



# Høgskulen på Vestlandet

## Masteroppgave

MAKP601

### Predefinert informasjon

<b>Startdato:</b>	08-05-2019 09:00	<b>Termin:</b>	2019 VÅR
<b>Sluttdato:</b>	15-05-2019 14:00	<b>Vurderingsform:</b>	Norsk 6-trinns skala (A-F)
<b>Eksamensform:</b>	Masteroppgave	<b>Studiepoeng:</b>	45
<b>SIS-kode:</b>	203 MAKP601 1 MG 2019 VÅR		
<b>Intern sensor:</b>	(Anonymisert)		

### Deltaker

**Kandidatnr.:** 417

### Informasjon fra deltaker

**Antall ord \*:** 18599

**Egenerklæring \*:** Ja

**Inneholder besvarelsen  
konfidensiell materiale?:** Nei

**Jeg bekrefter at jeg har  
registrert oppgavetittelen  
på norsk og engelsk i  
StudentWeb og vet at  
denne vil stå på  
vitnemålet mitt \*:** Ja

### Gruppe

**Gruppenavn:** (Anonymisert)

**Gruppenummer:** 1

**Andre medlemmer i  
gruppen:** 418

Jeg godkjenner avtalen om publisering av masteroppgaven min \*

Ja

Er masteroppgaven skrevet som del av et større forskningsprosjekt ved HVL? \*

Nei

Er masteroppgaven skrevet ved bedrift/virksomhet i næringsliv eller offentlig sektor? \*

Nei



Western Norway  
University of  
Applied Sciences

# MASTER'S THESIS

A Systematic Review on the Effect of  
Exercise for Depression in Children and  
Adolescents

**Sølvi Biedilæ and Brynhildur Axelsdottir**

Master in Evidence-Based Practice in the Health Sciences  
Faculty of Health and Social Sciences  
Centre for Evidence-Based Practice  
Supervisor Lillebeth Larun  
Submission Date: May 15<sup>th</sup> 2019

We confirm that the work is self-prepared and that references/source references to all sources used in the work are provided, cf. Regulation relating to academic studies and examinations at the Western Norway University of Applied Sciences (HVL), § 10.

## Erklæring

Denne masteroppgaven er en systematisk oversikt basert på en protokoll publisert i det internasjonale PROSPERO-registeret 20.07.2018, hvor Brynhildur Axelsdottir og Sølvi Biedilæ står oppført som forfattere. Selv om protokollen har flere medforfattere erklærer vi herved at masteroppgaven er et selvstendig arbeid hvor vi har hatt ansvar for utforming, gjennomføring og rapportering av den systematiske oversikten.

Oslo, 8. mai 2019

Studentenes signatur:

Sølvi Biedilæ og Brynhildur Axelsdottir

Sølvi Biedilæ Brynhildur Axelsdottir

# **A Systematic Review on the Effect of Exercise for Depression in Children and Adolescents**

(Title in English)

# **En systematisk oversikt over effekten av trening for depresjon hos barn og unge**

(Title in Norwegian)

Master's students: Sølvi Biedilæ and Brynhildur Axelsdóttir

Main supervisor: Lillebeth Larun

Co-supervisor: Lena Victoria Nordheim

Submission date: May 15<sup>th</sup> 2019

Total number of words: 13889

## Preface

We have worked as librarians at the Centre for Child and Adolescents Mental Health (RBUP) for several years. Working alongside many talented researchers, teachers, and practitioners inspired us to want to learn more about evidence-based practice and research methodology. Our director Arild Bjørndal and his passion for evidence-based practice has been a major inspiration for us. During our studies at Høgskulen på Vestlandet, our interest in systematic reviews has grown. When the suggestion of doing a systematic review on the topic of exercise for children and adolescents with depression came along, we decided that this was a perfect project for us. Luckily our employer agreed, and we could use one working day a week on the project. For that, we are were grateful to our supervisor Astrid Dahlgren and RBUP. Working on this thesis has been challenging, sometimes hard, but mainly rewarding and educational. And we are still friends! Everything we have learned while writing this systematic review will hopefully be useful both to our professional development and future projects at RBUP.

We have many people we would like to thank. First and foremost, our fantastic supervisors Lillebeth Larun and Lena Victoria Nordheim for all your help, support, cheering and for always replying to our emails faster than the speed of light. Big thanks to Astrid Dahlgren for believing in us and inspiring us on a daily basis. Your feedback has significantly improved this thesis. Thanks to Åse Sagatun for interesting discussions about exercise interventions and their potential mechanisms for depression. We are also grateful for your feedback on the study protocol and the article manuscript. We thank our fellow librarians Marte Ødegaard and Mari Elvsåshagen for helping with peer-reviewing the search strategy. Statistician Tore Wentzel-Larsen helped us with assessing the randomization in one of the trials. We appreciate that researchers Simon-Peter Neumer and Parvin Kiamanesh helped us with reading a few articles in German and Persian. We will thank Ragnar Gunnarsson for feedback on the article manuscript and his support. Also, thanks to Ove Dale for encouragement including cinnamon buns when most needed. Last, but not least, thanks to all our wonderful colleagues at RBUP for your support, interest in our project and encouragement.

# Abstract

## **Background**

Depression is a common mental health problem in adolescents with a one-year prevalence estimate of 5.6% among 13-18-year olds. It can cause problems at school, with friends, and in the family and may have adverse effects on educational attainment and later employment status.

## **Objective**

The objective of this systematic review was to examine the effects of exercise interventions as treatment of depression in children and adolescents compared to other treatments or no treatment.

## **Methods**

The bibliographic databases Cochrane Central Register of Controlled Trials (CENTRAL), Medline (Ovid), Embase (Ovid), PsycINFO (Ovid), AMED (Ovid), SPORTDiscus, PEDro, CINAHL (EBSCO), ERIC (EBSCO) and Web of Science were searched from inception to December 2018, in addition to grey literature, ongoing and unpublished trials. Trials were included if they were randomized controlled trials of exercise interventions for children and adolescents 6-18 years with depression. Two authors independently screened references, extracted data and assessed the quality of the included trials with the Cochrane Risk of Bias tool. The certainty of the evidence was assessed using GRADE.

## **Results**

Of 11007 retrieved references, four trials were included ( $n=143$ ). Meta-analysis was conducted using a random-effects model on the outcome of depression post-intervention and found a moderate effect in favour of exercise in adolescents (SMD= -0.59, 95% CI= -1.11, to -0.07). The trials had a low number of participants and were assessed as having an unclear or high risk of bias. The certainty of the evidence was graded as low. None of the trials commented on the presence or absence of adverse events.

## **Conclusion**

Exercise appears to be a promising intervention for children and adolescents with depression. However, large, high-quality trials with longer follow-up time are needed.

## **Keywords**

Depression (MeSH), Depressive Disorder (MeSH), Adolescent (MeSH), Child (MeSH), Exercise (MeSH) Systematic review [Publication Type] (MeSH), Meta-Analysis [Publication Type] (MeSH).

## **Sammendrag på norsk**

### **Bakgrunn**

Depresjon er et vanlig psykisk helseproblem hos ungdom. Forekomst i løpet av et år er estimert til å være 5.6% hos 13-18 åringer. Depresjon kan føre til skoleproblemer og frafall, problemer med venner og i familien og risiko for å falle utenfor arbeidslivet.

### **Hensikt og problemstilling**

Hensikten med denne systematiske oversikten er å undersøke effekten av trening som behandling av depresjon hos barn og unge sammenlignet med andre behandlinger eller ingen behandling.

### **Metode**

De bibliografiske databasene Cochrane Central Register of Controlled Trials (CENTRAL), Medline (Ovid), Embase (Ovid), PsycINFO (Ovid), AMED (Ovid), SPORTDiscus, PEDro, CINAHL (EBSCO), ERIC (EBSCO) og Web of Science ble søkt fra starten til desember 2018, i tillegg til grå litteratur, pågående og upubliserte studier. Studier ble inkludert dersom de var randomiserte kontrollerte forsøk med trening for barn og ungdom mellom 6-18 år med depresjon. To forfattere uavhengig leste gjennom artiklene, trakk ut data og kvalitetsvurderte de inkluderte studiene med Cochrane Risk of Bias verktøyet. Kvaliteten på dokumentasjonen ble vurdert med GRADE.

### **Resultater**

Av 11007 treff ble 4 studier inkludert ( $n=143$ ). Meta-analyse ble utført med en random-effects modell på utfallet depresjon etter intervensjonen og fant en moderat effekt i favør av trening hos ungdom (SMD= -0.59, 95% CI= -1.11, to -0.07). Studiene hadde få deltakere, og ble vurdert at de hadde uklar eller høy risiko for skjevheter. Kvalitet på dokumentasjonen ble gradert som lav. Ingen av studiene rapporterte om det hadde vært noen uønskede hendelser.



## **Konklusjon**

Trening synes å være en lovende behandling for barn og ungdom med depresjon. Imidlertid behøves større studier med bedre kvalitet og lengre oppfølgingstid.

## **Nøkkelord**

Depresjon (MeSH), Depressiv forstyrrelse (MeSH), Ungdom (MeSH), Barn (MeSH), Trening (MeSH), Systematisk oversikt, publikasjonstype (MeSH), Metaanalyse, publikasjonstype (MeSH)

# Table of contents

<b>INTRODUCTION AND BACKGROUND .....</b>	<b>1</b>
BACKGROUND .....	1
PREVIOUS RESEARCH .....	3
<b>OBJECTIVES AND RESEARCH QUESTION .....</b>	<b>4</b>
<b>METHODS.....</b>	<b>4</b>
ETHICAL CONSIDERATIONS.....	5
PRELIMINARY SEARCHES.....	5
PROTOCOL .....	5
SELECTION CRITERIA .....	6
<i>Participants</i> .....	7
<i>Interventions</i> .....	8
<i>Comparisons</i> .....	9
<i>Outcomes</i> .....	9
<i>Types of studies</i> .....	11
<i>Language, publication year and publication status</i> .....	11
SEARCH METHODS FOR IDENTIFICATION OF STUDIES.....	11
STUDY SELECTION .....	15
DATA EXTRACTION .....	16
RISK OF BIAS ASSESSMENTS IN INCLUDED STUDIES .....	18
DATA ANALYSIS .....	20
SUBGROUP ANALYSIS AND INVESTIGATION OF HETEROGENEITY .....	21
SENSITIVITY ANALYSIS .....	21
ASSESSMENT OF PUBLICATION BIAS .....	21
CERTAINTY OF THE EVIDENCE (GRADE) .....	22
<b>RESULTS .....</b>	<b>23</b>
INCLUDED STUDIES.....	25
RISK OF BIAS IN THE INCLUDED STUDIES .....	28
EFFECTS OF INTERVENTIONS.....	30
<i>Meta-analysis results</i> .....	30
<i>Depression (post-intervention)</i> .....	30
<i>Depression (follow-up)</i> .....	31
<i>Quality of Life</i> .....	31

CERTAINTY OF THE EVIDENCE (GRADE).....	32
<i>Depression, post-intervention</i> .....	32
<i>Depression at follow-up (six months)</i> .....	32
<b>DISCUSSION .....</b>	<b>33</b>
SUMMARY OF MAIN RESULTS .....	34
THE STRENGTHS AND LIMITATIONS OF THE INCLUDED STUDIES .....	34
<i>Sample sizes</i> .....	34
<i>Participants</i> .....	34
<i>Exercise interventions</i> .....	35
<i>Comparisons</i> .....	36
<i>Outcomes</i> .....	36
<i>Reporting of the studies</i> .....	37
METHODOLOGICAL STRENGTHS AND LIMITATIONS OF THIS SYSTEMATIC REVIEW .....	38
<i>Preliminary searches</i> .....	38
<i>The protocol</i> .....	38
<i>Selection criteria</i> .....	39
<i>The Literature searches</i> .....	40
<i>Study selection</i> .....	41
<i>Risk of bias assessment</i> .....	42
<i>Data extraction</i> .....	42
<i>Assessment of reporting bias</i> .....	43
<i>Data analysis</i> .....	43
<i>Certainty of the evidence (GRADE)</i> .....	43
COMPARISON WITH OTHER SYSTEMATIC REVIEWS .....	44
IMPLICATIONS FOR FUTURE RESEARCH .....	44
IMPLICATIONS FOR PRACTICE .....	44
CONFLICT OF INTEREST / DECLARATIONS OF INTEREST.....	44
<b>REFERENCES .....</b>	<b>45</b>

## List of tables, figures, appendices and supplementaries

### Introduction

Table 1	PICOS
Table 2	Description of the MEDLINE (Ovid) search strategy
Table 3	TIDieR checklist
Table 4	GRADE criteria for assessing certainty of evidence
Table 5	Characteristics of included trials
Table 6	Summary of findings table
Figure 1	PRISMA Flow Diagram
Figure 2 and 3	Risk of bias graph
Figure 4	Forest plot of comparison: exercise versus control, post-intervention, outcome: reduction in depression
Figure 5	Forest plot of comparison exercise versus control, follow-up, outcome: reduction in depression
Figure 6	Forest plot of comparison exercise versus control, post-intervention outcome: quality of life
Appendix I	PRESS 2015 Guideline Evidence-Based Checklist
Appendix II	Study protocol in PROSPERO
Appendix III	TIDieR tables
Appendix IV	List of ongoing trials
Appendix V	List of excluded trials with primary reason of exclusion
Appendix VI	Risk of bias assessments

### Article manuscript

Figure 1	PRISMA flow diagram
Figures 2 and 3	Risk of Bias graph
Figure 4	Forest Plot of comparison: exercise versus control, outcome: reduction in depression symptoms post-treatment
Table 1	Characteristics of included studies
Table 2	Summary of findings table
Supplementary S1	PRISMA checklist
Supplementary S2	Complete search strategies
Supplementary S3	Detailed characteristics of included studies

## Introduction and background

This master's thesis is a systematic review of the effects of exercise interventions in children and adolescents with depression.

The thesis has an introduction and a journal article manuscript. In the introduction, we describe in detail the methods we used for conducting the systematic review. Additionally, we discuss the weaknesses and strengths of our methods. We plan to publish the article in a peer-review academic journal.

### **Background**

Depression is one of the most common psychiatric disorders in children and adolescents. (Dunn & Weintraub, 2008; Pan & Brent, 2018). It is characterized by persistent sadness, a loss of interest in and ability to carry out daily activities, fatigue or loss of energy, sleep problems and impairment of functioning (Bonin & Moreland, 2019; World Health Organization, 2017). Depression is highly comorbid with other diseases, both mental disorders such as anxiety, and somatic disorders (Pan & Brent, 2018).

Depression is a chronic and recurrent illness (Pan & Brent, 2018). Childhood depression can lead to social problems, problems in schools, functional impairment, and increases the risk of suicide and substance abuse (Pan & Brent, 2018). Depression in childhood or adolescence often persists into adulthood (Dunn & Weintraub, 2008).

Worldwide, depression is the leading cause of years lost due to disability (YLDs) in females aged 15-24 years, and the third leading cause in males (Mokdad et al., 2016). Prevalence rates are estimated in a meta-analysis of 26 epidemiological studies to be 5.6% among adolescents 13-18 years old, and 2.8% among children under 13 years (Costello, Erkanli, & Angold, 2006). Other studies find higher prevalence rates. In the USA, the 2017 National Survey on Drug Use and Health estimate the past year prevalence of major depressive episode among adolescents to be 13.3% (National Institute of Mental Health, 2019). In a cross-national survey in Norway among adolescents aged 13-16 years, the prevalence of boys with high levels of depressive symptoms was 5.8 % and among girls as high as 17.1 % (Abebe, Froyland, Bakken, & von Soest, 2016). Depression is more common in children with a chronic medical illness (Pinquart & Shen, 2011).

The clinical guideline on depression in children and adolescents from the National Institute for Health and Care Excellence (NICE) recommends psychological therapies for mild depression, supplemented with antidepressant medications for moderate and severe depression (2005). Even though psychological therapies are recommended, many patients do not have access to it. There can be long waiting lists, and those who have mild depression are often not prioritized in the health care system. There can also be practical problems, patients can live remotely and far from qualified therapists, and in some countries, there are patients who are not able to pay for treatment. Also, not all patients want therapy, due to stigma and prejudice (Mohr et al., 2010). Antidepressant medications can have adverse effects, and many patients do not want to take them (Pan & Brent, 2018). Both of these treatments unfortunately have modest effects and high rates of relapse (Cipriani et al., 2016; Cox et al., 2014; Cox et al., 2012; Hetrick, McKenzie, Cox, Simmons, & Merry, 2012; Weisz et al., 2017).

Exploring alternative or adjunct treatments, to be used either instead of, or in addition to established treatments, or while waiting for help, is essential. Exercise is one such treatment option. Exercise is recommended as a health-promoting strategy to supplement the standard treatment of depression in children and adolescents in the NICE guideline (NICE, 2005). Many people experience improved mood while and after exercise (American College of Sports Medicine, 2014, p. 255). Exercise is accessible and feasible and has several health benefits (American College of Sports Medicine, 2017, pp. 8-10; Carter, Morres, Repper, & Callaghan, 2016; Dopp, Mooney, Armitage, & King, 2012; Peterson, 2017).

It has been suggested that the physiological changes in the body during and after exercise such as changes in the monoamine systems, and  $\beta$ -endorphin levels, may have an impact on depression and mood (American College of Sports Medicine, 2014, p. 255).

The social aspects of group-based exercise may also have a positive effect on depression. People with depression often isolate themselves, and an intervention that helps them to socialize with peers, and perhaps make new friends may improve their mood (Lam & Riba, 2016, p. 31).

Other aspects of exercise that may influence depression include improved self-esteem and self-efficacy, and exercise can be a diversion from negative thoughts (Biddle & Asare, 2011; Cooney et al., 2013; Lam & Riba, 2016, p. 31). Sleep problems are common in people with depression, and many people find that they sleep better after exercise (Lam & Riba, 2016, p. 31).

## Previous research

Observational studies show that those who participate in exercise have a lower prevalence of depression (Dale, Vanderloo, Moore, & Faulkner, In press). However, people with depression are much less likely to exercise since depression leads to low energy levels, and less interest and ability to participate in daily activities, including exercise (World Health Organization, 2017). Observational studies are therefore unable to conclude about the effect of exercise in this population.

In the last few years, four systematic reviews have been published that cover the effect of exercise or physical activity on depression or depressive symptoms in children, adolescents and young people (Bailey, Hetrick, Rosenbaum, Purcell, & Parker, 2017; H. E. Brown, Pearson, Braithwaite, Brown, & Biddle, 2013; Carter, Morres, Meade, & Callaghan, 2016; Radovic, Gordon, & Melvin, 2017). These four systematic reviews excluded non-English language studies, and studies not published in peer-reviewed journals.

In their systematic review, H. E. Brown et al. (2013) included nine studies and found a small overall effect for physical activity on depression. They, however, included and combined studies on both clinical and non-clinical populations, i.e., participants with and without a diagnosis of depression. The synthesis of results was for this reason based on studies both on treatment as well as on prevention. Furthermore, several of the included studies were non-randomised controlled trials. The participants in the intervention and control groups could, therefore, be different regarding, e.g., the motivation for exercise or severity of depression.

Radovic et al. (2017) included eight studies and found a moderate effect of exercise on the reduction of depressive symptoms. This systematic review also included studies where the participants were not randomized. Contradictory to their stated inclusion criteria, they included at least two studies where the participants were not diagnosed with depression, again mixing treatment and prevention studies (S. W. Brown, Welsh, Labbe, Vitulli, & Kulkarni, 1992; Hilyer et al., 1982). Also, the participants in one of the included studies were adolescents diagnosed with chronic fatigue syndrome (Gordon, Knapman, & Lubitz, 2010).

Carter, Morres, Meade, et al. (2016) performed a sensitivity analysis of a clinical sample in their systematic review and found a moderate effect of exercise for depression in adolescents. However, one of the included studies compared one type of exercise to another type of

exercise. Also, in one study the intervention was dance movement therapy, a type of psychotherapy, not exercise.

Bailey et al. (2017) included five trials on adolescents under 18 years old, both with and without depression, in their systematic review and found a moderate effect of physical activity on depression. Similar to Carter, Morres, Meade, et al. (2016) they included a study comparing exercise to another type of exercise, and a study where the intervention was dance movement therapy.

In this systematic review, we wanted to investigate the effect of exercise on children and adolescents with depression and not on the general population. We included trials where the intervention was exercise, and the control groups received a non-exercise treatment or no treatment. We wanted to include a wider range of important outcomes than the earlier reviews. Additionally, we included trials in all languages, all publication types and non-published trials to reduce the risk of biased results.

## Objectives and research question

The objective of this systematic review is to summarize studies on the effects of exercise interventions as treatment of depression in children and adolescents compared to other treatments or no treatment. The research question is: “*What are the effects of exercise interventions in children and adolescents with depression?*”.

## Methods

A systematic review attempts to summarize all empirical evidence that fits pre-specified eligibility criteria. It involves an explicit, reproducible methodology, a systematic search to attempt to identify all relevant studies, an assessment of the risk of bias of the included studies and a systematic synthesis and presentation of the findings (Green et al., 2011, chapter 1.2.2).

In this review, we followed the Cochrane Collaboration methodology for conducting systematic reviews (Higgins & Green, 2011). We have also followed the PRISMA guidelines for the reporting (see Appendix I) (Moher, Liberati, Tetzlaff, & Altman, 2009). Additionally, we have written the article and the introduction according to the structure of IMRAD



(International Committee of Medical Journal Editors, 2010), and the author guideline for PLOS One, the journal we are planning to submit the article. Our methods are described and discussed in this section.

## **Ethical considerations**

This project does not require ethical approval from the Regional Committees for Medical and Health Research Ethics (REC) since this is not research on humans, human biological material or personal health information (REK (Regional Committees for Medical and Health Research Ethics), 2012).

## **Preliminary searches**

Before starting the work on this systematic review, we searched for other reviews on the subject. It is important to identify existing or ongoing reviews on the same subject to avoid unnecessary duplication, and waste time and resources (Moher, 2013).

We did a scoping search in various databases that index systematic reviews, Epistemonikos, MEDLINE, PsycINFO. We also checked PROSPERO to see if any other reviews on this subject were ongoing.

We identified reviews that partially overlap the subject of this systematic review. Details about these reviews are covered above in the section “Previous research”.

## **Protocol**

The next step was to develop a protocol for our systematic review. It is important to have a detailed protocol that describes the aim of the review and a plan for the methods, e.g., inclusion and exclusion criteria, a plan for the literature search, data selection, quality assessment, and data extraction and analysis (Moher et al., 2015). A carefully planned protocol promotes explicit and transparent decisions. It is also important to have clear criteria to ensure consistency and avoid problems while deciding to include or exclude studies and during the data extraction and analysis process. The review team can avoid having to make ad

hoc decisions because they have (hopefully) anticipated possible problems in advance (Moher et al., 2015).

We registered the protocol in PROSPERO, an international prospective register for systematic review protocols, CRD42018101982 (Centre for Reviews and Dissemination, 2017). It is important to prospectively register review protocols to avoid unplanned duplication of work since other research teams can see that there is already a review ongoing when planning a new review. Registration can also lead to less reporting bias and ad hoc changes during the review process since journals, and peer reviewers have access to the original protocol (PROSPERO, 2019). (See study protocol in Appendix II).

## Selection criteria

Deciding eligibility criteria is an essential part of the systematic review process. Inclusion and exclusion criteria must be described clearly and detailed (O'Connor, Green, & Higgins, 2011, chapter 5.1.2). When defining the inclusion and exclusion criteria, The Cochrane Handbook recommends using the PICOS framework for specifying the population, intervention, control, outcome, and study design (O'Connor et al., 2011, chapter 5.1.1). See Table 1 for PICOS for this systematic review. More details and rationale behind these decisions will be described in the next section.

**Table 1. PICOS**

<b>P</b> (Participants)	Children and adolescents (6-18 years) with depression
<b>I</b> (Intervention)	Exercise interventions, e.g., running, circuit training or weight lifting
<b>C</b> (Comparison)	Other treatments: Psychological therapies, pharmacological treatments, alone or in combination, treatment as usual or other alternative treatments. No treatment: Waiting list or a non-intervention group
<b>O</b> (Outcome)	Primary outcomes: Depression. Adverse events Secondary outcomes: Psychological well-being. Social functioning. Quality of life
<b>S</b> (Study design)	Randomized controlled trials

## ***Participants***

### **Age**

Previous systematic reviews on the same subject have different inclusion criteria for age. The Cochrane Review by Larun, Nordheim, Ekeland, Hagen, and Heian (2006) included children and young people from 0 up to 20 years. Carter (2016) included adolescents aged 13 to 17 years, while Bailey (2017) included adolescents and young people 12-25 years. Radovic (2017) chose participants between 12 and 18 years old, while Brown (2013) included children and adolescents between 5 and 19 years.

