidence relating to whether outcomes of interest can be affected by non-pharmacological interventions for children and young people, and begin to identify broad features of interventions that are associated with effectiveness. These findings will be discussed with a stakeholder group comprised of people with ADHD, parents, school staff and experts in education and psychology in order to discuss the context and implications of the results, and the feasibility of delivering these in primary schools.

Given the anticipated difficulty of establishing whether individual intervention components of multi-component complex interventions have an effect on outcomes, following the initial evidence synthesis to quantify effect sizes, intervention mapping [47] will be applied to the most promising strategies with the strongest evidence for effectiveness, and studies meeting inclusion criteria that report using these components will be scrutinised. Intervention mapping is a theory- and evidence-based approach to understanding which components of interventions

are likely to result in behaviour change, so the theoretical pathway linking each intervention component with the outcome will be elicited. Logic models of behaviour change will be constructed for each promising intervention-outcome component, underpinned by evidence and theory, and components that align with empirical and theoretical evidence will be selected for inclusion in the toolkit [47]. In order to achieve this, intervention manuals, process evaluations and other publications relating to interventions will also be retrieved by contacting authors or via searches, findings and implications from relevant systematic reviews will be integrated, and literature relating to identified theories such as behaviour change and complex systems theories will also be drawn upon.

Discussion

This systematic review will identify and quantify the evidence for non-pharmacological interventions that target a range of outcomes of importance to people with ADHD, parents, school staff and experts. These include the core symptoms of ADHD, as well as relationships or conflict with staff and peers (including indicators of social impairment), self-esteem, organisation skills and a variety of aspects of functioning. This evidence synthesis will move beyond the contributions of existing studies in this field by providing up-to-date quantitative assessments of effectiveness, and explicitly mapping the evidence for individual intervention components to change the outcomes of interest. We will also synthesise and extend existing systematic reviews in these areas by identifying subsequent studies and synthesising findings in light of what is already known. Intervention mapping will extend the evidence synthesis by integrating theory and evidence for the most promising intervention components, and explicitly mapping out pathways to behaviour change. This will be used to create logic models of behaviour change that would be required for each component to be effective, ultimately facilitating the translation of identified evidence-based components and strategies into a toolkit for non-specialists to use working in schools with children with traits of ADHD.

Abbreviations

ADHD: Attention deficit/hyperactivity disorder; RCT: Randomised controlled trial; TiDiEr: Template for intervention description and replication; SD: Standard deviation.

Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s13643-022-01902-x>.

Additional file 1. PRISMA-P 2015 Checklist.

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Authors' contributions

AR conceptualised and designed the review, and drafted the protocol. DM designed the review and advised on methodology. AS, TF, BD, RH, ESB, LP and JK assisted with conceptualisation and design and determined inclusion and exclusion criteria. All critically revised the manuscript. All authors read and approved the final manuscript.

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Availability of data and materials

N/A

Declarations

Ethics approval and consent to participate

Ethics approval is not required for the current study.

Consent for publication

N/A

Competing interests

The authors declare that they have no competing interests.

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