After consulting with experts on depression in children we decided to set 6 years old as our lowest age limit. This is the lowest age children are diagnosed for depression, and several of the measurement tools are validated for children six or seven years and older (APA, 2013).

We decided to set our upper age limit at 18 years old for two reasons. First, there already exists a Cochrane review (Cooney et al., 2013) that covers adults aged 18 and above. Second, life for many young people change around that age and they meet new challenges and opportunities. Many start university or college, or start working, and move away from their parents and family and have to create their own lives.

### **Diagnosis**

In this systematic review, we decided only to include studies where the participants had depression. There are different ways of diagnosing depression, either using the criteria in the international diagnostic classification systems DSM (the most recent version is DSM-5 (APA, 2013)) or ICD (current version is ICD-10 (World Health Organization, 2011)), or screening using various measurement tools.

Since we expected that the included studies would have used different diagnostic methods, we decided to use the same criterion as the Cochrane review on adults (Cooney et al., 2013). Studies were thus included if the author defined the trial participants as having depression (by any method of diagnosis and with any severity of depression).

Some of the previous reviews mentioned above have included and pooled both studies where all the participants had depression, and studies on general populations (e.g., whole school classes). We wanted to explore the effect of exercise on children and adolescents with

depression, and therefore excluded studies on general populations unless they reported effect sizes for participants with depression separately.

We excluded trials that include children and adolescents with psychotic or borderline conditions, autism, physical handicaps, eating disorders and/or chronic or serious somatic diseases. Exercise interventions for these populations require individual adjustments due to health risks or limitations.

### ***Interventions***

Physical activity and exercise are terms that are often used interchangeably. The American College of Sports Medicine defines physical activity as “any bodily movement produced by the contraction of skeletal muscles that results in a substantial increase in caloric requirements over resting expenditure” (American College of Sports Medicine, 2017, p. 1). Exercise is a type of physical activity, defined as “planned, structured and repetitive bodily movement done to improve and/or maintain one or more components of physical fitness” (American College of Sports Medicine, 2017). Components of physical fitness are health related such as, e.g., cardiorespiratory endurance, muscular strength, and endurance and flexibility, or skill-related such as, e.g., agility, balance, and speed (American College of Sports Medicine, 2017, p. 2). Exercise contains purpose and intention. These definitions are based on the work of Caspersen, Powell, and Christenson (1985).

In this systematic review, we only included trials on exercise, not all physical activity. We used the definition of the American College of Sports Medicine mentioned above (2017). This is a very commonly used definition and is the same criteria used by the Cochrane review on exercise for depression in adults (Cooney et al., 2013), and the Cochrane review on exercise for chronic fatigue syndrome (Larun, Brurberg, Odgaard-Jensen, & Price, 2017). Within this definition falls both aerobic, anaerobic, resistance, flexibility, and mixed fitness training exercise. Types of exercise that are often low intensity, e.g., yoga and tai chi, may also be included in this definition. Trials on dance movement therapy were excluded since it is a type of psychotherapy and different from exercise in its purpose and goal. It is also the subject of a separate Cochrane review (Meekums, Karkou, & Nelson, 2015).

Trials that measured outcomes immediately before and after a single exercise session and trials which provided less than a week of exercise were excluded. This criterion is similar to Cooney et al. (2013). A single session of exercise is unlikely to have any long-lasting effects

on the body. Depression scores after just one session have no practical significance and are probably not indicative of the real effects of exercise.

Exercise is a low-cost intervention that requires minimal equipment and can be done at the community level, requiring only minimal cultural adaptation. We considered it to be an intervention that has approximately the same effect irrespective of the cultural or socioeconomic background of the participants, or developmental level of the country where the intervention takes place. We included all settings since exercise can probably be executed in similar ways irrespective of setting, whether it is in schools, primary care settings, or hospitals.

### ***Comparisons***

We only included studies that compared an exercise intervention to a non-exercise intervention or no intervention. We decided to exclude trials that compared either two types of exercise or intensities of exercise because those trials explore which type of exercise is most effective, not whether exercise is effective.

### ***Outcomes***

We chose a wider range of outcomes than the previous reviews on this subject, which mainly looked at the outcome of depression. We also wanted to investigate other outcomes that are important and relevant to patients, and not only to researchers or clinicians.

Core outcome sets (COS) are an agreed standardized set of outcomes that are important to patients, carers and health personnel. COSes are developed in a consensus process where these stakeholders participate (Williamson et al., 2017). There are currently two ongoing projects that work on producing a core outcome set (COS) for depression in children and/or adolescents for depression (Comet Initiative, 2019a, 2019b). There is a core outcome set for depression and anxiety in adults (including adolescents above the age of 14 years) (Obbarius et al., 2017). The working group behind this COS agreed on four general treatment outcomes: Symptom burden, functioning, disease progression and treatment sustainability, and potential side effects of treatment. We chose outcomes based on these recommendations. These are also the same outcomes as in the Cochrane review on exercise for depression in adults (Cooney et al., 2013).

## **Primary outcomes**

Depression: The primary outcome was a measure of depression, either as a continuous measure or as a dichotomous outcome. Depression could be measured by self-report, health personnel report, parent report and/or teacher report with a standardized procedure. A variety of assessment tools are used to measure depression in children and adolescents. Examples of validated and commonly used tools are Beck Depression Inventory (BDI) (Stockings et al., 2015) and Children's Depression Inventory (CDI) (Kovacs, 1992).

Adverse events reported in any way (e.g., using reporting systems such as Serious adverse reactions (SARs) (European Union Clinical Trials Directive 2001)) was also considered a primary outcome since it is important to investigate whether exercise can harm this population. When choosing an intervention in clinical practice, one must balance benefits and harms (Reeves, Deeks, Higgins, & Wells, 2011, chapter 13.2.1.2 ). Adverse events in exercise interventions can include musculoskeletal injury, musculoskeletal pain or fatigue, and in rare cases cardiac events or death (American College of Sports Medicine, 2017, pp. 10-16; Peterson).

## **Secondary outcomes**

Psychological well-being measured using any validated scale (e.g., KIDSCREEN (Ravens-Sieberer et al., 2014) and Child Health Questionnaire (CHQ) (Hullmann, Ryan, Ramsey, Chaney, & Mullins, 2011)).

Social functioning measured using any validated scale (e.g., Child and Adolescents Social and Adaptive Functioning Scale (CASAFS) (Price, Spence, Sheffield, & Donovan, 2002)).

Quality of life (QOL): measured using any validated scale (e.g., The Pediatric Quality of Life Inventory (PedsQL) (Varni, Sherman, Burwinkle, Dickinson, & Dixon, 2004)).

Acceptability measured as dropouts. This is an important outcome because it does not matter if an intervention is effective, if the participants do not want to, or are able to participate.

## **Timing of outcome assessment**

We included data from both the end of treatment and if available, any follow-up. Long-term effects are important to investigate (Obbarius et al., 2017).

### ***Types of studies***

We only included randomized controlled trials (RCTs). The research question in this systematic review is about the effects of an intervention, and RCTs are the best study design for answering effects questions. Randomization minimizes the risk of systematic baseline differences between the intervention and control groups (O'Connor et al., 2011).

### ***Language, publication year and publication status***

Trials published in any language were included. Systematic reviews that are based on only English-language trials can miss trials, and therefore be biased. Some research indicates that negative results are more often published in local, non-English journals, while positive results are more frequently published in international, English-language journals (Sterne, Egger, & Moher, 2011). No limitations on publication year were applied since neither the intervention (exercise) nor the definition of depression has changed considerably. This also makes older studies interesting, and fairly similar to current studies. We applied no limitations on publication status either. In addition to journal articles, we wanted to include grey literature such as dissertations, theses, and reports, as well as unpublished trials. By doing this, we hoped to find a more complete picture of the research, in contrast to the previous systematic reviews on the same topic that only included articles in peer-reviewed journals (O'Connor et al., 2011). Searching for and including grey literature decreases the risk of publication bias in systematic reviews. Trials that have not been published might have negative results (Sterne et al., 2011).

### **Search methods for identification of studies**

Systematic reviews require an exhaustive, unbiased and reproducible literature search in a range of sources to identify as many relevant studies as possible (Lefebvre, Manheimer, & Glanville, 2011, chapter 6.1.1.2). In systematic reviews, the literature search is a key component. The quality and scope of the literature search is an important factor in the quality of the systematic review. A comprehensive search minimizes the risk of bias in the systematic review (Lefebvre et al., 2011). It is necessary to identify all of the evidence before we can synthesize and assess it (Levay & Craven, 2019, p. 2). Finding all trials, however, is often

only theoretically possible. The goal should be to find as many relevant studies as possible within the resource limits (Lefebvre et al., 2011). These limits can be time, both for doing the literature searches and study selection, access to databases, the functionality of the databases and how they are indexed, and knowledge and skills of the person who do the searches (Levay & Craven, 2019, p. 52).

Cochrane recommends having an experienced information specialist doing the literature searches for systematic reviews (Lefebvre et al., 2011). Both authors are librarians, so we performed the searches ourselves.

The first step in a literature search process for a systematic review consists of deciding where and how to search for evidence (Levay & Craven, 2019, p. 53). Choosing where to search depends on the research question, how much time is available, and which databases we have access to (Levay & Craven, 2019, pp. 74-77). Our research question is multidisciplinary, and of interest to several different research fields. We, therefore, decided to search a wide range of bibliographic databases within medicine, psychology, healthcare and sports science. We decided which databases to search based on advice in the Cochrane handbook, the Campbell Methods guide and previous systematic reviews on this subject (Kugley et al., 2017; Lefebvre et al., 2011). In this project, we had access to all the major bibliographic databases we needed, either through Høgskulen på Vestlandet or through our place of work.

We expected that trials could be published not only as journal articles, but also as dissertations and theses, reports and other grey publications, and therefore included databases that index those publication types in our search. Trials registers were also searched because they can be important sources of unpublished and ongoing trials since many journals and research funders require pre-registration of trials (Dwan, Gamble, Williamson, & Altman, 2008).

When designing a search strategy, the first step is to translate the research question into searchable concepts (Levay & Craven, 2019, p. 59). The PICOS for the research question is a helpful guide when deciding these concepts. Each part of the PICOS may be one concept or be split into two or more concepts. It is not necessary to include every part of the PICOS in the search strategy. Abstracts and titles might have limited details, making it difficult to find all potential trials if one uses too many concepts in a search strategy. In systematic reviews on the effects of an intervention, it is often recommended to use only P, I and S (Lefebvre et al., 2011).



In our PICOS, the P (population) could be split into two different concepts, “children and adolescents” and “depression”. For each of these concepts, we found search terms (both index terms and text words), and combined them with the boolean operator OR. The I (intervention), exercise, is one concept. We found a wide range of search terms for exercise and combined them with OR. The C (comparison) is all non-exercise interventions or no intervention. Since the search terms for these interventions can be unlimited, we decided not to include this concept in the literature search since we did not want to miss any relevant trials. The O (outcome) was also excluded from the literature search since, according to our experience, outcomes are often poorly reported or reported in many different ways in the titles or abstracts of studies on mental health. In this research field, it is often implied, but not explicitly, that the outcome is symptom severity, measured using one of the numerous different measuring tools.

The S (study design) is randomized controlled trials. We applied a search filter with search terms for randomized controlled trials in databases where the number of references would have been unmanageable without adding such a filter. We used validated RCT filters in the databases where available (The InterTASC Information Specialists' Sub-Group Search Filter Resource, 2017).

Finally, we combined all included search concepts (“children and adolescents”, “depression”, “exercise” and “randomized controlled trials”) using the boolean operator AND since we wanted to find references where all of these concepts were present.

When searching for a systematic review, it is recommended to search with both index terms and text terms to get a comprehensive search that finds as many studies as possible that fits the eligibility criteria (Lefebvre et al., 2011). Finding search terms for the different concepts in the search strategy can be time-consuming. The goal is to find all, or at least as many as possible, terms that are used in articles that fulfill the inclusion criteria (Lefebvre et al., 2011). On the other hand, a very sensitive literature search can lead to an unmanageable number of references, most of them not relevant, that is not possible to handle within the resources of the review team (Lefebvre et al., 2011, chapter 6.1.1.2).

We started by designing the search strategy for the MEDLINE (Ovid) database. We looked for index terms (MeSH-terms) and text words for every concept of the P and I. To find MeSH-terms we searched the MEDLINE-thesaurus for different synonyms for and types of exercise. We also looked at the search strategies for the previous systematic reviews on this

subject and other reviews (especially Cochrane-reviews) where the intervention was exercise. To find text words, we also looked at other reviews. In addition, we browsed the reference lists of these reviews, and primary studies we knew. We also used general thesauri and Google-searches. We found validated search filters for children and adolescents and used terms from them in addition to the ones we found via other sources (The InterTASC Information Specialists' Sub-Group Search Filter Resource).

We discovered that there is a rich terminology in this field, and the author of trials have used many different terms in their titles and abstracts. We, therefore, used a wide range of search terms to minimize the risk of missing relevant trials. We truncated many of the text words to ensure that we would find all versions of the words. We combined the search terms in accordance with the search functionalities in Ovid.

For the S (study design) we used the Cochrane Highly Sensitive Search Strategy for identifying randomized trials in MEDLINE: sensitivity-maximizing version (Lefebvre et al., 2011). See Table 2. for a description of the search strategy.

Table 2. Description of the MEDLINE (Ovid) search strategy

<b>Topic</b>	<b>Search line</b>
<b>Participants (P)</b>	
Condition (depression) (MeSH)	1-2
Condition (depression) in title and abstract	3-4
Combined	5
Children and adolescents (MeSH)	6
Children and adolescents (6-18 years) in title and abstracts	7-8
Combined	9
<b>Intervention (I)</b>	
Exercise (MeSH)	10
Exercise (all kinds) in title and abstract	11
Combined	12
Condition + Children and adolescents + Exercise	13
<b>Study design (S)</b>	
Methodological search filter for RCTs (randomized controlled trials)	14-24
<b>P + I + S</b>	25

After designing the MEDLINE (Ovid) search strategy, we checked it several times to detect any mistakes or omissions. Small details are important in literature searches. One example is from one of the search strategies where we detected a missing end parenthesis. When it was added, the number of hits decreased from 1488 to 773. Two experienced medical librarians peer-reviewed the MEDLINE (Ovid) search strategy using the PRESS checklist (McGowan, Sampson, Cogo, Foerster, & Lefebvre, 2016). When we were satisfied with the MEDLINE (Ovid) search strategy, the strategy was translated to the other databases. Each database has slightly different ways of searching, different index terms (or no index terms) and their quirks.

## **Study selection**

References from the electronic searches were exported to an EndNote library (Clarivate Analytics, 2017). Duplicates were removed with a de-duplication method (Bramer, Giustini, de Jonge, Holland, & Bekhuis, 2016), and the remaining references were exported to Covidence (Veritas Health Innovation, 2019). More duplicates were removed in the duplicate removal process in Covidence.

The two authors independently screened all articles for eligibility, as recommended by the Cochrane Handbook (Higgins & Deeks, 2011). Title and abstracts were screened. All references that one or both of us had selected “include” on was ordered in full text, and the PDFs were imported into Covidence. We then screened the full texts independently. There were a few conflicts after the full-text screening, that was resolved by consulting a third reviewer. The web-based tool Covidence was used to screen articles at the title/abstract-level and full text (Veritas Health Innovation, 2019). Several different tools have been developed to help with the screening process in systematic reviews. We chose Covidence because our place of work has a subscription, we have considerable experience in using it from previous projects, and we find Covidence to be user-friendly.

A few studies in German and Persian appeared to be eligible for inclusion based on the English language title and abstract. We were helped by two native speakers (both are experienced researchers) who read the full text, and we decided that none of these articles were eligible for inclusion.

A PRISMA flowchart was created for the visualization of the study selection process (Moher et al., 2009).

## Data extraction

We made a data extraction form based on the recommendations in the Cochrane Handbook (Higgins & Green, 2011, chapter 7.3). We extracted the following data from the included studies:

- Methods: study design
- Participants: number (randomized and analyzed), drop-outs, age, gender, recruitment, baseline severity of depression, inclusion and exclusion criteria, location.
- Interventions: type of exercise, intensity, intervention provider, modes of delivery, duration of the trial, frequency, number of sessions, duration of each session, setting, control intervention(s).
- Outcomes: primary and secondary outcomes, measurement tools and timing of measurement
- Notes: publication type, funding, conflicts of interest, trial registration, intention to treat analysis, sample size calculation

The data extraction form was pilot tested using one of the included studies (Higgins & Deeks, 2011, chapter 7.6.3). We then independently completed the data extraction from the other trials.

For descriptions of the interventions in the included trials, we used the Template for Intervention Description and Replication (TIDieR) checklist and guide (Hoffmann et al., 2014). TIDieR was developed to improve the completeness of reporting of interventions. We used TIDier to ensure that we extracted the recommended items for describing an intervention. See the TIDieR checklist below in Table 3, and the TIDieR tables in Appendix III.

Table 3. TIDieR checklist



The TIDieR (Template for Intervention Description and Replication) Checklist\*:

Information to include when describing an intervention and the location of the information

Item number	Item	Where located **	
		Primary paper (page or appendix number)	Other † (details)
1.	<b>BRIEF NAME</b> Provide the name or a phrase that describes the intervention.	_____	_____
2.	<b>WHY</b> Describe any rationale, theory, or goal of the elements essential to the intervention.	_____	_____
3.	<b>WHAT</b> Materials: Describe any physical or informational materials used in the intervention, including those provided to participants or used in intervention delivery or in training of intervention providers. Provide information on where the materials can be accessed (e.g. online appendix, URL).	_____	_____
4.	Procedures: Describe each of the procedures, activities, and/or processes used in the intervention, including any enabling or support activities.	_____	_____
5.	<b>WHO PROVIDED</b> For each category of intervention provider (e.g. psychologist, nursing assistant), describe their expertise, background and any specific training given.	_____	_____
6.	<b>HOW</b> Describe the modes of delivery (e.g. face-to-face or by some other mechanism, such as internet or telephone) of the intervention and whether it was provided individually or in a group.	_____	_____
7.	<b>WHERE</b> Describe the type(s) of location(s) where the intervention occurred, including any necessary infrastructure or relevant features.	_____	_____

TIDieR checklist

8.	<b>WHEN and HOW MUCH</b> Describe the number of times the intervention was delivered and over what period of time including the number of sessions, their schedule, and their duration, intensity or dose.	_____	_____
9.	<b>TAILORING</b> If the intervention was planned to be personalised, titrated or adapted, then describe what, why, when, and how.	_____	_____
10.*	<b>MODIFICATIONS</b> If the intervention was modified during the course of the study, describe the changes (what, why, when, and how).	_____	_____
11.	<b>HOW WELL</b> Planned: If intervention adherence or fidelity was assessed, describe how and by whom, and if any strategies were used to maintain or improve fidelity, describe them.	_____	_____
12.*	Actual: If intervention adherence or fidelity was assessed, describe the extent to which the intervention was delivered as planned.	_____	_____

\*\* **Authors** - use N/A if an item is not applicable for the intervention being described. **Reviewers** – use ‘?’ if information about the element is not reported/not sufficiently reported.

† If the information is not provided in the primary paper, give details of where this information is available. This may include locations such as a published protocol or other published papers (provide citation details) or a website (provide the URL).

‡ If completing the TIDieR checklist for a protocol, these items are not relevant to the protocol and cannot be described until the study is complete.

\* We strongly recommend using this checklist in conjunction with the TIDieR guide (see *BMJ* 2014;348:g1687) which contains an explanation and elaboration for each item.

\* The focus of TIDieR is on reporting details of the intervention elements (and where relevant, comparison elements) of a study. Other elements and methodological features of studies are covered by other reporting statements and checklists and have not been duplicated as part of the TIDieR checklist. When a **randomised trial** is being reported, the TIDieR checklist should be used in conjunction with the CONSORT statement (see [www.consort-statement.org](http://www.consort-statement.org)) as an extension of **Item 5 of the CONSORT 2010 Statement**. When a **clinical trial protocol** is being reported, the TIDieR checklist should be used in conjunction with the SPIRIT statement as an extension of **Item 11 of the SPIRIT 2013 Statement** (see [www.spirit-statement.org](http://www.spirit-statement.org)). For alternate study designs, TIDieR can be used in conjunction with the appropriate checklist for that study design (see [www.equator-network.org](http://www.equator-network.org)).

TIDieR checklist

Hoffmann, T. C., Glasziou, P. P., Boutron, I., Milne, R., Perera, R., Moher, D., . . . Michie, S. (2014). Better reporting of interventions: template for intervention description and replication (TIDieR) checklist and guide. *BMJ*, 348, g1687. doi:10.1136/

We planned to contact the authors of the included trials in the case of missing data (Moher et al., 2009). However, no data were missing for completing the analyses and the data extractions.

### **Risk of Bias assessments in included studies**

Despite the highest methodological standards when conducting a trial, it still may have biases. Bias is a systematic error that can threaten the true effect of an intervention and can raise questions about the internal validity of the trial. Evaluating the validity of the included trials with a risk of bias tool is an important factor when conducting a systematic review and should be taken into consideration in the analysis and the conclusions of the review (Higgins, Altman, & Sterne, 2011, chapter 8.4).

Risk of bias assessments requires two persons to evaluate each trial independently, and because of subjectivity in each decision, they may come to a different conclusion. Discrepancies should be resolved by consensus or by consulting a third reviewer (Higgins & Deeks, 2011, chapter 7.6.5).

We independently assessed the quality of the included trials with the Cochrane Collaboration Risk of Bias Tool (Higgins et al., 2011), using the following criteria: Sequence generation, allocation concealment, blinding of participants and care providers, blinding of outcome assessors, incomplete outcome data, selective outcome reporting and other sources of bias. Each criterion was evaluated as either “high,” “unclear” or “low” risk of bias, and presented in a table and as a figure, according to the Cochrane Handbook (Higgins et al., 2011, figure 8.6.a and figure 8.6.c).

Sequence generation is a domain which addresses the process of random assignment of participants in either an intervention or a control group. Assignment, when it is done randomly and properly, secures that each participant has the same opportunity to be assigned to either an intervention or a control group. Random assignment increases the likelihood of similarity between the groups at the start of the trial. It also makes potentially confounding factors balanced between the groups and may reduce systematic errors. Random assignment can be achieved by using a published list of random numbers or to a list of random assignments generated by a computer (Higgins et al., 2011, chapter 8.9.2).

Allocation concealment is a domain which refers to the random assignment being concealed from the person recruiting participants, to prevent selective enrolment. There are different methods used to conceal allocation. A proper method is when the allocation is done by a third party and involves using sequentially numbered, opaque, sealed envelopes. It is essential that researchers make sure the envelopes are opened sequentially after the envelope has been assigned to the participant and cannot change the result of the assignment (Higgins et al., 2011, chapter 8.10.2).

Blinding of participants and personnel means that participants or personnel are unaware of group allocation. Blinding reduces the risk introduced when a participant or investigator know which intervention a participant received, which in turn may affect the outcomes. Blinding can be impossible in some interventions; such is the case in this review, where the intervention is exercise and both participants and personnel know if they have participated in an exercise group. However, other measures could be taken to reduce the risk of bias, for example, using a strict protocol to reduce the risk of differential behaviours by participants and personnel (Higgins et al., 2011, chapter 8.11.2).

Blinding of outcome assessors is a domain which refers to the person who assesses the outcome data being unaware of the intervention allocations. This is particularly important when the outcome is subjective, as with self-reported outcome measures (Higgins et al., 2011, chapter 8.12.1). It can affect the outcome assessment and bias the result of the trial. Outcome assessments may be made by the participants themselves, by their personnel or by independent assessors. Cochrane handbook recommends to group outcomes with similar risks of bias, instead of assessing the risk of bias for each outcome separately. For example, assessment of the risk of bias for all subjective outcomes separate from assessment of blinding for all objective outcomes (Higgins et al., 2011, chapter 8.12.2).

The domain of incomplete outcome data refers to outcome data being missed due to attrition (drop-out) or participants being excluded from analysis from different reasons. Incomplete outcome data can bias the effect estimate. The Cochrane handbook recommends an intention-to-treat (ITT) analysis as the least biased way to estimate intervention effects. The method includes analyzing the participants within the groups they were allocated to regardless of the intervention they received (Higgins et al., 2011, chapter 8.13.2).

Selective outcome reporting occurs when researchers select one type of data for an outcome, or they select which outcomes to report. If that selection is made based on the results, the

concern is that statistically non-significant results may be withheld from publication. If a study protocol is available, outcomes in the protocol should be compared to those in the published article. If not, the outcomes listed in the methods section of an article can be compared with those results reported. These methods can indicate whether selective reporting has occurred (Higgins et al., 2011, chapter 8.14.2).

Other sources of bias are a domain where other potential threats to validity in a trial are assessed, for example, design-specific risks of bias, sources of funding, or any other sources of bias that should be investigated. Finally, we assessed the overall bias for each included trial.

## **Data analysis**

A meta-analysis is a statistical method which summarizes the effectiveness of the experimental intervention compared with a control intervention (Deeks, Higgins, & Altman, 2011, chapter 9.4.1). The possible advantage of a meta-analysis is increased power and improved precision. Authors of systematic reviews should reflect on if it is appropriate to combine the results, from all or some of the included trials in a meta-analysis. Only when the trials are sufficiently homogeneous in terms of participants, interventions, and outcomes should they be combined statistically to provide a meaningful summary. If inappropriate to conduct a meta-analysis because of heterogeneity, a narrative synthesis is a proper method. (Deeks et al., 2011).

The trials were assessed as similar enough to be appropriate to synthesize the results of the outcome depression severity at post-intervention in a meta-analysis. We used the software RevMan to perform the meta-analysis and to create forest plots that visually present the effect estimates for each outcome (The Cochrane Collaboration, 2014). We started by identifying the data for the outcome measures from the included studies. Continuous outcomes were reported as standardized mean difference (SMD) since the outcomes were measured using different instruments across the included studies. We reported 95% confidence intervals and p-values (Deeks, Higgins, & Altman, 2011, chapter 9.2).

We interpreted the heterogeneity results of the  $I^2$  statistic according to the Cochrane Handbook: 0% to 40%: might not be important; 30% to 60%: may represent moderate heterogeneity; 50% to 90%: may represent substantial heterogeneity; 75% to 100%: considerable heterogeneity (Deeks et al., 2011, chapter 9.5.2). We expected that there would



be heterogeneity between the studies, e.g., different types and doses of exercise, or that the participants would be different at baseline and react differently to the intervention due to depression severity, gender or motivation to exercise. We used a random effects model since it is recommended over a fixed effects model when there is heterogeneity (Deeks et al., 2011, chapter 9.5.4).

### **Subgroup analysis and investigation of heterogeneity**

There is a risk of heterogeneity when different trials are pooled together in a systematic review (Deeks et al., 2011). We, therefore, planned to perform subgroup analyses for the variables: type and intensity of the exercise interventions. The advice for undertaking subgroup analyses is that at least ten studies are included in a meta-analysis. Not enough number of trials met our inclusion criteria, and we were, therefore, unable to investigate if the heterogeneity was affected by these variables.

### **Sensitivity analysis**

In the study protocol, we planned to perform sensitivity analyses for the primary outcomes by removing trials with high or unclear risk of bias. Methodological differences across the trials, such as concealment allocation, blinding of outcome assessor and the dropout rate was to be used to conduct the analyses. However, none of the included trials were assessed as having a low risk of bias, and therefore, we were unable to perform a sensitivity analysis.

### **Assessment of publication bias**

The reasons for assessing publication bias is the concern that statistically non-significant results may be selectively not published. This can lead to overestimating intervention effects and pose a threat to the validity of the review (Higgins et al., 2011, chapter 10.2.2.5).

Negative results in trials can be unpublished because authors may think journal editors do not want to publish negative results (Sterne et al., 2011). The most common approach to assess publication bias is by visually examining funnel plots for asymmetry; the required number is at least ten trials. We included only four trials which made it impossible to assess publication bias in this way. However, we attempted to search as widely as possible, for published, unpublished and ongoing trials. We searched for grey literature, conference abstracts, and

dissertations databases and in trials register. There is, however, always a possibility to miss out on publications.

### **Certainty of the evidence (GRADE)**

To assess the certainty of the evidence for each outcome, we used the GRADE (Grading of Recommendations, Assessment, Development, and Evaluation) approach and the GradePro software to create a “Summary of findings”-table (McMaster University and Evidence Prime Inc., 2015; Schünemann et al., 2011, chapter 12.2.1).

GRADE is a framework to present summaries of evidence with a systematic approach to making clinical practice recommendations (Guyatt et al., 2008). GRADE provides explicit criteria for rating the certainty of evidence. The criteria include study design, risk of bias, imprecision, inconsistency, indirectness, and magnitude of the effect. GRADE has four levels of evidence: very low, low, moderate, and high (see further description for the domains below and the GRADE criteria for assessing certainty of evidence in table 4).

The study design is the start point for grading. Randomized controlled trials start at high certainty and are either downgraded or upgraded. Observational studies start at low certainty (Guyatt et al., 2011).

The overall risk of bias is assessed and downgraded by one level for serious limitations, and by two levels for very serious limitations. Inconsistency is assessed and downgraded by one level if there are unexplained variations in the results of the trials (high heterogeneity) and downgraded by two levels where there is serious unexplained variability. Indirectness is assessed and downgraded by one level if there is a wide variation of the population, intervention, control groups, and outcomes. It can affect the generalizability of the results. For very serious indirectness is downgraded by two levels. Imprecision is assessed and downgraded by one level if confidence intervals affect the quality of the data. For very serious imprecisions is downgraded by two levels. Publication bias refers to when trials with “negative” findings remain unpublished and can bias the review outcome. For the likelihood of publication bias is downgraded by one level and if publication bias is very likely, it is downgraded by two levels.

Table 4. the GRADE criteria for assessing certainty of evidence

Study Design	Quality of Evidence	Lower if	Higher if
Randomized trial →	High	Risk of bias -1 Serious -2 Very serious	Large effect +1 Large +2 Very large
	Moderate	Inconsistency -1 Serious -2 Very serious	Dose response +1 Evidence of a gradient
Observational study →	Low	Indirectness -1 Serious -2 Very serious	All plausible confounding +1 Would reduce a demonstrated effect or
	Very low	Imprecision -1 Serious -2 Very serious  Publication bias -1 Likely -2 Very likely	+1 Would suggest a spurious effect when results show no effect

Guyatt, G., Oxman, A. D., Akl, E. A., Kunz, R., Vist, G., Brozek, J., . . . Schunemann, H. J. (2011). GRADE guidelines: 1. Introduction-GRADE evidence profiles and summary of findings tables. *Journal of Clinical Epidemiology*, 64(4), 383-394. doi:10.1016

## Results

The comprehensive literature search retrieved a total of 15869 records from all bibliographic databases. The initial search in March 2018 retrieved 13079 records, the update search in December 2018 retrieved 2464 records. Searching for grey literature and ongoing trials identified 538 records, of which 212 were manually screened. After removing duplicate records, 11007 remained for screening. We excluded 10698 references based on the title and abstract screening. We assessed 309 full-text articles and excluded 301 references.

We identified four ongoing trials (De Volder, 2018; Dopp, 2018; Lin, 2018; Oberste et al., 2018). Three of the four trials were located in ClinicalTrials.gov, and one trial was published as a study protocol in a journal (Oberste et al., 2018). Further description of ongoing trials is in Appendix IV.

Completing the study selection process, four trials ( $n=143$ ) met the inclusion criteria. Details of the study selection process and reasons for exclusions are given in the PRISMA flow diagram (figure 1) and a list of excluded trials with the primary reason for exclusion in Appendix V.



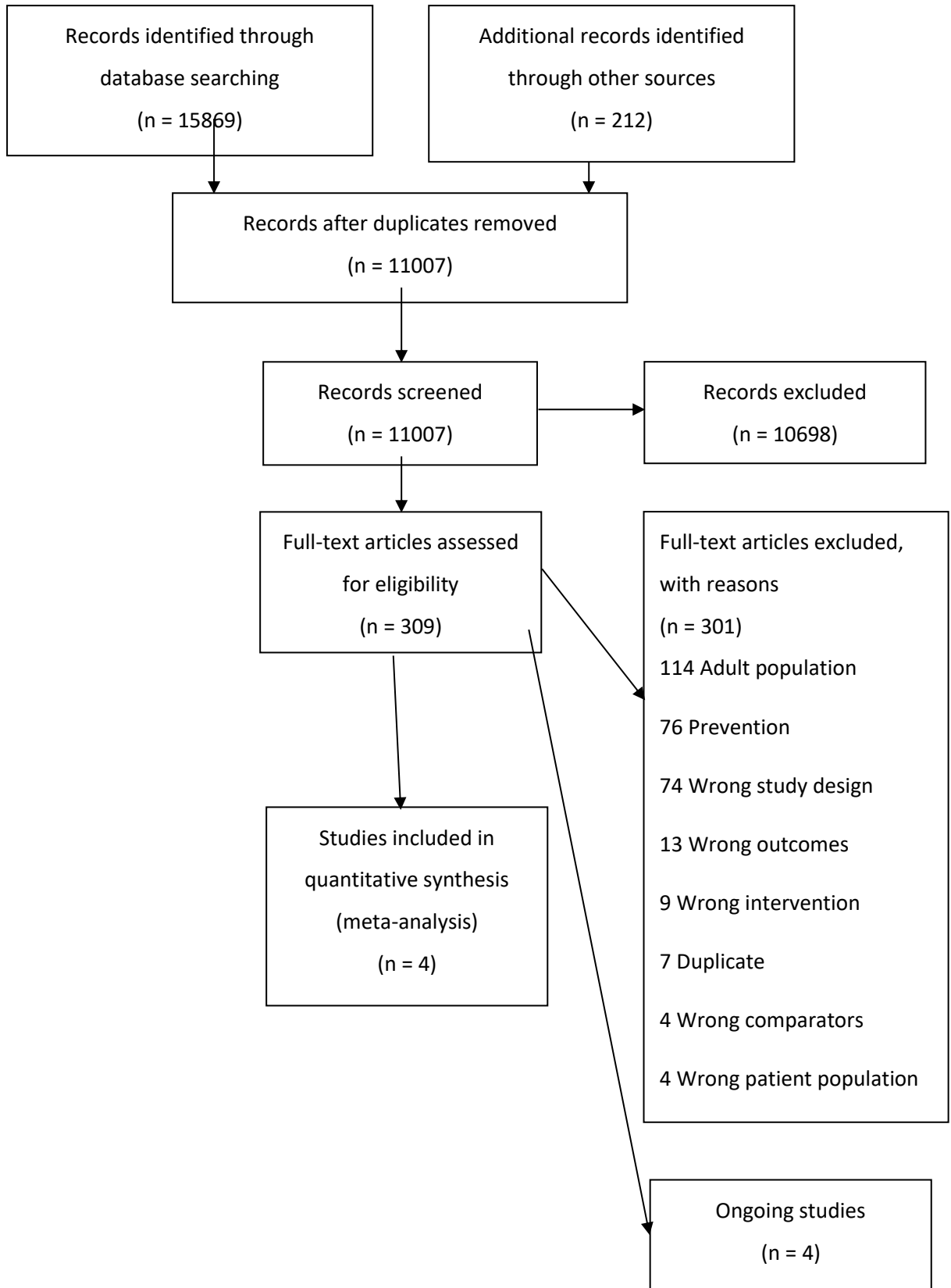
# PRISMA 2009 Flow Diagram

Identification

Screening

Eligibility

Included



## Included studies

Two of the four included trials were articles published in peer-reviewed journals and performed in the UK (Carter et al., 2015) and Iran (Roshan, Pourasghar, & Mohammadian, 2011). Moreover, two trials were doctoral dissertations, both performed in the USA (Beffert, 1993; Burrus, 1984). All included trials were published in English.

The four trials were randomized controlled trials. Carter et al. (2015) implemented a pragmatic randomized controlled trial design. Pragmatic trials are designed to show the real-life effectiveness of the intervention and are useful in trials with small samples, because such trials may overestimate benefits and underestimate harm (Patsopoulos, 2011). Burrus (1984) used a stratified random sampling procedure due to the variance found in levels of depression and cardiovascular fitness among participants. Both variables were stratified and statistically analyzed to ensure that the groups were equivalent. Stratified randomization is performed separately within strata and generates separate randomization for subsets of participants. (Higgins et al., 2011, chapter 8.9.2.1). Roshan et al. (2011) and Beffert (1993) had no reporting of adjustments to the study design in their trials.

The age of participants in the trials was similar and ranged from 12 and 18 years of age. The only trial that included participants below the teenage was Beffert (1993), which included children from 12 to 15 years. The other three trials included participants from the age of 14 or 15 years.

The four trials consisted of different types of exercises and comparisons. All interventions were group-based training, and all except one trial were supervised by experienced instructors or therapists (Roshan et al., 2011). By using the TIDieR framework (Hoffmann et al., 2014), we have described the interventions in detail (see TIDieR tables in Appendix III). The TIDieR tables show the difference in duration, intensity, and mode of delivery of the exercises. The interventions in the included trials are adequately described. The time period of the interventions was similar, six weeks in three trials (Beffert, 1993; Carter et al., 2015; Roshan et al., 2011) and nine weeks in one trial (Burrus, 1984). The intensity was slightly different across studies; in three trials the maximum heart rate was between 60-85%, while in Carter et al. (2015) the participants could choose the level of intensity.

The comparison groups consisted of no exercise (Roshan et al., 2011), or waitlist (Beffert, 1993). Burrus (1984) implemented two comparison groups, one with medium physiological

activity based on anaerobic exercise and one with low physiological activity based on first aid and personal safety class. However, only the non-exercise comparison group was included in the analysis for this systematic review. That decision was based on the inclusions criteria of not including trials comparing exercise with a different type of exercise. Carter et al. (2015) however, compared to treatment as usual which consisted of psychological therapies and medications.

All four trials evaluated depression as the primary outcome. Three trials used self-reported outcome measurement tools (Beffert, 1993; Burrus, 1984; Carter et al., 2015) and one used a clinician-rated outcome measurement tool (Roshan et al., 2011).

Another primary outcome in this review was adverse events. However, none of the included trials reported any adverse events. Only one trial (Carter et al., 2015) evaluated quality of life, a secondary outcome in this review. Other secondary outcomes, psychological well-being, and social functioning were not reported in the trials, and drop-out reporting was unclear in several of the trials.

For a further description of the trials that met the inclusion criteria see Table 1. Characteristics of included trials.

Table 5. Characteristics of included trials

Intervention (exercise component)								
Study, year	Participants	Country, Setting	Type	Dose, Intensity (max. heart rate)	Control	Outcome Measures (depression)	Baseline severity of depression Mean (SD)	Results (lower score is better) SMD (CI)
Carter <i>et al.</i> 2015	<i>n</i> = 64 14-17 years M=15.4 years 78% females	UK Community centres	Circuit-training (aerobic and strengthening exercises)	45 min 2 times/wk 6 weeks Preferred intensity	Treatment as usual	CDI-2 Self-report	I: 29.1 (9.4) C: 28.2 (6.8)	-0.19 (-0.69, 0.30)
Roshan <i>et al.</i> 2011	<i>n</i> =24 15-18 years M=16.9 years 100% females	Iran High school	Pool-walking program	3 times/wk 6 weeks 60-70%	No exercise, no anti-depressant treatment	Ham-D Clinician-rated	I: 30.15 (7.62) C: 29.58 (7.25)	-1.39 (-2.30, -0.48)
Beffert 1993	<i>n</i> =26 12-15 years M=N/A 83% females	USA High school	Walking-running (aerobic exercises)	20 min 3 times/wk 6 weeks 60-85%	Waitlist	RADS Self-report	I: 122.53 (6.03) C: 124.91 (6.92)	-0.85 (-1.66, -0.03)
Burrus 1984	<i>n</i> =29 15-18 years M=N/A 60% females	USA High school	Walk-jog-run (aerobic running program)	45 min 4 times/wk 9 weeks 75%	Anaerobic treatment, Red Cross First Aid and Personal Safety Class	DACL Self-report	I: 19.14 (3.73) C: 19.33 (3.71)	-0.27 (-1.00, 0.46)

\*All trials are RCTs (Randomised Controlled Trials)

\*All interventions were group-based and supervised.

Note: CDI-2= Children's Depression Inventory; Ham-D= Hamilton Rating Scale for Depression; RADS= Reynolds Adolescent Depression Scale; DACL= Depression Adjective Checklist.

## Risk of bias in the included studies

We assessed one trial (Carter et al., 2015) as having an overall unclear risk of bias and the other three trials as having an overall high risk of bias (Beffert, 1993; Burrus, 1984; Roshan et al., 2011), (see figure 2 and 3). Mostly all domains across the trials were rated as unclear risk of bias. Blinding of participants and personnel was rated as high risk of bias in all the trials due to the nature of the intervention exercise, as it was not possible to blind neither the participants nor the personnel. The blinding of outcome assessors was also rated as high risk of bias in two of the trials and unclear in the other two trials. For full detail of the risk of bias assessments see Appendix VI.

Figure 2. Risk of bias graph

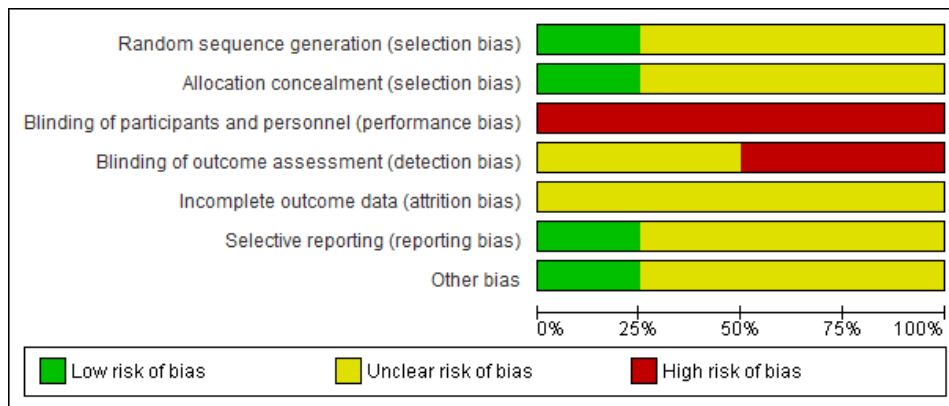
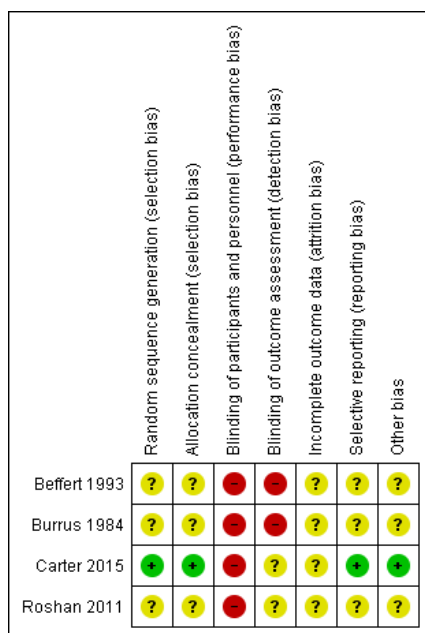


Figure 3. Risk of bias graph





We assessed the risk of bias due to inadequate *sequence generation* to be low in only one trial (Carter et al., 2015), where the random allocation sequence was computer generated by the trial statistician using permuted block randomization with varying block size. In the other three trials, we assessed this domain as having an unclear risk of bias. In Roshan et al. (2011) the participants were divided randomly into experimental group or control group, without any description of the randomization process. Burrus (1984) attempted assignment to treatment groups to be random, however, due to variance in levels of depression and cardiovascular fitness, both variables were stratified and statistically analyzed to ensure the groups to be equivalent. Beffert (1993) randomly assigned students who scored a 75 or higher on the RADS scale to either a treatment group or a waitlist control group, without describing the process.

We assessed the risk of bias due to *allocation concealment* as low risk in one trial (Carter et al., 2015), who used sequentially numbered opaque sealed envelopes to ensure allocation concealment. Whereas in the other three trials we assessed the risk as unclear since there was no mention of concealment allocation.

We assessed the risk of bias due to *blinding of participants and personnel* as high risk in all the four trials because of the nature of the interventions; all participants were aware that they participated in the exercise group.

We assessed the risk of bias due to *blinding of outcome assessments* as an unclear risk in two trials (Carter et al., 2015; Roshan et al., 2011) and high risk in two trials, due to self-reported outcomes measurement tools (Beffert, 1993) (Burrus, 1984). Roshan (Roshan et al., 2011) used a tool administered by a health-care professional (HAM-D) and was therefore assessed as unclear risk of bias. Carter et al. (2015, p. 2. ) also used a self-rated outcome measurement tool (CDI-2). However, he informed that “outcome assessors, including the data input administrator, were blind to treatment group at both follow-up time points”. “The analysis was conducted on a data set in which group allocation was unlabelled”. Therefore, it was rated as unclear risk of bias.

We assessed the risk of bias due to *incomplete outcome data* to be unclear in all four trials. In Carter et al. (2015) the description of attrition and lost to follow-up was unclear. Burrus (1984) reports attrition of only one student who, for medical reasons, dropped out of school. (Beffert, 1993) did not report precise numbers for drop-out and Roshan et al. (2011) had no reporting of drop-out at all.

We assessed the risk of bias due to *selective reporting* as low risk in one trial since a published protocol for the study was available at ClinicalTrials.gov, NCT01474837 (Carter et al., 2015). The other three trials were assessed as having an unclear risk of bias, Roshan et al. (2011) had published a retrospective registration of study protocol, and for the other two trials, no published protocol was available.

We assessed the risk of bias due to *other potential sources of bias* as low risk in one trial (Carter et al., 2015) and unclear risk in the other three trials.

## **Effects of interventions**

### ***Meta-analysis results***

The four trials used different outcome measurement tools to evaluate depression post-intervention. The effect sizes were reported as continuous data. Accordingly, we summarized the results by calculating standardized mean differences (SMD) using Hedges  $g$  in RevMan. Some systematic reviews convert scores from different tools to be able to pool the results from different trials, but since all included trials had different measurement tools we decided to avoid that.

A random-effects model was used since we expected heterogeneity across the trials. We assessed the heterogeneity as being moderate ( $I^2=52\%$ ), using the  $I^2$  statistics. We anticipated that the heterogeneity could be explained by different control interventions and measurement tools, but we decided to go forward with pooling the data. The clinical questions, the participants and the exercise interventions were similar enough to justify pooling the results in a meta-analysis.

### ***Depression (post-intervention)***

The primary meta-analysis pooled four trials ( $n=143$ ) testing the effects of exercise on depression at post-intervention compared with a control, finding a moderate effect in favour of exercise (SMD= -0.59, 95% CI= -1.11, to -0.07,  $p=0.03$ ,  $I^2=52\%$ ), see figure 4.

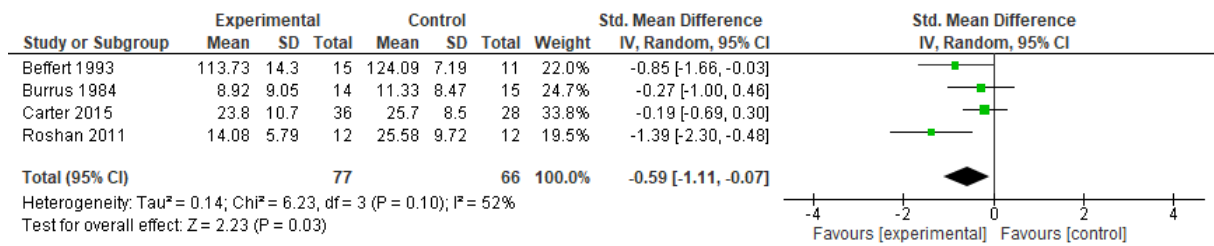


Figure 4 Forest plot of comparison: exercise versus control, post-intervention, outcome: change in depression

### Depression (follow-up)

A meta-analysis of exercise versus control was not possible, as change in depression at follow-up was reported in only one trial ( $n=42$ )(Carter et al., 2015). The trial found a moderate effect in favour of exercise (SMD= -0.59, 95% CI= -1.22, to -0.04,  $p=0.07$ ), see figure 5. With only one trial the test for heterogeneity was not applicable.

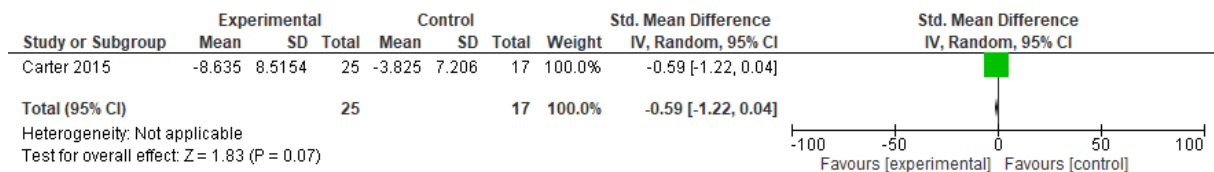


Figure 5 Forest plot of comparison exercise versus control, follow-up, outcome: change in depression

### Quality of Life

A meta-analysis of exercise versus control was not possible, as quality of life at post-intervention was reported in only one trial ( $n=42$ )(Carter et al., 2015). The trial found no statistically significant differences (SMD= 0.27 , 95% CI= -0.35, to 0.89,  $p=0.39$ ), see figure 6. With only one trial the test for heterogeneity was not applicable.

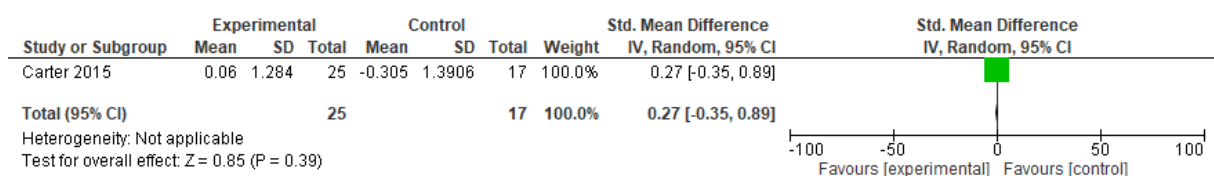


Figure 6 Forest plot of comparison exercise versus control, post-intervention outcome: quality of life

## **Certainty of the evidence (GRADE)**

The GRADE approach was used to assess the certainty of the evidence, and we created a summary of findings table (see table 6) (Schünemann et al., 2011). We independently graded the primary outcome of change in depression, post-intervention and at a follow-up.

### ***Depression, post-intervention***

For the domain risk of bias, we downgraded by one level for lack of blinding and sequence generation, which was unclear in three of the trials. Imprecision was downgraded by one level due to a low number of participants. Heterogeneity across the trials was moderate and therefore not downgraded for. Overall certainty of the evidence for the outcome change in depression, post-intervention, was rated as low. Our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect.

### ***Depression at follow-up (six months)***

For the domain risk of bias, we downgraded by one level for lack of blinding and unclear sequence generation in three of the trials. For imprecision we downgraded by two levels due to a low number of participants in the trials and the width of the confidence interval was consistent with both important benefit and harm. Overall certainty of the evidence for the outcome change in depression at follow-up was rated as very low. We have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect.

Table 6. Summary of findings table.

Outcomes	Anticipated absolute effects* (95% CI)		Relative effect (95% CI)	№ of participants (studies)	Certainty of the evidence (GRADE)
	Risk with control	Risk with Exercise			
Change in depression post-intervention		SMD 0.59 lower (1.11 lower to 0.07 lower)		143 (4 RCTs)	⊕⊕⊕⊖ LOW <sup>1 2</sup>
Change in depression follow-up (6 months)		SMD 0.59 lower (1.22 lower to 0.04 higher)		42 (1 RCT)	⊕⊖⊖⊖ VERY LOW <sup>1 2 3</sup>
<p><b>GRADE Working Group grades of evidence.</b></p> <p><b>High certainty:</b> we are very confident that the true effect lies close to that of the estimate of the effect.</p> <p><b>Moderate certainty:</b> we are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.</p> <p><b>Low certainty:</b> our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect.</p> <p><b>Very low certainty:</b> we have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect.</p>					
<p><i>Footnotes</i></p> <p><sup>1</sup> Lack of blinding probably increased effect sizes. Sequence generation was considered unclear in 3 studies.</p> <p><sup>2</sup> Imprecision (total number of participants less than 400). The 95% CI around the estimate of effect of all studies included in the meta-analysis was very wide.</p> <p><sup>3</sup> The width of confidence interval was consistent with both important benefit and harm.</p>					

## Discussion

The first part of the discussion is a summary of the main results, followed by the methodological limitations of the included trials, and the strength and limitation of the current systematic review. Finally, we discuss the implications for practice and future research.

## **Summary of main results**

Our focus was the effect of exercise intervention on depression in children and adolescents. We included four trials with a similar exercise intervention, with exclusively adolescent participants. By pooling the results of the four included trials, we found a moderate effect in favour of exercise on depression post-intervention, with a wide confidence interval. The trials had a low number of participants and were assessed as having an unclear or high risk of bias. The certainty of the evidence of the primary outcome, depression post-intervention, was graded as low. Our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect.

## **The strengths and limitations of the included studies**

In the following section, we will discuss the strengths and limitations of the included studies, and their generalizability to children and adolescents with depression.

### ***Sample sizes***

The included studies had a low number of included participants ( $n=24-64$ ). Using small samples increases the chance of having participants who are not representative of the population (Polit & Beck, 2012, p. 284). The effect estimates are less precise, and small studies are underpowered to detect a true difference between the groups. The risk of false positive or false negative findings is increased in underpowered studies (Polit & Beck, 2012, pp. 422-423). Only one of the included studies, Carter et al. (2015), performed a sample size calculation before recruitment started. They calculated that to detect a medium effect size they required 158 participants. They were however only able to recruit 87 participants, and only 64 finished the trial. Not even when we pooled all the four included studies ( $n=143$ ) did we reach the number required according to the study (Carter et al., 2015).

### ***Participants***

Three of the studies screened high school students for depression (Beffert, 1993; Burrus, 1984; Roshan et al., 2011). In two of the trials students who scored above the cut-off point of the assessment tool, were screened a second time 1-6 months later to ensure that depression

was not short term or situational (Beffert, 1993; Burrus, 1984). Students who scored above the cut-off point in both screenings were invited to participate in the trials. In Carter et al. (2015) the participants were recruited among adolescents receiving treatment from a health or social care professional for depression and scoring above cut off point on the Children's Depression Inventory-2 (Kovacs, 1992). The participants in the included studies were representative of adolescents with depression. That increases the applicability of the included trials for practice.

### *Exercise interventions*

Blinding of participants and personnel is not possible in exercise interventions. In the included trials, as in most studies on exercise interventions, the lack of blinding creates a risk of bias (Higgins et al., 2011, chapter 8.11.1).

Hoffmann et al. (2014) emphasize the importance of a precise description of interventions in trials. If interventions are inadequately described or defined, it inhibits replication and verification of the trial result and makes it impossible to implement the intervention in practice or further research. The interventions are well described in all the included studies. The type of exercise, intensity, frequency, and duration, are reported in detail. This makes it possible for readers to understand what the intervention consists of and researchers would be able to replicate the studies. Practitioners can also implement the interventions in practice based on the information in the published studies.

The types of interventions are sensible, and feasible in practice. Two of the trials use walking/running which is easy to do in practice in most settings (Beffert, 1993; Burrus, 1984). It is a low-cost intervention, requires no or little equipment, and minimal extra training of personnel. A PE teacher, physiotherapist or a sports trainer would be able to organize and implement this intervention easily. In one of the studies, Roshan et al. (2011), the intervention is pool walking, which requires access to a swimming pool. This is not available in all settings, and water-based activities might not be culturally acceptable everywhere. This study, however, included girls in Iran, a conservative country, so with some adaptations, it might be suitable in various cultural settings. In Carter et al. (2015) the intervention is circuit training. This intervention requires some equipment, but can also be done with low-cost equipment.

The dose of the intervention (length of each session and frequency) is according to the recommendations of the American College of Sports Medicine of exercising 3-5 days per week, for 20-60 minutes (American College of Sports Medicine, 2014, p. 468). The length of

the intervention (6-9 weeks) might have been too short to see the full effect of exercise in this population. It is not known if a longer intervention time would have had a different impact. The only trial that measured follow-up data, Carter et al. (2015), did not report how many of the participants they measured after six months had continued to exercise after the intervention stopped. It would have been interesting to investigate if the long-term effect differed among participants who continued to exercise after the intervention, versus those who stopped exercise after the end of the intervention.

### ***Comparisons***

The comparison groups in the included trials received different control conditions. In Roshan et al. (2011) the comparison group received no treatment. Since these participants had been diagnosed with depression, it can be considered unethical not to offer them any treatment, or at least refer them to other treatment options (Stang, Hense, Jöckel, Turner, & Tramèr, 2005). In Beffert (1993) the comparison group was on a waitlist and received the exercise intervention later. When comparing an exercise intervention to no treatment or waitlist it is not possible to disentangle the specific effect of exercise from the other factors that are present in the interventions. Such factors include the social aspect of doing activities in a group with other adolescents, the motivational role of the supervisor, diversion from negative thoughts, and the effects of receiving attention (Craft & Perna, 2004).

In Carter et al. (2015) exercise was an adjunct intervention to treatment as usual. This study design could not take into account other factors of exercise intervention. In Burrus (1984) the control group participated in a first aid and personal safety course with similar attention time as the intervention group. In other words, this control group received everything that intervention group received except the exercise. This type of control condition might indicate if it is the exercise part itself that has an effect or if the other factors are more important. However, this study was unfortunately too small to draw any such conclusions.

### ***Outcomes***

The core outcome set for depression and anxiety (Obbarius et al., 2017) agreed on four general treatment outcomes: Symptom burden, functioning, disease progression and treatment sustainability, and potential side effects of treatment. Symptom burden (i.e., depression severity) was measured in all the four included trials. Functioning was not measured in any of



the trials, which is unfortunate since it is an essential measure for patients. Disease progression and treatment sustainability requires long term follow up. Only Carter et al. (2015) measured follow up effects, after six months. Long term follow-up trials, preferably longer than six months, are needed since depression is a recurrent disease (Pan & Brent, 2018). Side effects or adverse events of exercise interventions were not reported in any of the trials. There has been an increasing focus on adverse events in all types of interventions. All interventions should attempt not to harm participant, and it should be obligatory to access and report this outcome (Loke, Price, & Herxheimer, 2011). Adverse events can potentially lead to discontinuing further exercise interventions. Carter et al. (2015) also measured Quality of Life which is an important outcome measure. Drop-out was not adequately addressed in the included trials.

Depression severity and quality of life are measured using different measuring tools, either self-report or health personnel report. They are all subjective measures, which is a risk of bias (Higgins et al., 2011, chapter 8.12.1) There is however no objective way of measuring these outcomes (Uher et al., 2012).

### ***Reporting of the studies***

It is recommended (and obligatory for publication in high-impact peer-review journals) that study protocols for clinical trials are registered prospectively to avoid the risk of bias (De Angelis et al., 2004). Inconsistent reporting between protocols and published articles are frequent, and prospectively registered study protocols can reveal unpublished results (Li et al., 2018).

Carter et al. (2015) is the only of the studies who registered their trial prospectively. Roshan et al. (2011) registered their trial retrospectively after the journal had received the article manuscript, and just two days before it was accepted for publication (Iranian Registry of Clinical Trials, 2011). Retrospective registration makes it impossible to investigate selective reporting, or if they had followed their study protocol. The other included trials were older and conducted before it was standard practice to register study protocols.

Carter et al. (2015) adhered to and referenced the CONSORT statement for the reporting of trials. Roshan et al. (2011) did not follow this reporting standard. The other two trials were older doctoral dissertations and published before CONSORT was developed.

## **Methodological strengths and limitations of this systematic review**

The main strengths of this systematic review are the standardized methods we have followed, and the comprehensive systematic literature search performed to identify trials.

In the conducting of this systematic review, we followed the methods of the Cochrane Handbook (Higgins & Green, 2011). Cochrane systematic reviews are known for their explicit, transparent and systematic methods, and Cochrane is a leading provider of systematic reviews in health care (Petticrew, Wilson, Wright, & Song, 2002). Additionally, we have reported according to the PRISMA guidelines (preferred reporting items for systematic reviews and meta-analysis) (Moher et al., 2009). PRISMA guidelines and checklist were developed to improve reporting in systematic reviews and meta-analysis. Our efforts of following international quality standards for conducting systematic reviews can nevertheless have been affected by both authors being inexperienced reviewers.

### ***Preliminary searches***

Efforts were made to identify other systematic reviews and ongoing reviews on the same topic, to avoid duplication. We searched various databases that index journals with systematic reviews and found reviews that somewhat overlapped. Also, we searched relevant databases for protocols to reveal ongoing systematic reviews. When starting to work on a new systematic review, reviewers should do their best to find existing systematic reviews on the same topic. This attempt has strengthened this project and is the best way to avoid unnecessary duplication (Moher, 2013).

### ***The protocol***

In the current project, we developed a pre-specified protocol and published it in the PROSPERO database (see appendix x). Publishing a protocol helps to detect selective reporting bias (Green & Higgins, 2011, chapter 2.1). We followed our protocol with some minor adjustments.

## *Selection criteria*

### **Participants**

Participants, from six to eighteen years old, were included in the review. The main reason for the low number of included trials in our analysis was that we excluded participants older than 18-year-old. During the study selection, we observed several trials with participants older than 18 years. Eighteen-year-old is the legal age in many countries. Before that age, it is mandatory to have consent from parents or guardians to participate in clinical trials, which may complicate the recruitment of younger participants. A difference between a 17-year-old and a 20-year-old may exist. During these years there is often a transition in the life of young people, which may include changing school and environment and even friends. However, the results of the effect of exercise for depression may be transferable across these age groups.

During the study selection process, we discovered that some trials do not report the age of the participants but refer to them as, e.g., college students. We checked the age of college students in the countries involved (e.g., China). In all cases, we classified them as over the age of 18 years, and therefore excluded them.

The included trials had participants with diagnosed depression or participants that reported above a clinical cut-off point for depression. The current inclusion criterion makes the results of our review more applicable to adolescents with depression than if we had also included the general population (participants without depression). However, previous systematic reviews show that exercise also probably decreases depressive symptoms in adolescents who are below the clinical level of depression (Bailey et al., 2017; Carter, Morres, Meade, et al., 2016).

### **Interventions**

A strength of this systematic review was the use of a well-defined and widely used definition of exercise (American College of Sports Medicine, 2014, p. 2.). A clear definition was helpful and resulted in the improved decision process in the study selection. We discovered that several eligible trials had “combination of interventions,” where exercise was one component of the combination. For example, exercise and cognitive behaviour therapy. This was something we did not anticipate and is, therefore, missing in the protocol. We decided, however, to exclude trials with “combination of interventions” because we could not separate

the effect of exercise from the effect of the other components. Cooney et al. (2013) have the same exclusion criterion in their Cochrane review.

## **Comparisons**

An additional strength of our review was the exclusion of trials comparing two types of exercise or two different intensities of exercise. Comparing two types of exercise interventions makes it impossible to conclude on the sole effect of exercise. In one of the included trials (Burrus, 1984), one of two control group was another type of exercise, anaerobic treatment consisting of a weight training program. The results from this control group were not included in the meta-analysis in the review.

Despite the differences in the comparisons, we decided to pool the results in a meta-analysis. We reflected on this and are aware of the critics of this practice (Ekkekakis, 2015). Other systematic reviews have come to the same conclusion and have included different control groups in their meta-analyses (Bailey et al., 2017; Carter, Morres, Meade, et al., 2016; Cooney et al., 2013).

## **Outcomes**

The process of identifying important outcomes for this review was done in several ways. We checked the core outcome sets (COMET)(Williamson et al., 2017) and looked through other systematic reviews of this population. The choice of including more outcomes than the other systematic reviews has highlighted the lack of important outcomes. This may inspire researchers to address these gaps in future studies (O'Connor et al., 2011). More attention is now given to outcomes that are important to the people involved. Another initiative that involves stakeholders is the James Lind Alliance, which brings patients, carers, and clinicians together in a consensus process to identify and prioritize unanswered questions or evidence uncertainties (Cowan & Oliver, 2018).

## ***The Literature searches***

One of the main strengths of this review is the comprehensive systematic literature search. Ten bibliographic databases within medicine, psychology, healthcare, and sports science were

searched. The choice of databases was based on recommendations in the Cochrane handbook and the Campbell Methods guide (Kugley et al., 2017; Lefebvre et al., 2011). The search strategies were designed based on the rich terminology of the subject. A wide range of search terms was applied to minimize the risk of missing relevant trials which is also one of the recommendations of the Cochrane Handbook (Lefebvre et al., 2011, chapter 6.4.6). Cochrane Highly Sensitive Search Strategy for identifying randomized trials in MEDLINE: sensitivity-maximizing version, was implemented (Lefebvre et al., 2011).

Furthermore, unpublished and grey literature were also searched to minimize publication bias that can threaten the validity of the review (Sterne et al., 2011, chapter 10.3.2). Bibliographies of included trials and previous systematic reviews were screened for relevant trials. The initial MEDLINE search strategy was peer-reviewed by two librarians independently, using the PRESS checklist (McGowan et al., 2016). Peer-reviewing search strategies, especially for systematic reviews, are recommended to identify search errors and improve the selection of search terms (McGowan et al., 2016).

A search update was carried out after the initial search, but no new eligible trials were found. At the time of submission of this thesis, only five months have passed since the update search which is shorter than in most systematic reviews (Beller, Chen, Wang, & Glasziou, 2013). We received e-mail alerts from the main databases when new references that matched our search strategy are added. There is however a chance that we have missed a newly published study.

No language restriction was applied in the searches, and during the study selection process we found several trials on the subject from China, Iran, and Germany. Therefore, we could have considered searching in country-specific databases.

As a sign of the thorough systematic literature search, we included one trial that has not been included in any other systematic review on this topic, as far as we know (Burrus, 1984).

### ***Study selection***

The study selection was carried out independently by two review authors, according to the method of systematic reviews (Higgins & Deeks, 2011, chapter 7.2.3). The comprehensive literature search resulted in a very large number of references (11007 records after removal of duplicates) that we screened for eligibility. This was a time-consuming process. All retrieved references were screened in Covidence, a user-friendly web-based screening tool which minimizes the risk of excluding a trial by mistake. Using Covidence is both time saving compared to other screening methods and helps manage the whole screening process,

especially with the high number of references. Having a protocol with clear inclusion and exclusion criteria, eased the study selection process and made it more consistent.

A limitation of this review is that neither of the review authors are professional experts on exercise nor mental health in children and adolescents. We were aware of this limitation and therefore checked more references that we were unsure about in full text rather than excluding them based on title and abstract. Additionally, we received assistance assessing the type of intervention in a few cases from a third reviewer (LL).

### ***Risk of bias assessment***

Risk of bias assessments were carried out by two review authors independently, according to the methods (Higgins et al., 2011). Since both authors were inexperienced in the risk of bias assessment, we compensated by independently assessing all the trials. We then discussed the results and resolved the discrepancies by consensus. The assessments were performed with the Cochrane risk of bias tool, and the assessments were also included in the data analyses and the conclusion of the review. Assessing internal validity in included trials and reflect on their impact of the results is essential in conducting a systematic review (Higgins et al., 2011), and strengthens the validity of this systematic review.

### ***Data extraction***

Data extraction of the included trials was performed independently by two reviewers. We developed a data extraction form based on the RevMan “characteristics of studies” form (The Cochrane Collaboration, 2014). We pilot tested the form with one of the included trials (Carter et al., 2015). The forms were then checked for compliance, before extracting data from the remaining trials. When preparing for data extraction, Cochrane Handbook recommends that all forms should be pilot tested (Higgins & Deeks, 2011).

Another strength of this review was the use of TIDieR, a standardized template, and checklist for the description of the interventions in included trials (Hoffmann et al., 2014). The TIDieR template consists of 12 items including the procedure, provider, mode of delivery, the adherence and fidelity of the intervention. By filling out the TIDieR tables for the

interventions, comparing the exercise interventions across the trials was more effortless and increased transparency.

### ***Assessment of reporting bias***

One limitation was that it was not possible to assess reporting bias in included trials due to a low number of included trials. To test for funnel plot asymmetry, at least ten trials are required (Sterne et al., 2011, chapter 10.4.3.1). Review authors should strive to assess the reporting bias because it can threaten the validity of the review (Sterne et al., 2011). To weigh up for this, we have attempted to search as extensively as possible, for grey literature, conference abstracts, and dissertations in various databases. We also searched trials registers to identify protocols of trials with unpublished results. We assume that the subject of this review is not of a high risk of reporting bias.

### ***Data analysis***

We were able to perform a meta-analysis by pooling the results of the primary outcome, post-intervention depression, as all the four trials reported this outcome. Even though it was moderate heterogeneity between the studies, we assessed that it was appropriate. The difference of the control groups may explain the moderate heterogeneity in the analysis of this review.

The value of a meta-analysis in a review is an increase in power and the ability to detect if a real effect exists (Deeks et al., 2011, chapter 9.1.3). However, results of a meta-analysis can be misleading, and review authors should evaluate each step of the review process carefully before deciding if the data is appropriate to pool the studies in a meta-analysis (Deeks et al., 2011). Unfortunately, the other outcomes, depression at follow-up and quality of life was only measured in one trial, and we were therefore not able to pool these outcomes.

### ***Certainty of the evidence (GRADE)***

For assessing certainty of the evidence, we used the GRADE approach, that is by far the most widely used method (Goldet & Howick, 2013). The GRADE assessments are subjective and challenging. We independently graded all outcomes, discussed and resolved the discrepancies to improve the GRADE assessments.

## **Comparison with other systematic reviews**

The main result of our systematic review is that there is a moderate effect of exercise on depression severity in adolescents with depression. These findings are consistent with the results of the previous systematic reviews, despite the differences in inclusion criteria. Several of the earlier reviews had, e.g., included participants both with and without depression, unlike our review that only included participants with depression. We also identified two dissertations that were not included in any of the earlier reviews.

## **Implications for future research**

Large, high-quality trials including children and adolescents with depression are needed. Adequate numbers of participants should be recruited to detect a difference between the groups and to reduce the risk of bias. The trials need to have a longer follow-up time to assess long-term effectiveness. The comparison groups should be offered either treatment as usual or other recommended treatments for depression (e.g., cognitive behaviour therapy). Studies, where exercise is an add-on to other treatments, are also needed since that is perhaps the most realistic in real-life situations. A wider range of outcomes should be measured in future trials. Adverse effects of exercise interventions and drop-out rate should also be adequately addressed.

## **Implications for practice**

Exercise interventions may have a beneficial effect on the depression severity in adolescents with depression. However, the four included trials had a limited number of participants and had a high or unclear risk of bias. The overall certainty of the evidence is low or very low. The effect of exercise on social functioning or psychological well-being is not known. Adverse events were not addressed in any of the included trials, and it is therefore not known if exercise interventions can be harmful to children and adolescents with depression.

## **Conflict of interest / Declarations of interest**

The authors have no known conflicts of interest to declare.



The authors received no specific funding for this work, but the work on this thesis has partly been done as a part of our work at the Regional Centre for Child and Adolescent Mental Health, Eastern and Southern Norway (RBUP). The Centre has not influenced objectives, research question, methods or conclusions.

## References

- Abebe, D. S., Froyland, L. R., Bakken, A., & von Soest, T. (2016). Municipal-level differences in depressive symptoms among adolescents in Norway: Results from the cross-national Ungdata study. *Scandinavian Journal of Public Health, 44*(1), 47-54. doi:10.1177/1403494815604764
- American College of Sports Medicine. (2014). *ACSM's Resource Manual for Guidelines for Exercise Testing and Prescription* (7th ed.). Philadelphia, PA: Wolters Kluwer, Lippincott Williams & Wilkins.
- American College of Sports Medicine. (2017). *ACSM's guidelines for exercise testing and prescription* (10th ed.). Philadelphia, PA: Wolters Kluwer.
- APA. (2013). *Diagnostic and Statistical Manual of Mental Disorders* (5 ed.). Washington, DC: American Psychiatric Publishing.
- Bailey, A. P., Hetrick, S. E., Rosenbaum, S., Purcell, R., & Parker, A. G. (2017). Treating depression with physical activity in adolescents and young adults: a systematic review and meta-analysis of randomised controlled trials. *Psychological Medicine, 1*-20. doi:10.1017/s0033291717002653
- Beffert, J. W. (1993). *Aerobic exercise as treatment of depressive symptoms in early adolescents*. (PhD Dissertation), University of Northern Colorado, Greeley, CO.
- Beller, E. M., Chen, J. K., Wang, U. L., & Glasziou, P. P. (2013). Are systematic reviews up-to-date at the time of publication? *Syst Rev, 2*, 36. doi:10.1186/2046-4053-2-36

- Biddle, S. J. H., & Asare, M. (2011). Physical activity and mental health in children and adolescents: a review of reviews. *British Journal of Sports Medicine*, 45(11), 886-895. doi:10.1136/bjsports-2011-090185
- Bonin, L., & Moreland, C. S. (2019, 27. October). Overview of prevention and treatment for pediatric depression. *UpToDate*. Retrieved from <https://www.uptodate.com/contents/1231>
- Bramer, W. M., Giustini, D., de Jonge, G. B., Holland, L., & Bekhuis, T. (2016). De-duplication of database search results for systematic reviews in EndNote. *Journal of the Medical Library Association : JMLA*, 104(3), 240-243. doi:10.3163/1536-5050.104.3.014
- Brown, H. E., Pearson, N., Braithwaite, R. E., Brown, W. J., & Biddle, S. J. H. (2013). Physical activity interventions and depression in children and adolescents: A systematic review and meta-analysis. *Sports Medicine*, 43(3), 195-206. doi:10.1007/s40279-012-0015-8
- Brown, S. W., Welsh, M. C., Labbe, E. E., Vitulli, W. F., & Kulkarni, P. (1992). Aerobic exercise in the psychological treatment of adolescents. *Perceptual and Motor Skills*, 74(2), 555-560. doi:10.2466/pms.1992.74.2.555
- Burrus, M. J. (1984). *The effects of a running treatment program on depressed adolescents*. (PhD Dissertation), University of Miami, Coral Gable, FL.
- Carter, T., Guo, B., Turner, D., Morres, I., Khalil, E., Brighton, E., . . . Callaghan, P. (2015). Preferred intensity exercise for adolescents receiving treatment for depression: a pragmatic randomised controlled trial. *BMC Psychiatry*, 15(1), 247. doi:10.1186/s12888-015-0638-z
- Carter, T., Morres, I., Repper, J., & Callaghan, P. (2016). Exercise for adolescents with depression: valued aspects and perceived change. *Journal of Psychiatric and Mental Health Nursing*, 23(1), 37-44. doi:10.1111/jpm.12261
- Carter, T., Morres, I. D., Meade, O., & Callaghan, P. (2016). The Effect of exercise on depressive symptoms in adolescents: A systematic review and meta-analysis. *Journal of the American Academy of Child and Adolescent Psychiatry*, 55(7), 580-590. doi:10.1016/j.jaac.2016.04.016
- Centre for Reviews and Dissemination. (2017). PROSPERO : International Prospective Register of Systematic Reviews. Retrieved from <https://www.crd.york.ac.uk/prospero/>
- Cipriani, A., Zhou, X., Del Giovane, C., Hetrick, S. E., Qin, B., Whittington, C., . . . Xie, P. (2016). Comparative efficacy and tolerability of antidepressants for major depressive

- disorder in children and adolescents: a network meta-analysis. *Lancet*, 388(10047), 881-890. doi:10.1016/S0140-6736(16)30385-3
- Clarivate Analytics. (2017). EndNote [Computer Software] (Version X8). Retrieved from <http://endnote.com/>
- Comet Initiative. (2019a). Core set of outcomes for adolescents with major depressive disorder: A tool of standardized outcomes for clinical research and practice. Retrieved from <http://www.comet-initiative.org/studies/details/1122?result=true>
- Comet Initiative. (2019b). ICHOM Depression and anxiety for children and young people. Retrieved from <http://www.comet-initiative.org/studies/details/978>
- Cooney, G. M., Dwan, K., Greig, C. A., Lawlor, D. A., Rimer, J., Waugh, F. R., . . . Mead, G. E. (2013). Exercise for depression. *Cochrane Database Syst Rev*(9). doi:10.1002/14651858.CD004366.pub6
- Costello, J. E., Erkanli, A., & Angold, A. (2006). Is there an epidemic of child or adolescent depression? *Journal of Child Psychology and Psychiatry and Allied Disciplines*, 47(12), 1263-1271. doi:10.1111/j.1469-7610.2006.01682.x
- Cowan, K., & Oliver, S. (2018). *The James Lind Alliance Guidebook*. In. Retrieved from <http://www.jla.nihr.ac.uk/jla-guidebook/>
- Cox, G. R., Callahan, P., Churchill, R., Hunot, V., Merry, S. N., Parker, A. G., & Hetrick, S. E. (2014). Psychological therapies versus antidepressant medication, alone and in combination for depression in children and adolescents. *Cochrane Database Syst Rev*(11). doi:10.1002/14651858.CD008324.pub3
- Cox, G. R., Fisher, C. A., De Silva, S., Phelan, M., Akinwale, O. P., Simmons, M. B., & Hetrick, S. E. (2012). Interventions for preventing relapse and recurrence of a depressive disorder in children and adolescents. *Cochrane Database Syst Rev*(11). doi:10.1002/14651858.CD007504.pub2
- Craft, L. L., & Perna, F. M. (2004). The Benefits of Exercise for the Clinically Depressed. *Primary Care Companion to the Journal of Clinical Psychiatry*, 6(3), 104-111.
- Dale, L. P., Vanderloo, L., Moore, S., & Faulkner, G. (In press). Physical activity and depression, anxiety, and self-esteem in children and youth: An umbrella systematic review. *Mental Health and Physical Activity*. doi:10.1016/j.mhpa.2018.12.001
- De Angelis, C., Drazen, J. M., Frizelle, F. A., Haug, C., Hoey, J., Horton, R., . . . Van Der Weyden, M. B. (2004). Clinical trial registration: a statement from the International Committee of Medical Journal Editors. *The Lancet*, 364(9438), 911-912. doi:10.1016/S0140-6736(04)17034-7

- De Volder, A. G. (2018). Move and Feel Good : Effects of Intensive Physical Training on Brain Plasticity, Cognition and Psychological Well-being. (Move&FG). *Trials* NCT02970825.
- Deeks, J. J., Higgins, J. P. T., & Altman, D. G. (2011). Chapter 9: Analysing data and undertaking meta-analyses. In J. P. T. Higgins & J. J. Deeks (Eds.), *Cochrane handbook for systematic reviews of interventions*. Version 5.1.0. Retrieved from [www.handbook.cochrane.org](http://www.handbook.cochrane.org).
- Dopp, R. R. (2018). Exercise as Treatment for Adolescents With Depressive Disorders. *Trials* NCT00964054.
- Dopp, R. R., Mooney, A. J., Armitage, R., & King, C. (2012). Exercise for adolescents with depressive disorders: a feasibility study. *Depression Research and Treatment*, 2012, 257472. doi:10.1155/2012/257472
- Dunn, A. L., & Weintraub, P. (2008). Exercise in the prevention and treatment of adolescent depression: A promising but little researched intervention. *American Journal of Lifestyle Medicine*, 2(6), 507-518. doi:10.1177/1559827608323225
- Dwan, K., Gamble, C., Williamson, P. R., & Altman, D. G. (2008). Reporting of clinical trials: a review of research funders' guidelines. *Trials*, 9, 66-66. doi:10.1186/1745-6215-9-66
- Ekkekakis, P. (2015). Honey, I shrunk the pooled SMD! Guide to critical appraisal of systematic reviews and meta-analyses using the Cochrane review on exercise for depression as example. *Mental Health and Physical Activity*, 8(Supplement C), 21-36. doi:10.1016/j.mhpa.2014.12.001
- European Union Clinical Trials Directive 2001. Directive 2001/20/EC of the European Parliament and of the Council of 4 April 2001 on the approximation of the laws, regulations and administrative provisions of the Member States relating to the implementation of good clinical practice in the conduct of clinical trials on medicinal products for human use. *Official Journal of the European Communities*, L 121(34).
- Goldet, G., & Howick, J. (2013). Understanding GRADE: an introduction. *Journal of Evidence-Based Medicine*, 6(1), 50-54. doi:10.1111/jebm.12018
- Gordon, B. A., Knapman, L. M., & Lubitz, L. (2010). Graduated exercise training and progressive resistance training in adolescents with chronic fatigue syndrome: a randomized controlled pilot study. *Clinical Rehabilitation*, 24(12), 1072-1079. doi:doi:10.1177/0269215510371429

- Green, S., & Higgins, J. P. T. (2011). Chapter 2: Preparing a Cochrane review. In J. P. T. Higgins & J. J. Deeks (Eds.), *Cochrane handbook for systematic reviews of interventions*. Version 5.1.0. Retrieved from [www.handbook.cochrane.org](http://www.handbook.cochrane.org).
- Green, S., Higgins, J. P. T., Alderson, P., Clarke, M., Mulrow, C. D., & Oxman, A. D. (2011). Chapter 1: Introduction. In J. P. T. Higgins & J. J. Deeks (Eds.), *Cochrane handbook for systematic reviews of interventions*. Version 5.1.0. Retrieved from [www.handbook.cochrane.org](http://www.handbook.cochrane.org).
- Guyatt, G. H., Oxman, A. D., Akl, E. A., Kunz, R., Vist, G., Brozek, J., . . . Schunemann, H. J. (2011). GRADE guidelines: 1. Introduction-GRADE evidence profiles and summary of findings tables. *Journal of Clinical Epidemiology*, *64*(4), 383-394. doi:10.1016/j.jclinepi.2010.04.026
- Guyatt, G. H., Oxman, A. D., Vist, G. E., Kunz, R., Falck-Ytter, Y., Alonso-Coello, P., & Schunemann, H. J. (2008). GRADE: an emerging consensus on rating quality of evidence and strength of recommendations. *BMJ*, *336*(7650), 924-926. doi:10.1136/bmj.39489.470347.AD
- Hetrick, S. E., McKenzie, J. E., Cox, G. R., Simmons, M. B., & Merry, S. N. (2012). Newer generation antidepressants for depressive disorders in children and adolescents. *Cochrane Database Syst Rev*(11). doi:10.1002/14651858.CD004851.pub3
- Higgins, J. P. T., Altman, D. G., & Sterne, J. A. C. (2011). Chapter 8: Assessing risk of bias in included studies. In J. P. T. Higgins & J. J. Deeks (Eds.), *Cochrane handbook for systematic reviews of interventions*. Version 5.1.0. Retrieved from [www.handbook.cochrane.org](http://www.handbook.cochrane.org).
- Higgins, J. P. T., & Deeks, J. J. (2011). Chapter 7: Selecting studies and collecting data. In J. P. T. Higgins & J. J. Deeks (Eds.), *Cochrane handbook for systematic reviews of interventions*. Version 5.1.0. Retrieved from [www.handbook.cochrane.org](http://www.handbook.cochrane.org).
- Higgins, J. P. T., & Green, S. (2011). *Cochrane Handbook for Systematic Reviews of Interventions. Version 5.1.0*. In. Retrieved from <http://handbook.cochrane.org/>
- Hilyer, J. C., Wilson, D. G., Dillon, C., Caro, L., Jenkins, C., Spencer, W. A., . . . Booker, W. (1982). Physical fitness training and counseling as treatment for youthful offenders. *Journal of Counseling Psychology*, *29*(3), 292-303. doi:10.1037/0022-0167.29.3.292
- Hoffmann, T. C., Glasziou, P. P., Boutron, I., Milne, R., Perera, R., Moher, D., . . . Michie, S. (2014). Better reporting of interventions: template for intervention description and replication (TIDieR) checklist and guide. *BMJ*, *348*, g1687. doi:10.1136/bmj.g1687

- Hullmann, S. E., Ryan, J. L., Ramsey, R. R., Chaney, J. M., & Mullins, L. L. (2011). Measures of general pediatric quality of life: Child Health Questionnaire (CHQ), DISABKIDS Chronic Generic Measure (DCGM), KINDL-R, Pediatric Quality of Life Inventory (PedsQL) 4.0 Generic Core Scales, and Quality of My Life Questionnaire (QoML). *Arthritis Care & Research*, 63(S11), S420-S430. doi:10.1002/acr.20637
- International Committee of Medical Journal Editors. (2010). Uniform requirements for manuscripts submitted to biomedical journals: Writing and editing for biomedical publication. *Journal of Pharmacology & Pharmacotherapeutics*, 1(1), 42-58.
- Iranian Registry of Clinical Trials. (2011). The Relationship Urine Hydroxyphenylglycol sulfate and Hamilton Scale Index in depressed girls after intermittent walking in water. Retrieved from <http://www.irct.ir/trial/726>
- Kovacs, M. (1992). *Children's Depression Inventory*. Toronto, Canada; New York, NY: Multi-Health Systems Inc.
- Kugley, S., Wade, A., Thomas, J., Mahood, Q., Jørgensen, A.-M. K., Hammerstrøm, K., & Sathe, N. (2017). *Searching for studies: a guide to information retrieval for Campbell systematic reviews*. In. Retrieved from <https://www.campbellcollaboration.org/library/searching-for-studies-information-retrieval-guide-campbell-reviews.html>
- Lam, L. C. W., & Riba, M. B. (2016). *Physical exercise interventions for mental health* (Adapted edition. ed.). Cambridge: Cambridge University Press.
- Larun, L., Nordheim, L. V., Ekeland, E., Hagen, K. B., & Heian, F. (2006). Exercise in prevention and treatment of anxiety and depression among children and young people. *Cochrane Database Syst Rev*(3). doi:10.1002/14651858.CD004691.pub2
- Lefebvre, C., Manheimer, E., & Glanville, J. (2011). Chapter 6: Searching for studies. In J. P. T. Higgins & J. J. Deeks (Eds.), *Cochrane handbook for systematic reviews of interventions*. Version 5.1.0. Retrieved from [www.handbook.cochrane.org](http://www.handbook.cochrane.org).
- Levay, P., & Craven, J. (2019). *Systematic searching : Practical ideas for improving results*. London: Facet Publishing.
- Li, G., Abbade, L. P. F., Nwosu, I., Jin, Y., Leenus, A., Maaz, M., . . . Thabane, L. (2018). A systematic review of comparisons between protocols or registrations and full reports in primary biomedical research. *BMC Medical Research Methodology*, 18(1), 9-9. doi:10.1186/s12874-017-0465-7
- Lin, K. (2018). A Study of Aerobic Exercise for Adolescents With Subthreshold Mood Syndromes. *Trials NCT03300778*.

- Loke, Y. K., Price, D., & Herxheimer, A. (2011). Chapter 14: Adverse effects. In J. P. T. Higgins & J. J. Deeks (Eds.), *Cochrane handbook for systematic reviews of interventions*. Version 5.1.0. Retrieved from [www.handbook.cochrane.org](http://www.handbook.cochrane.org).
- McGowan, J., Sampson, M. S., D.M., Cogo, E., Foerster, V., & Lefebvre, C. (2016). *PRESS Peer Review of Electronic Search Strategies : 2015 Guidelines Explanation and Elaboration (PRESS E&E)*. Ottawa, Canada: Canadian Agency for Drugs and Technologies in Health.
- McMaster University and Evidence Prime Inc. (2015). GRADEpro GDT. Retrieved from <https://gradepro.org/>
- Meekums, B., Karkou, V., & Nelson, E. A. (2015). Dance movement therapy for depression. *Cochrane Database of Systematic Reviews*(2). doi:10.1002/14651858.CD009895.pub2
- Moher, D. (2013). The problem of duplicate systematic reviews. *BMJ : British Medical Journal*, 347, f5040. doi:10.1136/bmj.f5040
- Moher, D., Liberati, A., Tetzlaff, J., & Altman, D. G. (2009). Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *BMJ*, 339, b2535. doi:10.1136/bmj.b2535
- Moher, D., Shamseer, L., Clarke, M., Ghersi, D., Liberati, A., Petticrew, M., . . . Stewart, L. A. (2015). Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement. *Syst Rev*, 4, 1. doi:10.1186/2046-4053-4-1
- Mohr, D. C., Ho, J., Duffecy, J., Baron, K. G., Lehman, K. A., Jin, L., & Reifler, D. (2010). Perceived barriers to psychological treatments and their relationship to depression. *Journal of Clinical Psychology*, 66(4), 394-409. doi:10.1002/jclp.20659
- Mokdad, A. H., Forouzanfar, M. H., Daoud, F., Mokdad, A. A., El Bcheraoui, C., Moradi-Lakeh, M., . . . Murray, C. J. L. (2016). Global burden of diseases, injuries, and risk factors for young people's health during 1990–2013: a systematic analysis for the Global Burden of Disease Study 2013. *Lancet*, 387(10036), 2383-2401. doi:10.1016/S0140-6736(16)00648-6
- National Institute of Mental Health. (2019). Major Depression. Retrieved from [https://www.nimh.nih.gov/health/statistics/major-depression.shtml#part\\_155031](https://www.nimh.nih.gov/health/statistics/major-depression.shtml#part_155031)
- NICE. (2005). Clinical Guideline: Depression in children and young people: identification and management. Retrieved from <https://www.nice.org.uk/guidance/cg28>
- O'Connor, D., Green, S., & Higgins, J. P. T. (2011). Chapter 5: Defining the review question and developing criteria for including studies. In J. P. T. Higgins & J. J. Deeks (Eds.),

- Cochrane handbook for systematic reviews of interventions. Version 5.1.0. Retrieved from [www.handbook.cochrane.org](http://www.handbook.cochrane.org).
- Obbarius, A., van Maasackers, L., Baer, L., Clark, D. M., Crocker, A. G., de Beurs, E., . . . Rose, M. (2017). Standardization of health outcomes assessment for depression and anxiety: recommendations from the ICHOM Depression and Anxiety Working Group. *Quality of Life Research*, 26(12), 3211-3225. doi:10.1007/s11136-017-1659-5
- Oberste, M., Grossheinrich, N., Wunram, H. L., Graf, J. L., Ziemendorff, A., Meinhardt, A., . . . Bender, S. (2018). Effects of a 6-week, whole-body vibration strength-training on depression symptoms, endocrinological and neurobiological parameters in adolescent inpatients experiencing a major depressive episode (the "Balancing Vibrations Study"): study protocol for a randomized placebo-controlled trial. *Trials*, 19(1), 347. doi:10.1186/s13063-018-2747-8
- Pan, L., & Brent, D. A. (2018). Depression in children. *BMJ Best Practice*. Retrieved from <https://bestpractice.bmj.com/topics/en-gb/785/pdf/785.pdf>
- Patsopoulos, N. A. (2011). A pragmatic view on pragmatic trials. *Dialogues in Clinical Neuroscience*, 13(2), 217-224.
- Peterson, D. M. (2017). The benefits and risks of exercise. *UpToDate*. Retrieved from <https://www.uptodate.com/contents/2786>
- Petticrew, M., Wilson, P., Wright, K., & Song, F. (2002). Quality of Cochrane reviews. Quality of Cochrane reviews is better than that of non-Cochrane reviews. *BMJ (Clinical research ed.)*, 324(7336), 545-545. doi:10.1136/bmj.324.7336.545/a
- Pinquart, M., & Shen, Y. (2011). Depressive symptoms in children and adolescents with chronic physical illness: an updated meta-analysis. *Journal of Pediatric Psychology*, 36(4), 375-384. doi:10.1093/jpepsy/jsq104
- Polit, D. F., & Beck, C. T. (2012). *Nursing research : generating and assessing evidence for nursing practice* (9th ed. ed.). Philadelphia, Pa: Wolters Kluwer Health.
- Price, C. S., Spence, S. H., Sheffield, J., & Donovan, C. (2002). The development and psychometric properties of a measure of social and adaptive functioning for children and adolescents. *Journal of Clinical Child and Adolescent Psychology*, 31(1), 111-122. doi:10.1207/s15374424jccp3101\_13
- PROSPERO. (2019). What is registration? Retrieved from <https://www.crd.york.ac.uk/prospéro/#aboutpage>



- Radovic, S., Gordon, M. S., & Melvin, G. A. (2017). Should we recommend exercise to adolescents with depressive symptoms? A meta-analysis. *Journal of Paediatrics and Child Health*, 53(3), 214-220. doi:10.1111/jpc.13426
- Ravens-Sieberer, U., Herdman, M., Devine, J., Otto, C., Bullinger, M., Rose, M., & Klasen, F. (2014). The European KIDSCREEN approach to measure quality of life and well-being in children: development, current application, and future advances. *Quality of Life Research*, 23(3), 791-803. doi:10.1007/s11136-013-0428-3
- Reeves, B. C., Deeks, J. J., Higgins, J. P. T., & Wells, G. A. (2011). Chapter 13: Including non-randomized studies. In J. P. T. Higgins & J. J. Deeks (Eds.), *Cochrane handbook for systematic reviews of interventions*. Version 5.1.0.
- REK (Regional Committees for Medical and Health Research Ethics). (2012, 12. January). Health Research. Retrieved from [https://helseforskning.etikkom.no/reglerogrutiner/soknadsplikt?p\\_dim=34997&\\_ikbLanguageCode=us](https://helseforskning.etikkom.no/reglerogrutiner/soknadsplikt?p_dim=34997&_ikbLanguageCode=us)
- Roshan, D. V., Pourasghar, M., & Mohammadian, Z. (2011). The Efficacy of intermittent walking in water on the rate of MHPG sulfate and the severity of depression. *Iran J Psychiatry Behav Sci*, 5(2), 26-31.
- Schünemann, H. J., Oxman, A. D., Vist, G. E., Higgins, J. P. T., Deeks, J. J., Glasziou, P. P., & Guyatt, G. (2011). Chapter 12: Interpreting results and drawing conclusions. In J. P. T. Higgins & J. J. Deeks (Eds.), *Cochrane handbook for systematic reviews of interventions*. Version 5.1.0. Retrieved from [www.handbook.cochrane.org](http://www.handbook.cochrane.org).
- Stang, A., Hense, H.-W., Jöckel, K.-H., Turner, E. H., & Tramèr, M. R. (2005). Is it always unethical to use a placebo in a clinical trial? *PLoS Medicine*, 2(3), e72-e72. doi:10.1371/journal.pmed.0020072
- Sterne, J. A. C., Egger, M., & Moher, D. (2011). Chapter 10: Addressing reporting biases. In J. P. T. Higgins & J. J. Deeks (Eds.), *Cochrane handbook for systematic reviews of interventions*. Version 5.1.0. Retrieved from [www.handbook.cochrane.org](http://www.handbook.cochrane.org).
- Stockings, E., Degenhardt, L., Lee, Y. Y., Mihalopoulos, C., Liu, A., Hobbs, M., & Patton, G. (2015). Symptom screening scales for detecting major depressive disorder in children and adolescents: a systematic review and meta-analysis of reliability, validity and diagnostic utility. *Journal of Affective Disorders*, 174, 447-463. doi:10.1016/j.jad.2014.11.061

- The Cochrane Collaboration. (2014). Review Manager (RevMan) 5.3 [Computer Software]. Retrieved from <http://community.cochrane.org/tools/review-production-tools/revman-5>
- The InterTASC Information Specialists' Sub-Group Search Filter Resource. (2017). ISSG Search Filters Resource. Retrieved from <https://sites.google.com/a/york.ac.uk/issg-search-filters-resource/home>
- Uher, R., Perlis, R. H., Placentino, A., Dernovšek, M. Z., Henigsberg, N., Mors, O., . . . Farmer, A. (2012). Self-report and clinician-rated measures of depression severity: can one replace the other? *Depression and Anxiety*, 29(12), 1043-1049. doi:10.1002/da.21993
- Varni, J. W., Sherman, S. A., Burwinkle, T. M., Dickinson, P. E., & Dixon, P. (2004). The PedsQL™ Family Impact Module: Preliminary reliability and validity. *Health Qual Life Outcomes*, 2, 55-55. doi:10.1186/1477-7525-2-55
- Veritas Health Innovation. (2019). Covidence Systematic Review Software [Computer Software]. Retrieved from <https://www.covidence.org/>
- Weisz, J. R., Kuppens, S., Ng, M. Y., Eckshtain, D., Ugueto, A. M., Vaughn-Coaxum, R., . . . Fordwood, S. R. (2017). What five decades of research tells us about the effects of youth psychological therapy: A multilevel meta-analysis and implications for science and practice. *American Psychologist*, 72(2), 79-117. doi:10.1037/a0040360
- Williamson, P. R., Altman, D. G., Bagley, H., Barnes, K. L., Blazeby, J. M., Brookes, S. T., . . . Young, B. (2017). The COMET Handbook: version 1.0. *Trials*, 18(3), 280. doi:10.1186/s13063-017-1978-4
- World Health Organization. (2011). *ICD-10 : International statistical classification of diseases and related health problems*. Geneva: World Health Organization.
- World Health Organization. (2017). Mental Health: Depression. Retrieved from [http://www.who.int/mental\\_health/management/depression/en/](http://www.who.int/mental_health/management/depression/en/)

# APPENDIX I

## PRESS 2015 Guideline Evidence-Based Checklist

McGowan, J., Sampson, M. S., D.M., Cogo, E., Foerster, V., & Lefebvre, C. (2016). PRESS Peer Review of Electronic Search Strategies : 2015 Guidelines Explanation and Elaboration (PRESS E&E). Ottawa, Canada: Canadian Agency for Drugs and Technologies in Health.

<b>Translation of the research question</b>	<p>Does the search strategy match the research question/PICO?</p> <p>Are the search concepts clear?</p> <p>Are there too many or too few PICO elements included?</p> <p>Are the search concepts too narrow or too broad?</p> <p>Does the search retrieve too many or too few records? (Please show number of hits per line.)</p> <p>Are unconventional or complex strategies explained?</p>
<b>Boolean and proximity operators (these vary based on search service)</b>	<p>Are Boolean or proximity operators used correctly?</p> <p>Is the use of nesting with brackets appropriate and effective for the search?</p> <p>If NOT is used, is this likely to result in any unintended exclusions?</p> <p>Could precision be improved by using proximity operators (eg, adjacent, near, within) or phrase searching instead of AND?</p> <p>Is the width of proximity operators suitable (eg, might adj5 pick up more variants than adj2)?</p>
<b>Subject headings (database specific)</b>	<p>Are the subject headings relevant?</p> <p>Are any relevant subject headings missing; for example, previous index terms?</p>

	<p>Are any subject headings too broad or too narrow?</p> <p>Are subject headings exploded where necessary and vice versa?</p> <p>Are major headings (“starring” or restrict to focus) used? If so, is there adequate justification?</p> <p>Are subheadings missing?</p> <p>Are subheadings attached to subject headings? (Floating subheadings may be preferred.)</p> <p>Are floating subheadings relevant and used appropriately?</p> <p>Are both subject headings and terms in free text (see the following) used for each concept?</p>
<p><b>Text word searching (free text)</b></p>	<p>Does the search include all spelling variants in free text (eg, UK vs. US spelling)?</p> <p>Does the search include all synonyms or antonyms (eg, opposites)?</p> <p>Does the search capture relevant truncation (ie, is truncation at the correct place)?</p> <p>Is the truncation too broad or too narrow?</p> <p>Are acronyms or abbreviations used appropriately? Do they capture irrelevant material? Are the full terms also included?</p> <p>Are the keywords specific enough or too broad? Are too many or too few keywords used? Are stop words used?</p> <p>Have the appropriate fields been searched; for example, is the choice of the text word fields (.tw.) or all fields (.af.) appropriate? Are there any other fields to be included or excluded (database specific)?</p>

	<p>Should any long strings be broken into several shorter search statements?</p>
<p><b>Spelling, syntax, and line numbers</b></p>	<p>Are there any spelling errors?</p> <p>Are there any errors in system syntax; for example, the use of a truncation symbol from a different search interface?</p> <p>Are there incorrect line combinations or orphan lines (ie, lines that are not referred to in the final summation that could indicate an error in an AND or OR statement)?</p>
<p><b>Limits and filters</b></p>	<p>Are all limits and filters used appropriately and are they relevant given the research question?</p> <p>Are all limits and filters used appropriately and are they relevant for the database?</p> <p>Are any potentially helpful limits or filters missing? Are the limits or filters too broad or too narrow? Can any limits or filters be added or taken away?</p> <p>Are sources cited for the filters used?</p>

Exercise for depression in children and adolescents: a systematic review of randomized controlled trials

*Brynhildur Axelsdottir, Solvi Biedilae, Lillebeth Larun, Lena Viktoria Nordheim, Ase Sagatun*

### Citation

Brynhildur Axelsdottir, Solvi Biedilae, Lillebeth Larun, Lena Viktoria Nordheim, Ase Sagatun. Exercise for depression in children and adolescents: a systematic review of randomized controlled trials. PROSPERO 2018 CRD42018101982 Available from: [http://www.crd.york.ac.uk/PROSPERO/display\\_record.php?ID=CRD42018101982](http://www.crd.york.ac.uk/PROSPERO/display_record.php?ID=CRD42018101982)

### Review question

What are the effects of exercise interventions in children and adolescents with depression?

### Searches

We will search a wide range of bibliographic databases within medicine, psychology, healthcare and sports science, including The Cochrane Central Register of Controlled Trials (CENTRAL), MEDLINE (Ovid), Embase (Ovid), PsycINFO (Ovid), AMED (Ovid), SPORTDiscus, PEDro, CINAHL (EBSCO), ERIC (EBSCO) and Web of Science.

We will not apply any limits on year, language or publication type.

We will search for grey literature in OpenGrey ([www.opengrey.eu/](http://www.opengrey.eu/)). We will search for dissertations and theses in Dissertations and Theses (ProQuest). We will also search for conference abstracts in Web of Science, PsycINFO (Ovid), ERIC (EBSCO) and Proceedings (OCLC). In addition, we will search the trial registers ClinicalTrials.gov ([www.ClinicalTrials.gov](http://www.ClinicalTrials.gov)) and WHO International Clinical Trials Registry Platform (ICTRP) ([www.who.int/ictcp/en/](http://www.who.int/ictcp/en/)) for ongoing and unpublished trials.

We will contact experts in the field, authors of included studies and professional organizations and associations for information about ongoing or unpublished studies. We intend to screen the bibliographies of all included studies for further relevant studies.

### Types of study to be included

Randomized controlled trials

### Condition or domain being studied

Depression is a mental disorder, characterized by persistent sadness and a loss of interest in and ability to carry out daily activities (World Health Organization, 2017). Depression is one of the five leading causes of disability and is projected to become the second leading contributor to the global burden of disease by the year 2020 (GBD Disease and Injury Incidence and Prevalence Collaborators, 2017).

Depression in adolescence can cause problems at school, with friends, and in the family. It may have adverse effects on educational attainment and later employment status. Severe depression can lead to suicide (World Health Organization, 2017).

The severity of depression is divided into following categories: mild, moderate or severe depression (NICE, 2005).

### Participants/population

Children and adolescents (6-18 years) with depression

### Intervention(s), exposure(s)

Exercise interventions, e.g., running, circuit training or weight lifting

### Comparator(s)/control

Other treatments: Psychological therapies, pharmacological treatments, alone or in combination, treatment as usual or other alternative treatments.

No treatment: Waiting list or a non-intervention group

## Context

### Main outcome(s)

1. Depression: The primary outcome is a measure of depression at the outcome assessment, either as a continuous measure or as a dichotomous outcome. Depression should be measured by self-report, health personnel report, parent report and/or teacher report with a standardized procedure. A variety of assessment tools are used to measure depression in children and adolescents. Examples of validated and commonly used tools are Beck Depression Inventory (BDI) and Children's Depression Inventory (CDI).
2. Adverse events: reported in any way (e.g., using reporting systems such as Serious adverse reactions (SARs)).

### Timing and effect measures

We will include data from the end of treatment and if possible any long-term follow-up. We will attempt, if appropriate, to group the outcomes by follow-up.

We will start by identifying the data for the outcome measures from the included studies. We will present the results for each outcome and comparison. We will report 95% confidence intervals and p-values where possible. Dichotomous outcomes will be reported as relative risk and risk difference. Continuous outcomes will be reported as mean difference (MD), and standardized mean difference (SMD) since the outcomes might be measured using different instruments across the included studies

### Additional outcome(s)

1. Psychological well-being: measured using any validated scale (e.g., KIDSCREEN and Child Health Questionnaire (CHQ)).
2. Social functioning: measured using any validated scale (e.g., Child and Adolescents Social and Adaptive Functioning Scale (CASAFS)).
3. Quality of life (QOL): measured using any validated scale (e.g., The Pediatric Quality of Life Inventory (PedsQL)).
4. Acceptability measured as dropouts

### Timing and effect measures

We will include data from the end of treatment and if possible any long-term follow-up. We will attempt, if appropriate, to group the outcomes by follow-up.

We will start by identifying the data for the outcome measures from the included studies. We will present the results for each outcome and comparison. We will report 95% confidence intervals and p-values where possible. Dichotomous outcomes will be reported as relative risk and risk difference. Continuous outcomes will be reported as mean difference (MD), and standardized mean difference (SMD) since the outcomes might be measured using different instruments across the included studies.

### Data extraction (selection and coding)

Two authors (SB and BA) will independently screen the references. Any disagreements will be resolved by discussion. If needed, a third author will be asked to participate in a final decision.

Two authors (SB and BA) will independently extract data from the included studies. We will extract the following data from the included studies:

- Methods: study design, study location, study setting
- Participants: number, age, gender, severity of depression, comorbidity, inclusion and exclusion criteria, drop-outs
- Interventions: type of exercise, intensity, duration, frequency, number of sessions, setting, intervention provider, modes of delivery, control intervention(s). For extracting data about the interventions, we will use

the template for intervention description and replication (TIDieR) checklist and guide (Hoffmann et al., 2014).

- Outcomes: primary and secondary outcomes at baseline, at the completion of the intervention and any follow-up measurements
- Notes: funding, conflict of interest

We will pilot test the data extraction form using one of the included studies, and if necessary, make adjustments to the form.

If any of the included studies are missing data, we will contact the study authors to obtain additional information.

### Risk of bias (quality) assessment

Two authors (SB and BA) will independently assess the quality of the included studies using the Cochrane Collaboration Risk of Bias Tool by the following criteria:

1. Sequence generation
2. Allocation concealment
3. Blinding of participants and care providers
4. Blinding of outcome assessors
5. Incomplete outcome data
6. Selective outcome reporting
7. Other sources of bias

We will evaluate each criterion as either “high,” “unclear” or “low” risk of bias.

### Strategy for data synthesis

We will perform a meta-analysis to synthesize the results if appropriate.

If a meta-analysis is inappropriate because of the heterogeneity of the included studies, we will carry out a narrative synthesis where we present the results in text and tables. We will use CRD’s framework for narrative synthesis (Centre for Reviews and Dissemination, 2009)

### Analysis of subgroups or subsets

If suitable and we have the adequate number of studies, we will perform subgroup analyses for the primary outcomes. We will consider the following variables:

- Intensity of exercise.
- Type of exercise.

### Contact details for further information

Brynhildur Axelsdottir  
ba@r-bup.no

### Organisational affiliation of the review

Centre for Child and Adolescent Mental Health, Eastern and Southern Norway (RBUP Oslo)  
<http://www.r-bup.no/no>

### Review team members and their organisational affiliations

Ms Brynhildur Axelsdottir. Centre for Child and Adolescent Mental Health, Oslo Norway (RBUP Oslo)  
Ms Solvi Biedilae. Centre for Child and Adolescent Mental Health, Eastern and Southern Norway (RBUP Oslo)



**PROSPERO**  
**International prospective register of systematic reviews**

Oslo)

Dr Lillebeth Larun. Norwegian Institute of Public Health, Division of Health Services

Ms Lena Viktoria Nordheim. Centre for Evidence-Based Practice, Western Norway University of Applied Sciences

Dr Ase Sagatun. Centre for Child and Adolescent Mental Health, Eastern and Southern Norway (RBUP Oslo)

**Type and method of review**

Intervention, Meta-analysis, Systematic review

**Anticipated or actual start date**

02 April 2018

**Anticipated completion date**

01 May 2019

**Funding sources/sponsors**

Centre for Child and Adolescent Mental Health, Eastern and Southern Norway (RBUP Oslo)

**Conflicts of interest****Language**

English

**Country**

Norway

**Stage of review**

Review Ongoing

**Subject index terms status**

Subject indexing assigned by CRD

**Subject index terms**

Adolescent; Child; Depression; Depressive Disorder; Exercise; Humans; Randomized Controlled Trials as Topic

**Date of registration in PROSPERO**

20 July 2018

**Date of publication of this version**

20 July 2018

**Details of any existing review of the same topic by the same authors**

Larun, L., Nordheim, L. V., Ekeland, E., Hagen, K. B., & Heian, F. (2006). Exercise in prevention and treatment of anxiety and depression among children and young people. *Cochrane Database of Systematic Reviews* (3). doi:10.1002/14651858.CD004691.pub2

**Stage of review at time of this submission**

<b>Stage</b>	<b>Started</b>	<b>Completed</b>
Preliminary searches	Yes	Yes
Piloting of the study selection process	Yes	Yes
Formal screening of search results against eligibility criteria	No	No
Data extraction	No	No
Risk of bias (quality) assessment	No	No
Data analysis	No	No

### Versions

20 July 2018

---

#### PROSPERO

This information has been provided by the named contact for this review. CRD has accepted this information in good faith and registered the review in PROSPERO. The registrant confirms that the information supplied for this submission is accurate and complete. CRD bears no responsibility or liability for the content of this registration record, any associated files or external websites.

**APPENDIX III**

## Aerobic exercise as treatment of depressive symptoms in early adolescents



## Aerobic exercise as treatment of depressive symptoms in early adolescents

<b>Why:</b>	Is it possible to effectively treat moderate depressive symptoms in early adolescents with a short-term aerobic exercise program in a school setting?
<b>What (material):</b>	N/A
<b>What (procedures):</b>	Treatment consisted of a walking-running program designed to increase the aerobic fitness of participants. The certified physical education instructor taught the students how to monitor their heart rate. During exercise treatment heart rate was monitored every five minutes in order to try to keep participants heart rates between 60-85% of maximum capacity. Students attempted to maintain a heart rate with a minimum of approximately 130 to 135 heart beats per minute.
<b>Who provided:</b>	The instructor was a certified physical education instructor at the junior high school.
<b>How (mode of delivery; individual or group):</b>	Group training.
<b>Where:</b>	In the school gym.
<b>When and how much:</b>	Participants in the exercise treatment group met on Monday, Wednesday and Friday during a six-week period for 20-minute sessions.
<b>Tailoring:</b>	N/A
<b>Modification:</b>	N/A
<b>How well (planned):</b>	Treatment integrity was monitored by the author through random weekly visits to the treatment class.
<b>How well (actual):</b>	N/A



## Effects of a running treatment program on depressed adolescents

<b>Why:</b>	To investigate the effects of a running treatment program on depressed adolescents.
<b>What (material):</b>	Each participant was given an general information about jogging in the heat (Appendix D in the Thesis) As well as the suggested schedule for the eight week running program (Appendix E in the Thesis). <a href="https://scholarlyrepository.miami.edu/dissertations/1432/">https://scholarlyrepository.miami.edu/dissertations/1432/</a>
<b>What (procedures):</b>	The program included a walk-jog-run for thirty-five minutes. The participants gradually increased their pace so that their heart rate reached 75% of maximum cardiac output. They were encouraged to move in such a way that they were never gasping for air and were therefore able to converse.
<b>Who provided:</b>	instructors were highly trained and experienced in their respective fields.
<b>How (mode of delivery; individual or group):</b>	Group training.
<b>Where:</b>	On the physical education field of the high school.
<b>When and how much:</b>	Each group met for forty-five minute sessions, four times per week for a duration of nine weeks.
<b>Tailoring:</b>	Each individual ran at a pace and distance commensurate with fitness level.
<b>Modification:</b>	N/A
<b>How well (planned):</b>	N/A
<b>How well (actual):</b>	N/A



## Preferred intensity exercise for adolescents receiving treatment for depression

<b>Why:</b>	To determine the effectiveness of a preferred intensity exercise intervention on the depressive symptoms of adolescents with depression
<b>What (material):</b>	N/A
<b>What (procedures):</b>	The circuit-training comprised of an interval pattern with eight separate exercise-stations. The stations consisted of strengthening and aerobic exercises: abdominal and back exercises from the supine and prone positions respectively; two medicine ball arm-based exercises from supine position; bouncing, static and dynamic balance exercises on a trampoline; body-weight squat exercise against the wall and stationary cycling. Following five minutes of stretching on major muscle groups in the upper and lower limbs, participants were encouraged to exercise for one minute then break for one minute, this was then repeated twice more.
<b>Who provided:</b>	A qualified exercise therapist supervised each session. Two additional staff members of the project exercised and interacted with participants in all sessions including the first author.
<b>How (mode of delivery; individual or group):</b>	Group-based (six to eight participants).
<b>Where:</b>	N/A
<b>When and how much:</b>	The intervention was a six week circuit-training consisting of 12 separate sessions which were run twice weekly. The total duration of each session was one hour (approximately 45 min of exercise and stretching). No pressure was applied to participants to attend the sessions.
<b>Tailoring:</b>	Preferred intensity was operationalised as follow: Participants could choose the order in which they undertook the different exercises as well as intensity in which they exercised on each station. They could choose to take rests when they wanted.
<b>Modification:</b>	N/A
<b>How well (planned):</b>	N/A
<b>How well (actual):</b>	N/A

## Intermittent walking in water on the severity of depression



## Intermittent walking in water on the severity of depression

<b>Why:</b>	To determine the effect of a six-week intermittent walking in the water on the rate of 24-hour urine MHPG sulfate and the severity of clinical depression in depressed girls.
<b>What (material):</b>	N/A
<b>What (procedures):</b>	A pool walking exercise program. 60-70% of maximum heart rate.
<b>Who provided:</b>	N/A
<b>How (mode of delivery; individual or group):</b>	N/A
<b>Where:</b>	The pool walking exercise was carried out in a pool with 15 meters width. The water height in the pool was considered as much as 70-80% of the cases height.
<b>When and how much:</b>	Pool walking exercise was implemented for 6 weeks and 3 sessions every week. The participants in the experimental group walked a total of 14.850 meters during 18 sessions. Generally the participants exercised two times daily during the first week, but for the next weeks they exercised three times daily.
<b>Tailoring:</b>	The experimental group were divided to some subgroups and in each subgroup, those who had similar VO2 max walked in the water with equal intensity and rhythm. After every set, the activity intensity was controlled with pulse rate.
<b>Modification:</b>	N/A
<b>How well (planned):</b>	N/A
<b>How well (actual):</b>	N/A

## APPENDIX IV

### List of ongoing trials

Principal investigator	Name of trial	Trial identifier	Institution	Status/date of last update posted
De Volder, Anne G.	Move and Feel Good : Effects of Intensive Physical Training on Brain Plasticity, Cognition and Psychological Well-being. (Move&FG)	NCT02970825	Université catholique de Louvain Brussels, Belgium	Recruiting/ May 14, 2018
<p><a href="https://clinicaltrials.gov/ct2/show/NCT02970825?titles=Move+and+Feel+Good&amp;rank=1">https://clinicaltrials.gov/ct2/show/NCT02970825?titles=Move+and+Feel+Good&amp;rank=1</a></p> <p>Study Type : Interventional (Clinical Trial)            Estimated Enrollment : 100 participants            Allocation: Randomized            Intervention Model: Parallel Assignment            Masking: Triple (Participant, Investigator, Outcomes Assessor)            Primary Purpose: Treatment            Official Title: Move and Feel Good : Effects of Intensive Physical Training on Brain Plasticity, Cognition and Psychological Well-being. "Effets de l'entraînement Physique Intensif Sur la plasticité cérébrale, la Cognition et le Bien être Psychologique".            Study Start Date : September 2016            Estimated Primary Completion Date : November 2018            Estimated Study Completion Date : December 2019</p>				

Principal investigator	Name of trial	Trial identifier	Institution	Status/date of last update posted
Oberste, M.	Effects of a 6-week, whole-body vibration strength-training on depression symptoms, endocrinological and neurobiological parameters in adolescent inpatients experiencing a major depressive episode (the "Balancing Vibrations Study"): study protocol for a	DRKS00011772 German Clinical Trials Register	Medical Center Kinder- und Jugendpsychiatrie der Uniklinik Köln	Recruiting ongoing/?

	randomized placebo-controlled trial			
<a href="https://trialsjournal.biomedcentral.com/articles/10.1186/s13063-018-2747-8">https://trialsjournal.biomedcentral.com/articles/10.1186/s13063-018-2747-8</a> <a href="https://www.drks.de/drks_web/navigate.do?navigationId=trial.HTML&amp;TRIAL_ID=DRKS00011772">https://www.drks.de/drks_web/navigate.do?navigationId=trial.HTML&amp;TRIAL_ID=DRKS00011772</a>				
DRKS-ID: DRKS00011772 Date of Registration in DRKS: 2017/03/20 (Anticipated or Actual) Date of First Enrollment: 2017/05/22 Target Sample Size: 82				

Principal investigator	Name of trial	Trial identifier	Institution	Status/date of last update posted
Lin, Kangguang	A Study of Aerobic Exercise for Adolescents with Subthreshold Mood Syndromes	NCT03300778	Guangzhou Brain Hospital Guangzhou, Guangdong	Completed/August 23, 2018
Study Type : Interventional (Clinical Trial) Actual Enrollment : 224 participants Allocation: Randomized Intervention Model: Parallel Assignment Masking: Double (Investigator, Outcomes Assessor) Primary Purpose: Treatment Official Title: A Randomised Controlled Trial of Aerobic Exercise for Adolescents With Subthreshold Depressive and/or Hypomanic Syndrome and for Non-clinical Adolescents Actual Study Start Date : October 10, 2017 Actual Primary Completion Date : January 5, 2018 Actual Study Completion Date : January 12, 2018				

Principal investigator	Name of trial	Trial identifier	Institution	Status/date of last update posted
Dopp, R. R.	Exercise as Treatment for Adolescents with Depressive Disorders	NCT00964054	National Institute of Mental Health (NIMH) USA	Completed/March 14, 2013



<p>Study Type : Interventional (Clinical Trial) Actual Enrollment : 9 participants Allocation: Randomized Intervention Model: Parallel Assignment Masking: Double (Investigator, Outcomes Assessor) Primary Purpose: Treatment Official Title: Adapting Exercise Treatment for Depression to Adolescents: A Pilot Study Study Start Date : September 2012 Actual Primary Completion Date : January 2013 Actual Study Completion Date : February 2013</p>				

## APPENDIX V

### List of excluded trials with reason for exclusion

References	Notes
5-HTTLPR and MTHFR 677C>T polymorphisms and response to yoga-based lifestyle intervention in major depressive disorder: A randomized active-controlled trial. 2018. 60. 4. 410-426	Exclusion reason: Adult population
Cutting edge. 2007. Journal of the Royal Society for the Promotion of Health. 127. 6. 251-252	Exclusion reason: Wrong study design
Exercise doesn't protect against adolescent depression. 2014. Brown University Child & Adolescent Psychopharmacology Update. 16. 12. 1-3	Exclusion reason: Wrong study design
PORÄ“WNANIE ZACHOWAN ANOREKTYCZNYCH GIMNAZJALISTEK ZE SZKÄ“ÅŃ SPORTOWYCH I NIESPORTOWYCH. 2009. Polish Journal of Sports Medicine / Medycyna Sportowa. 25. 6. 368-376	Exclusion reason: Wrong study design
Abdollahi, A. LeBouthillier, D. M. Najafi, M. Asmundson, G. J. G. Hosseinian, S. Shahidi, S. Carlbring, P. Kalhori, A. Sadeghi, H. Jalili, M. Effect of exercise augmentation of cognitive behavioural therapy for the treatment of suicidal ideation and depression. 2017. Journal of Affective Disorders. 219. 58-63	Exclusion reason: Adult population
Abenza, Lucia Olmedilla, Aurelio Ortega, Enrique Ato, Manuel Garcia-Mas, Alejandro. Analysis of the relationship between mood states and adherence behavior in injured athletes. 2010. Anales de Psicologia. 26. 1. 159-168	Exclusion reason: Wrong study design
Alharthi, Rajwa Saddik, Abdulmotaleb El. Exerlearn bike: An exergaming system for children's educational and physical well-being. 2012. 128	Exclusion reason: Wrong patient population
Annesi, J. J. Improvements in self-concept associated with reductions in negative mood in preadolescents enrolled in an after-school physical activity program. 2005. Psychological Reports. 97. 2. 400-404	Exclusion reason: Prevention
Annest, J. J. Correlations of depression and total mood disturbance with physical activity and self-concept in preadolescents enrolled in an after-school exercise program. 2005. Psychological Reports. 96. 3. 891-898	Exclusion reason: Wrong study design
Anonymous. 2013 SYR Accepted Poster Abstracts. 2013. International journal of yoga therapy. 23 Suppl. 32-53	Exclusion reason: Prevention
Ardic, Aysun Erdogan, Semra. The effectiveness of the COPE healthy lifestyles TEEN program: A school-based intervention in middle school adolescents with 12-month follow-up. 2017. Journal of Advanced Nursing. 73. 6. 1377-1389	Exclusion reason: Prevention
Atousa, G. D. Uzunboylu, H. Cavus, N. The effect of ten weeks individual and group training on the level of depression in female students of Islamic Azad University Ahvaz branch. 2009. 1. 1. 2637-2641	Exclusion reason: Adult population
Balchin, R. Linde, J. Blackhurst, D. Rauch, H. L. Schonbachler, G. Sweating away depression? The impact of intensive exercise on depression. 2016. Journal of Affective Disorders. 200. 218-21	Exclusion reason: Adult population

Balkin, Richard S. Tietjen-Smith, Tara Caldwell, Charmaine Shen, Yu-Pei. The Utilization of Exercise to Decrease Depressive Symptoms in Young Adult Women. 2007. ADULTSPAN Journal. 6. 1. 30-35	<b>Exclusion reason:</b> <b>Adult population</b>
Barbanti, Eliane Jani. AVALIAÇÃO DA EFICIÊNCIA E EFICÁCIA DA PRÁTICA DE DOIS TIPOS DE EXERCÍCIOS AERÓBICOS E ALONGAMENTO NA QUALIDADE VIDA NO TRATAMENTO DA DEPRESSÃO. 2010. Educaçãofísica em Revista. 4. 3. 1-15	<b>Exclusion reason:</b> <b>Adult population</b>
Barbosa Filho, V. C. Lopes Ada, S. Lima, A. B. de Souza, E. A. Gubert Fdo, A. Silva, K. S. Vieira, N. F. Trompieri Filho, N. de Araujo, T. S. de Bruin, P. F. Mota, J. Fortaleca sua Saude" Working, Group. Rationale and methods of a cluster-randomized controlled trial to promote active and healthy lifestyles among Brazilian students: the "Fortaleca sua Saude" program. 2015. BMC Public Health. 15. 1212	<b>Exclusion reason:</b> <b>Prevention</b>
Barnow, Sven Bernheim, Dorothee Schroder, Carmen Laufer, Heinz Fusch, Christoph Freyberger, Harald- I. Obesity in Childhood and Adolescence: First Results of a Multimodal Intervention Study in Mecklenburg-Vorpommern. 2003. PpM: Psychotherapie Psychosomatik Medizinische Psychologie. 53. 1. 7-14	<b>Exclusion reason:</b> <b>Prevention</b>
Bar-Or, Oded Rowland, Thomas W. Emotional and Mental Disorders. 2004. . . .	<b>Exclusion reason:</b> <b>Wrong study design</b>
Bartholomew, Jb Morrison, D Ciccolo, Jt. Effects of acute exercise on mood and well-being in patients with major depressive disorder. 2005. Medicine and Science in Sports and Exercise. 37. 12. 2032-2037	<b>Exclusion reason:</b> <b>Adult population</b>
Bass, M. A. Enochs, W. K. DiBrezza, R. Comparison of two exercise programs on general well-being of college students. 2002. Psychological Reports. 91. 3. 1195-1201	<b>Exclusion reason:</b> <b>Adult population</b>
Battaglia, C. di Cagno, A. Fiorilli, G. Giombini, A. Borrione, P. Baralla, F. Marchetti, M. Pigozzi, F. Participation in a 9-month selected physical exercise programme enhances psychological well-being in a prison population. 2015. Criminal Behaviour and Mental Health. 25. 5. 343-354	<b>Exclusion reason:</b> <b>Adult population</b>
Beets, M. W. Mitchell, E. Effects of yoga on stress, depression, and health-related quality of life in a nonclinical, bi-ethnic sample of adolescents: a pilot study. 2010. Hispanic Health Care International. 8. 1. 47-53	<b>Exclusion reason:</b> <b>Prevention</b>
Beffert, Jerry Wayne. Aerobic exercise as treatment of depressive symptoms in early adolescents. 1993. . 9404228. 166	<b>Exclusion reason:</b> <b>Duplicate</b>
Beltran, M Brown-Elhillali, A Held, A Ryce, P Ofonedu, Me Hoover, D Ensor, K Belcher, Hme. Yoga-based psychotherapy groups for boys exposed to trauma in urban settings. 2016. Alternative Therapies in Health and Medicine. 22. 1. 39-46.	<b>Exclusion reason:</b> <b>Wrong study design</b>
Benavides, S Caballero, J. Ashtanga yoga for children and adolescents for weight management and psychological well being: An uncontrolled open pilot study. 2009. Complementary Therapies in Clinical Practice. 15. 2. 110-14.	<b>Exclusion reason:</b> <b>Wrong study design</b>
Benhaberou-Brun, Dalila. [The benefits of physical activity]. 2012. Perspective Infirmiere. 9. 4. 22-25	<b>Exclusion reason:</b> <b>Wrong study design</b>
Berger, B. G. Exercice physique et reduction du stress. / Physical exercise and stress reduction. 1987. Science & Motricite. 3. 25-29	<b>Exclusion reason:</b> <b>Prevention</b>
Berger, B. G. Owen, D. R. Mood alteration in yoga and swimming: aerobic exercise not necessary. 1989. Unpublished Paper. [1-23]	<b>Exclusion reason:</b> <b>Adult population</b>
Berger, B. G. Owen, D. R. Stress reduction and mood enhancement in four exercise modes: swimming, body conditioning, Hatha yoga, and fencing. /	<b>Exclusion reason:</b> <b>Wrong study design</b>

Reduction du stress et amelioration de l ' humeur dans quatre types d ' exercice: natation, culture physique, hatha yoga, escrime. 1988. Research Quarterly for Exercise & Sport. 59. 2. 148-159	
Berger, Bg Owen, Dr. Mood alteration with swimming--swimmers really do 'feel better'. 1983. Psychosomatic Medicine. 45. 5. 425-433	<b>Exclusion reason: Adult population</b>
Berger, Bonnie G. Owen, David R. Man, Frantisek. A brief review of literature and examination of acute mood benefits of exercise in Czechoslovakian and United States swimmers. 1993. International Journal of Sport Psychology. 24. 2. 130-150	<b>Exclusion reason: Adult population</b>
Berger, Bonnie G. Owen, David R. Mood alteration with Yoga and swimming: Aerobic exercise may not be necessary. 1992. Perceptual and Motor Skills. 75. 3, Pt 2. 1331-1343	<b>Exclusion reason: Adult population</b>
Bershadsky, S Trumpfheller, L Kimble, Hb Pipaloff, D Yim, Is. The effect of prenatal Hatha yoga on affect, cortisol and depressive symptoms. 2014. Complementary Therapies in Clinical Practice. 20. 2. 106-13.	<b>Exclusion reason: Adult population</b>
Bhagirathi, Sameer E. Mehtaa, Deepak. THE EFFECT OF YOGA ON SELECTED PHYSIOLOGICAL VARIABLES OF SCHOOL GIRLS LIVING IN MOST POLLUTED AND LEAST POLLUTED AREAS OF BHOPAL CITY. 2011. International Journal of Sports Sciences & Fitness. 1. 2. 150-159	<b>Exclusion reason: Prevention</b>
Blumenthal, J. A. New frontiers in cardiovascular behavioral medicine: Comparative effectiveness of exercise and medication in treating depression. 2011. VOL 78 SUPP/1. S35-S43	<b>Exclusion reason: Adult population</b>
Boeger, Annette Dorfler, Tobias Schut-Ansteeg, Thomas. Project adventure with adolescents: Influence on psychopathology and self-esteem. 2006. Praxis der Kinderpsychologie und Kinderpsychiatrie. 55. 3. 181-197	<b>Exclusion reason: Prevention</b>
Bonhauser, Marco Fernandez, Gonzalo Puschel, Klaus Yanez, Fernando Montero, Joaquin Thompson, Beti Coronado, Gloria. Improving physical fitness and emotional well-being in adolescents of low socioeconomic status in Chile: Results of a school-based controlled trial. 2005. Health Promotion International. 20. 2. 113-122	<b>Exclusion reason: Prevention</b>
Boone, Erin M. Leadbeater, Bonnie J. Game On: Diminishing Risks for Depressive Symptoms in Early Adolescence Through Positive Involvement in Team Sports. 2006. Journal of Research on Adolescence. 16. 1. 79-90	<b>Exclusion reason: Wrong study design</b>
Boyll, Jeffery R. The effects of active exercise and passive electronic muscle stimulation on self-concept, anxiety, and depression. 1986. Dissertation Abstracts International. 47. 5-B. 2219	<b>Exclusion reason: Adult population</b>
Branco, JerĂ nimo Costa Jansen, Karen Oses, Jean Pierre de Mattos Souza, Luciano Dias da Silva Alves, Giovanna Del Grande Lara, Diogo Rizzato da Silva, Ricardo Azevedo. Practice of leisure-time physical activities and episodes of mood alteration amongst men and women. 2014. 169.165-169	<b>Exclusion reason: Adult population</b>
Brault, M. Fingerhut, R. Zelikovsky, N. Veltri, E. HEALTH LOCUS OF CONTROL, EXERCISE AND DEPRESSION IN COLLEGE STUDENTS. 2013. Annals of Behavioral Medicine. 45. S275-S275	<b>Exclusion reason: Wrong study design</b>
Brawner, Patricia S. Exercise as it relates to depression and locus-of-control. 1990. Dissertation Abstracts International. 50. 12-A, Pt 1. 3891	<b>Exclusion reason: Adult population</b>
Briggs, Jeralee M. Yoga as an ancillary treatment to acceptance and commitment therapy for depression. 2017. Dissertation Abstracts International: Section B: The Sciences and Engineering. 78. 4-B(E). No Pagination Specified	<b>Exclusion reason: Adult population</b>

Brollier, C. Hamrick, N. Jacobson, B. Aerobic exercise: A potential occupational therapy modality for adolescents with depression. 1993. Occupational Therapy in Mental Health. 12. 4. 19-29	<b>Exclusion reason: Wrong study design</b>
Brown, H. E. Whittle, F. Jong, S. T. Croxson, C. Sharp, S. J. Wilkinson, P. Wilson, E. C. F. van Sluijs, E. M. F. Vignoles, A. Corder, K. A cluster randomised controlled trial to evaluate the effectiveness and cost-effectiveness of the GoActive intervention to increase physical activity among adolescents aged 13-14 years. 2017. BMJ Open. 7. 9. 9	<b>Exclusion reason: Wrong outcomes</b>
Brown, Stella W. Welsh, M. Labbe, Elise E. Vitulli, William F. Kulkarni, Pandu. Aerobic exercise in the psychological treatment of adolescents. 1992. Perceptual and Motor Skills. 74. 2. 555-560	<b>Exclusion reason: Prevention</b>
Brown, Stella Watlington Welsh, M. Cay. Aerobic exercise in the psychological treatment of adolescents. 1991. 1344080. 192	<b>Exclusion reason: Duplicate</b>
Burrus, Meredith June. THE EFFECTS OF A RUNNING TREATMENT PROGRAM ON DEPRESSED ADOLESCENTS (AEROBIC). 1984. 8425890. 190	<b>Exclusion reason: Duplicate</b>
Byrom, John M. The effects of a cardiovascular fitness program on depression, anxiety, self-concept, and perceived physical fitness in college women. 1984. Dissertation Abstracts International. 45. 6-B. 1907	<b>Exclusion reason: Adult population</b>
Cadenas-Sánchez, C Mora-González, J Migueles, Jh Martán-Matillas, M Gómez-Vida, J Escolano-Margarit, Mv Maldonado, J Enriquez, Gm Pastor-Villaescusa, B Teresa, C Navarrete, S Lozano, Rm Dios, Beas-Jiménez J Estévez-López, F Mena-Molina, A Heras, Mj Chillón, P Campoy, C Muñoz-Hernández, V Martínez-Vila, Wd Merchan, Me Perales, Jc Gil, Álvaro Verdejo-García, A Aguilera, Cm Ruiz, Jr Labayen, I Catena, A Ortega, Fb. An exercise-based randomized controlled trial on brain, cognition, physical health and mental health in overweight/obese children (ActiveBrains project): rationale, design and methods. 2016. Contemporary Clinical Trials. 47. 315-324	<b>Exclusion reason: Prevention</b>
Cai, Sean. Physical Exercise and Mental Health: A Content Integrated Approach in Coping with College Students' Anxiety and Depression. 2000. Physical Educator. 57. 2. 69	<b>Exclusion reason: Prevention</b>
Call, D. Miron, L. Orcutt, H. Effectiveness of Brief Mindfulness Techniques in Reducing Symptoms of Anxiety and Stress. 2014. Mindfulness. 5. 6. 658-668	<b>Exclusion reason: Adult population</b>
Callister, R. Giles, A. Dascombe, B. Baker, A. Nasstasia, Y. Halpin, S. Hides, L. Yong, C. Healthy Body Healthy Mind: Development of an exercise intervention for the management of youth depression. 2012. VOL 15 SUPP/1. S158-S159	<b>Exclusion reason: Wrong study design</b>
Callister, R. Giles, A. Nasstasia, Y. Baker, A. Halpin, S. Hides, L. Kelly, B. 12-weeks supervised exercise training is a feasible and efficacious treatment for reducing depression in youth with major depressive disorder. 2013. Journal of Science and Medicine in Sport. 1). e16	<b>Exclusion reason: Adult population</b>
Callister, R. Giles, A. Nasstasia, Y. Baker, A. Halpin, S. Hides, L. Dascombe, B. Kelly, B. Participant expectations of the Healthy Body Healthy Mind exercise program for youth with major depressive disorder. 2014. Journal of Science & Medicine in Sport. 18. e88-e88	<b>Exclusion reason: Adult population</b>
Cao, G. M. Cao, H. An experimental study on the relationship between physical exercises and the college students' mental health. 2002. Journal of Wuhan Institute of Physical Education. 36. 1. 131146-131146	<b>Exclusion reason: Adult population</b>

Carlson, Jon. Holistic Health and Humanistic Education: The Physical Domain. 1982. Journal of Humanistic Education and Development. 21. 2. 51-92	<b>Exclusion reason: Wrong study design</b>
Carmack, Cindy Lynn. Aerobic fitness and leisure physical activity as moderators of the stress-illness relation. 1996. Dissertation Abstracts International: Section B: The Sciences and Engineering. 57. 2-B. 1432	<b>Exclusion reason: Wrong study design</b>
Carter, Jocelyn S. Karczewski, Sabrina DeCator, Draycen D. Hollowell, Alescia M. Ethnic differences in impact of physical activity program on psychological symptoms in youth. 2017. Journal of Physical Activity & Health. 14. 4. 283-289	<b>Exclusion reason: Prevention</b>
Case, Scott C. The effects of group therapy and exercise on depression and self-esteem in college students. 2003. Dissertation Abstracts International: Section B: The Sciences and Engineering. 64. 4-B. 1893	<b>Exclusion reason: Adult population</b>
Chalder, M. Montgomery, A. Hollinghurst, S. Sharp, D. Campbell, J. Lewis, G. Physical activity as a treatment for depression: An outline of the TREAD study. 2010. Journal of Affective Disorders. 1). 554	<b>Exclusion reason: Adult population</b>
Chancey, Leigh Patterson. School-based mindfulness and yoga with young adolescents as an enhanced health and physical education curriculum. 2019. . 80. 1-B(E). No Pagination Specified	<b>Exclusion reason: Prevention</b>
Chen, Tingting Yue, Guang H. Tian, Yingxue Jiang, Changhao. Baduanjin mind-body intervention improves the executive control function. 2017. Frontiers in Psychology Vol 7 2017, ArtID 2015. 7.	<b>Exclusion reason: Adult population</b>
Cheng, X. Wang, D. M. Chen, X. Wang, W. Liu, C. He, T. He, L. Qin, Q. Z. Health Qigong Wuqinxi improves hydrogen proton magnetic resonance spectra in prefrontal cortex and hippocampus in college students with mild depression. [Chinese]. 2016. 36. 11. 1468-1476	<b>Exclusion reason: Adult population</b>
Chetty, Julie Edwards, Stephen D. AN INVESTIGATION INTO THE USE OF EXERCISE AS A MEDIUM FOR MENTAL HEALTH PROMOTION AMONG INSTITUTIONALISED CHILDREN. 2007. South African Journal for Research in Sport, Physical Education & Recreation. 29. 2. 1-10	<b>Exclusion reason: Wrong study design</b>
Chu, I. H. Wu, W. L. Lin, I. M. Chang, Y. K. Lin, Y. J. Yang, P. C. Effects of Yoga on Heart Rate Variability and Depressive Symptoms in Women: A Randomized Controlled Trial. 2017. Journal of Alternative & Complementary Medicine. 23. 4. 310-316	<b>Exclusion reason: Adult population</b>
Cohen-Kahn, Dana Denise Gevirtz, Richard. The effects of a graded mastery weight-training program on depression and overall functioning in inpatient adolescents. 1994. 9500748. 161	<b>Exclusion reason: Duplicate</b>
Cohen-Kahn, Dana Denise. The effects of a graded mastery weight-training program on depression and overall functioning in inpatient adolescents. 1995. Dissertation Abstracts International: Section B: The Sciences and Engineering. 55. 8-B. 3582	<b>Exclusion reason: Prevention</b>
Collingwood, Thomas R. et al., Physical Fitness Effects on Substance Abuse Risk Factors and Use Patterns. 1991. Journal of Drug Education. 21. 1. 73-83	<b>Exclusion reason: Wrong study design</b>
Collingwood, Thomas R. Sunderlin, Jeff Reynolds, Roger Kohl, Harold W., III. Physical training as a substance abuse prevention intervention for youth. 2000. Journal of Drug Education. 30. 4. 435-451	<b>Exclusion reason: Wrong study design</b>
Copeland, Robert James. Exercise as a psychological therapy in obese adolescents. 2007. U491220. 1	<b>Exclusion reason: Wrong patient population</b>

Corder, K. Brown, H. E. Schiff, A. van Sluijs, E. M. F. Feasibility study and pilot cluster-randomised controlled trial of the GoActive intervention aiming to promote physical activity among adolescents: outcomes and lessons learnt. 2016. <i>BMJ Open</i> 6. 11. 14	<b>Exclusion reason: Wrong outcomes</b>
Costigan, S. A. Eather, N. Plotnikoff, R. C. Hillman, C. H. Lubans, D. R. High-Intensity Interval Training for Cognitive and Mental Health in Adolescents. 2016. <i>Medicine and Science in Sports and Exercise</i> . 48. 10. 1985-1993	<b>Exclusion reason: Wrong outcomes</b>
Crews, Debra J. Lochbaum, Marc R. Landers, Daniel M. Aerobic Physical Activity Effects on Psychological Well-being in Low-income Hispanic Children. 2004. <i>Perceptual and Motor Skills</i> . 98. 1. 319-324	<b>Exclusion reason: Prevention</b>
Cselik, Bence Szmodis, Mária Szots, Gábor Ács, Pongrác. Hungarian Dimensions of Physical Activity Based on Studies at School Ages. 2015. <i>Practice and Theory in Systems of Education</i> . 10. 2. 131-140	<b>Exclusion reason: Wrong study design</b>
Daley, A. J. Copeland, R. J. Wright, N. P. Roalfe, A. Wales, J. K. Exercise therapy as a treatment for psychopathologic conditions in obese and morbidly obese adolescents: a randomized, controlled trial. 2006. <i>Pediatrics</i> . 118. 5. 2126-34	<b>Exclusion reason: Prevention</b>
Daley, A. J. Copeland, R. J. Wright, N. P. Wales, J. K. H. Protocol for: Sheffield Obesity Trial (SHOT): A randomised controlled trial of exercise therapy and mental health outcomes in obese adolescents [ISRCT83888112]. 2005. <i>BMC Public Health</i> . 5 (no pagination). 113.	<b>Exclusion reason: Prevention</b>
Dassanayake, W. Springett, J. Shewring, T. The impact on anxiety and depression of a whole school approach to health promotion: evidence from a Canadian comprehensive school health (CSH) initiative. 2017. <i>Advances in School Mental Health Promotion</i> . 10. 4. 221-234	<b>Exclusion reason: Prevention</b>
Davis, C. L. Williams, C. Bustamante, E. E. Waller, J. L. Effects of regular exercise vs sedentary after school program on mood and quality of life of overweight children. 2014. <i>Psychosomatic Medicine</i> . 76 (3). A-113	<b>Exclusion reason: Prevention</b>
de Manincor, M. Bensoussan, A. Smith, C. A. Barr, K. Schweickle, M. Donoghoe, L. L. Bouchier, S. Fahey, P. Individualized Yoga for Reducing Depression and Anxiety, and Improving Well-Being: A Randomized Controlled Trial. 2016. <i>Depression &amp; Anxiety</i> . 33. 9. 816-28	<b>Exclusion reason: Adult population</b>
Demers, Nikki Richelle. The relationship between exercise and mental health in college students. 2014. <i>Dissertation Abstracts International: Section B: The Sciences and Engineering</i> . 74. 11-B(E). No Pagination Specified	<b>Exclusion reason: Adult population</b>
Depressed Adolescents Treated With Exercise (The DATE Study). 2009. <i>ClinicalTrials.gov</i>	<b>Exclusion reason: Wrong comparator</b>
Depression Outcomes Study of Exercise. 2009. <i>ClinicalTrial.gov</i>	<b>Exclusion reason: Wrong study design</b>
DeWolf, Todd R. The effects of levels of exercise and gender on depression and anxiety. 1992. <i>Dissertation Abstracts International</i> . 52. 8-A. 2862	<b>Exclusion reason: Adult population</b>
Diaz, Ann B. Motta, Robert. The effects of an aerobic exercise program on posttraumatic stress disorder symptom severity in adolescents. 2008. <i>International Journal of Emergency Mental Health</i> . 10. 1. 49-60	<b>Exclusion reason: Wrong study design</b>
Diaz, Ann. The effects of an aerobic exercise program on posttraumatic stress disorder symptom severity in adolescents. 2008. <i>Dissertation Abstracts International: Section B: The Sciences and Engineering</i> . 68. 8-B. 5564	<b>Exclusion reason: Wrong study design</b>

Doll, Norbert Mollenhauer, Alfred Renz, Petra Luntz, Jana. Therapeutic climbing for acute psychiatric patients. 2011. Pflegewissenschaft. 13. 9. 453-461	<b>Exclusion reason: Prevention</b>
Duan, W. J. Ho, S. M. Y. Tang, X. Q. Li, T. T. Zhang, Y. H. Character Strength-Based Intervention to Promote Satisfaction with Life in the Chinese University Context. 2014. Journal of Happiness Studies. 15. 6. 1347-1361	<b>Exclusion reason: Adult population</b>
Duberg, A. Hagberg, L. Sunvisson, H. Moller, M. Influencing self-rated health among adolescent girls with dance intervention: a randomized controlled trial. 2013. JAMA Pediatrics. 167. 1. 27-31	<b>Exclusion reason: Wrong outcomes</b>
Duberg, A. Moller, M. Taube, J. . 2013. Lakartidningen. 110. 36. 1539	<b>Exclusion reason: Wrong outcomes</b>
Duffy, Sophia Brown, Tasha M. Katsonga-Phiri, Tiemo Bouris, Alida Grant, Kathryn E. Keenan, Kate. Development of an empirically based preventive intervention for depression in preadolescent African American girls. 2016. Prevention Science. 17. 4. 503-512	<b>Exclusion reason: Wrong outcomes</b>
Duman, F. Kokacya, M. H. Dogru, E. Katayifci, N. Canbay, O. Aman, F. The Role of Active Video-Accompanied Exercises in Improvement of the Obese State in Children: A Prospective Study from Turkey. 2016. Journal of clinical research in pediatric endocrinology. 8. 3. 334-40	<b>Exclusion reason: Wrong study design</b>
Duman, Marilyn. Aerobic exercise and mood disturbance in college women. 1993. Dissertation Abstracts International. 53. 7-B. 3770	<b>Exclusion reason: Adult population</b>
Dunn, A. L. Trivedi, M. H. O Neal, H. A. Physical activity dose-response effects on outcomes of depression and anxiety. 2003. VOL 33 NO 6 SUPPL. S587-S597	<b>Exclusion reason: Wrong study design</b>
Eather, N. Morgan, P. J. Lubans, D. R. Effects of exercise on mental health outcomes in adolescents: Findings from the CrossFit (TM) teens randomized controlled trial. 2016. Psychology of Sport and Exercise. 26. 14-23	<b>Exclusion reason: Prevention</b>
Eby, John M. An investigation into the effects of aerobic exercise on anxiety and depression. 1985. Dissertation Abstracts International. 46. 5-B. 1734	<b>Exclusion reason: Adult population</b>
Edwards, Michelle Waldo, Michael. Effects of a mindfulness course on adolescent students: Examining levels of perceived stress, mindfulness, self-compassion and psychological symptoms. 2012. 3537760. 135	<b>Exclusion reason: Wrong intervention</b>
Einhaus, Lynne Blanken. A COMPARISON OF THE EFFECTS OF TWO EXERCISE PROGRAMS ON CHILDREN'S SELF-CONCEPT, LOCUS OF CONTROL, AND MOOD. 1984. 8500981. 110	<b>Exclusion reason: Prevention</b>
Fadillioglu, Ersin Kaya, Burhanettin Uz, Efkan Emre, Memet Hanifi Unal, Suheyla. Effects of moderate exercise on mild depressive mood, antioxidants and lipid peroxidation. 2000. Klinik Psikofarmakoloji Bulteni / Bulletin of Clinical Psychopharmacology. 10. 4. 194-200	<b>Exclusion reason: Adult population</b>
Falsafi, Nasrin. A randomized controlled trial of mindfulness versus yoga: Effects on depression and/or anxiety in college students. 2016. Journal of the American Psychiatric Nurses Association. 22. 6. 483-497	<b>Exclusion reason: Adult population</b>
Fathiahmadsaraei, N Amini, K Hamidi, E. Comparison self-esteem and anxiety in athletes and untrained adolescent girls in karaj. 2012. Iranian journal of psychiatry. 7. 4 suppl. 1. 171	<b>Exclusion reason: Prevention</b>
Federici, Joseph R. The effect of regular exercise on depressive symptomatology. 1986. Dissertation Abstracts International. 47. 6-B. 2613	<b>Exclusion reason: Adult population</b>



Feldman, Ellen. Physical Activity 'Moves' Teens Away from Depression. 2017. Integrative Medicine Alert. 20. 1. 4-7	<b>Exclusion reason: Wrong study design</b>
Felver, Joshua C. Butzer, Bethany Olson, Katherine J. Smith, Iona M. Khalsa, Sat Bir S. Yoga in public school improves adolescent mood and affect. 2015. Contemporary School Psychology. 19. 3. 184-192	<b>Exclusion reason: Wrong study design</b>
Feuerstein, Lee William. The relationship of aerobic exercise and task mastery to reduction of anxiety and depression. 1994. Dissertation Abstracts International: Section B: The Sciences and Engineering. 55. 2-B. 588	<b>Exclusion reason: Adult population</b>
Finocchiaro, Melanie S. Schmitz, Catherine L. Exercise: A holistic approach for the treatment of the adolescent psychiatric patient. 1984. Issues in Mental Health Nursing. 6. 3-4. 237-243	<b>Exclusion reason: Wrong study design</b>
Fishbein, D. Miller, S. Herman-Stahl, M. Williams, J. Lavery, B. Markovitz, L. Kluckman, M. Mosoriak, G. Johnson, M. Behavioral and Psychophysiological Effects of a Yoga Intervention on High-Risk Adolescents: A Randomized Control Trial. 2016. Journal of Child and Family Studies. 25. 2. 518-529	<b>Exclusion reason: Prevention</b>
Forsyth, A Deane, Fp Williams, P. A lifestyle intervention for primary care patients with depression and anxiety: a randomised controlled trial. 2015. Psychiatry Research. 230. 2. 537-544	<b>Exclusion reason: Adult population</b>
Forzani, Christina Ann. The experiences of adolescent females who practice yoga. 2009. Dissertation Abstracts International: Section B: The Sciences and Engineering. 70. 5-B. 3169	<b>Exclusion reason: Wrong study design</b>
Frank, J. L. Kohler, K. Peal, A. Bose, B. Effectiveness of a School-Based Yoga Program on Adolescent Mental Health and School Performance: Findings from a Randomized Controlled Trial. 2017. Mindfulness. 8. 3. 544-553	<b>Exclusion reason: Prevention</b>
Frank, Jennifer L. Bose, Bidyut Schrobenhauser-Clonan, Alex. Effectiveness of a school-based yoga program on adolescent mental health, stress coping strategies, and attitudes toward violence: Findings from a high-risk sample. 2014. Journal of Applied School Psychology. 30. 1. 29-49	<b>Exclusion reason: Prevention</b>
Fung, Annis Lai Chu Lee, Toney Ka Hung. Effectiveness of Chinese martial arts and philosophy to reduce reactive and proactive aggression in schoolchildren. 2018. 39. 5. 404-414	<b>Exclusion reason: Wrong patient population</b>
Gallego, J. Aguilar-Parra, J. M. Cangas, A. J. Langer, A. I. Manas, I. Effect of a mindfulness program on stress, anxiety and depression in university students. 2015. Spanish Journal of Psychology. 17. . E109	<b>Exclusion reason: Adult population</b>
Gangadhar, Bn Naveen, Gh Rao, Mg Thirthalli, J Varambally, S. Positive antidepressant effects of generic yoga in depressive out-patients: a comparative study. 2013. Indian Journal of Psychiatry. 55. 7. S369-s373	<b>Exclusion reason: Adult population</b>
Goldfield, G. S. Kenny, G. P. Alberga, A. S. Prud'homme, D. Hadjiyannakis, S. Gougeon, R. Phillips, P. Tulloch, H. Malcolm, J. Doucette, S. Wells, G. A. Ma, J. Cameron, J. D. Sigal, R. J. Effects of aerobic training, resistance training, or both on psychological health in adolescents with obesity: the HEARTY randomized controlled trial [with consumer summary]. 2015. Journal of Consulting and Clinical Psychology 2015 Dec83(6):1123-1135.	<b>Exclusion reason: Prevention</b>
Goodrich, Frederick G. The effects of aerobic fitness training on hostility and depression in a college population. 1984. Dissertation Abstracts International. 45. 6-B. 1920	<b>Exclusion reason: Prevention</b>
Greer, Tl Trombello, Jm Rethorst, Cd Carmody, Tj Jha, Mk Liao, A Grannemann, Bd Chambliss, Ho Church, Ts Trivedi, Mh. Improvements in psychosocial functioning and health-related quality of life following	<b>Exclusion reason: Adult population</b>

exercise augmentation in patients with treatment response but nonremitted major depressive disorder: Results from the tread study. 2016. <i>Depression and Anxiety</i> . 33. 9. 870-881	
Greist, Jh Klein, Mh Eischens, Rr Faris, Jw Gurman, As Morgan, Wd. Running as treatment for depression. 1979. <i>Comprehensive Psychiatry</i> . 20. 1. 41-54	<b>Exclusion reason:</b> <b>Adult population</b>
Guan, Shang-yi Li, Qui-li Zhang, Shao-sheng. Effect of strength training on depression and monoamine transmitters in female college students with depression symptoms. 2008. <i>Journal of Wuhan Institute of Physical Education</i> . 42. 10. 70-74	<b>Exclusion reason:</b> <b>Adult population</b>
Gurley, V. Neuringer, A. Masee, J. Dance and sports compared: effects on psychological well-being. / Comparaison danse et sports: les effets sur le bien-etre psychologique. 1984. <i>Journal of Sports Medicine &amp; Physical Fitness</i> . 24. 1. 58-68	<b>Exclusion reason:</b> <b>Wrong study design</b>
Hagins, M. Haden, S. C. Daly, L. A. A Randomized Controlled Trial on the Effects of Yoga on Stress Reactivity in 6th Grade Students. 2013. <i>Evidence-based Complementary and Alternative Medicine</i> . 9	<b>Exclusion reason:</b> <b>Prevention</b>
Hallam, K. Bilsborough, S. de Courten, M. "Happy feet": Evaluating the benefits of a 100-day 10,000 step challenge on mental health and wellbeing. 2018. <i>BMC Psychiatry Vol 18 2018, ArtID 19</i> . 18. .	<b>Exclusion reason:</b> <b>Adult population</b>
Hallgren, M. Kraepelien, M. Ojehagen, A. Lindefors, N. Zeebari, Z. Kaldo, V. Forsell, Y. Physical exercise and internet-based cognitive-behavioural therapy in the treatment of depression: randomised controlled trial. 2015. <i>British Journal of Psychiatry</i> . 207. 3. 227-34	<b>Exclusion reason:</b> <b>Adult population</b>
Hamre, Hj Witt, Cm Glockmann A. Eurythmy therapy in chronic disease: a four-year prospective cohort study. 2008. <i>Merkurstab</i> . 61. 4. 331-42.	<b>Exclusion reason:</b> <b>Wrong study design</b>
Harris, D. V. Rueter, M. Mutrie, N. The effects of running on individuals who are clinically depressed. 1985.	<b>Exclusion reason:</b> <b>Adult population</b>
Hernández-Martínez, Antonio. La relación entre la actividad física y los síntomas depresivos en adolescentes: una revisión sistemática. 2015. <i>Enfermería Clínica</i> . 25. 4. 215-216	<b>Exclusion reason:</b> <b>Wrong study design</b>
Hilgendorf, Kari Jo. Investigation into the potentially beneficial role of exercise for children suffering from maltreatment. 2017. <i>Dissertation Abstracts International: Section B: The Sciences and Engineering</i> . 77. 8-B(E). No Pagination Specified	<b>Exclusion reason:</b> <b>Wrong study design</b>
Hilyer, James C. Wilson, Dennis G. Dillon, Carol Caro, Laura Jenkins, Chester Spencer, William A. Meadows, Mark E. Booker, Wayne. Physical fitness training and counseling as treatment for youthful offenders. 1982. <i>Journal of Counseling Psychology</i> . 29. 3. 292-303	<b>Exclusion reason:</b> <b>Prevention</b>
Ho, Cassandra W. H. Chan, S. C. Wong, J. S. Cheung, W. T. Chung, Dicky W. S. Lau, Titanic F. O. Effect of Aerobic Exercise Training on Chinese Population with Mild to Moderate Depression in Hong Kong. 2014. 1-8	<b>Exclusion reason:</b> <b>Adult population</b>
Ho, F. K. W. Louie, L. H. T. Wong, W. H. S. Chan, K. L. Tiwari, A. Chow, C. B. Ho, W. Wong, W. Chan, M. Chen, E. Y. H. Cheung, Y. F. Ip, P. A Sports-Based Youth Development Program, Teen Mental Health, and Physical Fitness: An RCT. 2017. <i>Pediatrics</i> . 140. 4. 10	<b>Exclusion reason:</b> <b>Prevention</b>
Hodge, Tracy Michele Rabin, Adele. The effects of exercise on depressed mood in prepubertal children. 2003. 3079008. 314	<b>Exclusion reason:</b> <b>Duplicate</b>
Hodge, Tracy Michele. The effects of exercise on depressed mood in prepubertal children. 2003. <i>Dissertation Abstracts International: Section B: The Sciences and Engineering</i> . 64. 1-B. 421	<b>Exclusion reason:</b> <b>Wrong study design</b>

Hoganbruen, Kathleen Debra. Increasing girls' self-esteem and overall psychological well-being through sports: A program evaluation of a preventive intervention. 1999. Dissertation Abstracts International: Section B: The Sciences and Engineering. 60. 3-B. 1301	<b>Exclusion reason: Wrong study design</b>
Holmes, Ds Roth, DI. Effects of aerobic exercise training and relaxation training on cardiovascular activity during psychological stress. 1988. Journal of Psychosomatic Research. 32. 4-5. 469-474	<b>Exclusion reason: Prevention</b>
Hoying, Jacqueline Ann. COPE: A pilot study with urban sixth grade youth to improve physical activity and mental health outcomes. 2017. Dissertation Abstracts International: Section B: The Sciences and Engineering. 77. 10-B(E). No Pagination Specified	<b>Exclusion reason: Wrong study design</b>
Hoying, Jacqueline Melnyk, Bernadette Mazurek. COPE: A pilot study with urban-dwelling minority sixth-grade youth to improve physical activity and mental health outcomes. 2016. The Journal of School Nursing. 32. 5. 347-356	<b>Exclusion reason: Prevention</b>
Hughes, C. W. Barnes, S. Barnes, C. de Fina, L. F. Nakonezny, P. Emslie, G. J. Depressed Adolescents Treated with Exercise (DATE): a pilot randomized controlled trial to test feasibility and establish preliminary effect sizes. 2013. Mental Health and Physical Activity 2013 Jun6(2):119-131.	<b>Exclusion reason: Wrong comparator</b>
Hughes, Carroll W. Trivedi, Madhukar H. Cleaver, Joseph Greer, Tracy L. Emslie, Graham J. Kennard, Beth Dorman, Shauna Bain, Tyson Dubreuil, Judy Barnes, Conrad. DATE: Depressed adolescents treated with exercise: Study rationale and design for a pilot study. 2009. Mental Health and Physical Activity. 2. 2. 76-85	<b>Exclusion reason: Wrong comparator</b>
Hunt, Melissa Al-Braiki, Farah Dailey, Shannon Russell, Rachel Simon, Krystyna. Mindfulness training, yoga, or both? Dismantling the active components of a mindfulness-based stress reduction intervention. 2017. Mindfulness. . . No Pagination Specified	<b>Exclusion reason: Adult population</b>
I. Hua Chu Yuh-Jen, Lin Wen-Lan, Wu Yu-Kai, Chang I. Mei Lin. Effects of Yoga on Heart Rate Variability and Mood in Women: A Randomized Controlled Trial. 2015. Journal of Alternative & Complementary Medicine. 21. 12. 789-795	<b>Exclusion reason: Adult population</b>
IN2SHAPE: a Study of Physical Activity and Depressive Symptoms in Adolescence. 2008. ClinicalTrials.gov	<b>Exclusion reason: Wrong intervention</b>
Influencing Adolescent Girls' With Creative Dance Twice Weekly. 2012. ClinicalTrials.gov	<b>Exclusion reason: Prevention</b>
Jackson, Allen Greenleaf, Christy Martin, Scott Trent, Petrie. The Relations Between Health-Related Fitness and Depression in Middle School Children. 2011. Medicine & Science in Sports & Exercise. 43. . 274-274	<b>Exclusion reason: Wrong study design</b>
Jacobson, D. A primary care school age Healthy Choices Intervention program. 2009. Ph.D. 291 p-291 p	<b>Exclusion reason: Wrong study design</b>
Jacobson, Diana Melnyk, Bernadette Mazurek. A primary care Healthy Choices Intervention Program for overweight and obese school-age children and their parents. 2012. Journal of Pediatric Health Care. 26. 2. 126-138	<b>Exclusion reason: Wrong study design</b>
Jeitler, M. Zillgen, H. Hogl, M. Steckhan, N. Stockigt, B. Seifert, G. Michalsen, A. Kessler, C. Yoga in school sport-a non-randomized controlled pilot study in germany including a qualitative evaluation. 2017. BMC Complementary and Alternative Medicine. Conference: World Congress Integrative Medicine and Health. 17. Supplement 1.	<b>Exclusion reason: Wrong study design</b>

Jelalian, E. Jandasek, B. Wolff, J. C. Seaboyer, L. M. Jones, R. N. Spirito, A. Cognitive-Behavioral Therapy Plus Healthy Lifestyle Enhancement for Depressed, Overweight/Obese Adolescents: Results of a Pilot Trial. 2016. Journal of Clinical Child & Adolescent Psychology. 1-10	<b>Exclusion reason: Wrong intervention</b>
Johnson, Janice A. The effects of group and individualized running therapy on depression. 1986. Dissertation Abstracts International. 46. 10-A. 2926	<b>Exclusion reason: Adult population</b>
Jung Su, Yang Jae Myun, K. O. Hee Tae, R. O. H. Effects of regular Taekwondo exercise on mood changes in children from multicultural families in South Korea: a pilot study. 2018.30. 4. 496-499	<b>Exclusion reason: Prevention</b>
Kanner, K. D. High versus low-intensity exercise as part of an inpatient treatment program for childhood and adolescent depression. 1990.	<b>Exclusion reason: Prevention</b>
Kaplan, Kathy Mendelson, Linda B. Dubroff, Melissa P. The effect of a jogging program on psychiatric inpatients with symptoms of depression. 1983. Occupational Therapy Journal of Research. 3. 3. 173-175	<b>Exclusion reason: Wrong study design</b>
Keller, J. Exercise decreases risk of depression in kids. 2004. IDEA Fitness Journal. 1. 4. 21-21	<b>Exclusion reason: Wrong study design</b>
Kelly, Daniel J. Yoga and meditation in a therapeutic day school. 2007. Dissertation Abstracts International: Section B: The Sciences and Engineering. 68. 4-B. 2654	<b>Exclusion reason: Prevention</b>
Kennedy, Mm Newton, M. Effect of exercise intensity on mood in step aerobics. 1997. Journal of Sports Medicine and Physical Fitness. 37. 3. 200-204	<b>Exclusion reason: Adult population</b>
Kim, H. B. So, W. Y. EFFECT OF SIXTEEN WEEKS OF COMBINED EXERCISE ON BODY COMPOSITION, PHYSICAL FITNESS AND COGNITIVE FUNCTION IN KOREAN CHILDREN. 2015. South African Journal for Research in Sport Physical Education and Recreation. 37. 1. 47-57	<b>Exclusion reason: Prevention</b>
Kim, Kb Cohen, Sm Oh, Hk Sok, Sr. The effects of meridian exercise on anxiety, depression, and self-esteem of female college students in Korea. 2004. Holistic Nursing Practice. 18. 5. 230-234	<b>Exclusion reason: Adult population</b>
Kokinakis, Leah Hope. Yoga and adolescents: What do we know? the effects of yoga on adolescents' cognition and social-emotional development. 2012. Dissertation Abstracts International: Section B: The Sciences and Engineering. 73. 5-B. 3301	<b>Exclusion reason: Wrong outcomes</b>
Kong, H. S. Wu, C. Hung, J. K. Fan, R. Zhao, R. The Research of Experiment About the Sunlight Sports Affects to Shanghai Secondary Vocational Students Mental Healthy. 2015. 350-356	<b>Exclusion reason: Wrong study design</b>
Koppel, H. Beating the blues. 2001. CPJ: Counselling & Psychotherapy Journal. 12. 4. 14-15	<b>Exclusion reason: Wrong study design</b>
Kremer, P Elshaug, C Leslie, E Toumbourou, Jw Patton, Gc Williams, J. Physical activity, leisure-time screen use and depression among children and young adolescents. 2014. Journal of Science and Medicine in Sport. 17. 2. 183-7.	<b>Exclusion reason: Wrong study design</b>
Krogh, J. Petersen, L. Timmermann, M. Saltin, B. Nordentoft, M. Design paper: the DEMO trial: a randomized, parallel-group, observer-blinded clinical trial of aerobic versus non-aerobic versus relaxation training for patients with light to moderate depression. 2007. Contemporary Clinical Trials. 28. 1. 79-89	<b>Exclusion reason: Adult population</b>
Krogh, J. Rostrup, E. Thomsen, C. Elfving, B. Videbech, P. Nordentoft, M. The effect of exercise on hippocampal volume and neurotrophines in patients with major depression--a randomized clinical trial. 2014. Journal of Affective Disorders. 165. . 24-30	<b>Exclusion reason: Adult population</b>

Krogh, J. Videbech, P. Thomsen, C. Gluud, C. Nordentoft, M. DEMO-II trial. Aerobic exercise versus stretching exercise in patients with major depression-a randomised clinical trial. 2012. PLoS ONE [Electronic Resource]. 7. 10. e48316	<b>Exclusion reason: Adult population</b>
Krogh, Jesper Rostrup, Egill Thomsen, Carsten Elfving, Betina Videbech, Poul Nordentoft, Merete. The effect of exercise on hippocampal volume and neurotrophines in patients with major depression-A randomized clinical trial. 2014. 164. 24-30	<b>Exclusion reason: Adult population</b>
Kwan, Bethany M. Davis, Kyle J. Dunn, Andrea L. Physical activity for the prevention of depression. 2012. 97-119	<b>Exclusion reason: Wrong study design</b>
Lancer, Robert Motta, Robert Lancer, Dena. The effect of aerobic exercise on obsessive-compulsive disorder, anxiety, and depression: A preliminary investigation. 2007. the Behavior Therapist. 30. 3. 53, 57-62	<b>Exclusion reason: Adult population</b>
Lang, C. Feldmeth, A. K. Brand, S. Holsboer-Trachsler, E. Puhse, U. Gerber, M. Effects of a physical education-based coping training on adolescents' coping skills, stress perceptions and quality of sleep. 2017. Physical Education and Sport Pedagogy. 22. 3. 213-230	<b>Exclusion reason: Wrong outcomes</b>
Lau, P. W. C. Yu, C. W. Lee, A. Sung, R. Y. T. The physiological and psychological effects of resistance training on Chinese obese adolescents. 2004. Journal of Exercise Science and Fitness 20042(2):115-120.	<b>Exclusion reason: Prevention</b>
Lavey, Roberta Sherman, Tom Mueser, Kim T. Osborne, Donna D. Currier, Melinda Wolfe, Rosemarie. The Effects of Yoga on Mood in Psychiatric Inpatients. 2005. Psychiatric Rehabilitation Journal. 28. 4. 399-402	<b>Exclusion reason: Adult population</b>
Lee Melody, L. C. Luo, Chia Ming. HEALTH-RELATED FITNESS, PHYSICAL ACTIVITY BEHAVIOR, AND DEPRESSION. (Abstract). 2004.	<b>Exclusion reason: Adult population</b>
Legrand, Fabien D. Thatcher, Joanne. Acute mood responses to a 15-minute long walking session at self-selected intensity: Effects of an experimentally-induced telic or paratelic state. 2011. Emotion. 11. 5. 1040-1045	<b>Exclusion reason: Adult population</b>
Legrand, Fd. Effects of exercise on physical self-concept, global self-esteem, and depression in women of low socioeconomic status with elevated depressive symptoms. 2014. Journal of Sport & Exercise Psychology. 36. 4. 357-365	<b>Exclusion reason: Adult population</b>
Li, Gang Yin, Jian-Chun. The Effect of Shadowboxing Exercise on Mood and $\hat{\rho}^2$ -Ep in Still Condition of Female College Students. 2008. Journal of Beijing Sport University. 31. 3. 357-358	<b>Exclusion reason: Adult population</b>
Li, Menglong Lu, Liya. Intervention study on the psychological health of Chinese rural left-behind middle school students with internet addiction disorder by sunshine sports. 2016. Revista Argentina de Clinica Psicologica. 25. 2. 167-176	<b>Exclusion reason: Prevention</b>
Lim, Yb Kim, Jw Hong, Sb Kim, Jw. Association between BDNF and Antidepressant Effects of Exercise in Youth: a Preliminary Study. 2016. J korean acad child adolesc psychiatry. 27. 1. 72-81	<b>Exclusion reason: Prevention</b>
Lin, Susan H. Depression, health interventions, and play. 2012. OT Practice. 17. 15. 32-32	<b>Exclusion reason: Wrong study design</b>
Linck, Donna Teresa. Female Teens Step It Up with the Fitbit Zip: A Randomized Controlled Pilot Study. 2018. 1-1	<b>Exclusion reason: Prevention</b>
Lu, X. Wang, D. Q. Dong, Y. EFFECT OF SOLUTION-FOCUSED BRIEF THERAPY-BASED ON EXERCISE PRESCRIPTION INTERVENTION ON ADOLESCENT MENTAL HEALTH. 2017. Revista Argentina de Clinica Psicologica. 26. 3. 347-355	<b>Exclusion reason: Wrong intervention</b>

Luttenberger, Katharina Stelzer, Eva-Maria Forst, Stefan Schopper, Matthias Kornhuber, Johannes Book, Stephanie. Indoor rock climbing (bouldering) as a new treatment for depression: Study design of a waitlist-controlled randomized group pilot study and the first results. 2015. BMC Psychiatry Vol 15 2015, ArtID 201. 15.	<b>Exclusion reason: Adult population</b>
Mack, Mick G. Huddleston, Sharon. MOOD STATE CHANGES OF STUDENTS ENROLLED IN PHYSICAL ACTIVITY CLASSES. 2000. Perceptual & Motor Skills. 90. 3. 911	<b>Exclusion reason: Adult population</b>
MacMahon, Jr Gross, Rt. Physical and psychological effects of aerobic exercise in delinquent adolescent males. 1988. American journal of diseases of children (1960). 142. 12. 1361-1366	<b>Exclusion reason: Prevention</b>
Mailey, Emily L. Wojcicki, Thomas R. Motl, Robert W. Hu, Liang Strauser, David R. Collins, Kimberly D. McAuley, Edward. Internet-delivered physical activity intervention for college students with mental health disorders: A randomized pilot trial. 2010. Psychology, Health & Medicine. 15. 6. 646-659	<b>Exclusion reason: Adult population</b>
Marshall, Mary P. The relationship of aerobic exercise training and workouts to lower levels of anxiety and depression. 1984. Dissertation Abstracts International. 44. 12-B. 3716	<b>Exclusion reason: Adult population</b>
Martinsen, E. W. Medhus, A. Sandvik, L. Effects of aerobic exercise on depression: a controlled study. 1985. British Medical Journal Clinical Research Ed. 291. 6488. 109	<b>Exclusion reason: Adult population</b>
Martinsen, E. W. Physical activity in the prevention and treatment of anxiety and depression. 2008. . . NUMB 47. 25-29	<b>Exclusion reason: Wrong study design</b>
Mayer, J. S. Hees, K. Medda, J. Grimm, O. Asherson, P. Bellina, M. Colla, M. Ibanez, P. Koch, E. Martinez-Nicolas, A. Muntaner-Mas, A. Rommel, A. Rommelse, N. de Ruiter, S. Ebner-Priemer, U. W. Kieser, M. Ortega, F. B. Thome, J. Buitelaar, J. K. Kuntsi, J. Ramos-Quiroga, J. A. Reif, A. Freitag, C. M. Bright light therapy versus physical exercise to prevent co-morbid depression and obesity in adolescents and young adults with attention-deficit / hyperactivity disorder: study protocol for a randomized controlled trial. 2018. Trials [Electronic Resource]. 19. 1. 140	<b>Exclusion reason: Prevention</b>
McArthur, R. G. Emes, C. A comparison of two modes of delivering a fitness-based weight control program. 1989.	<b>Exclusion reason: Prevention</b>
McBride, Maureen A. Cardiovascular fitness training as an adjunct to depressive therapy. 1984. Dissertation Abstracts International. 44. 7-A. 2095	<b>Exclusion reason: Adult population</b>
McCabe, Kym M. The effects of yoga on symptoms associated with conduct disorder with callous unemotional traits as a moderator. 2010. Dissertation Abstracts International: Section B: The Sciences and Engineering. 71. 1-B. 664	<b>Exclusion reason: Prevention</b>
McCann, I. Holmes, David S. Influence of aerobic exercise on depression. 1984. Journal of Personality and Social Psychology. 46. 5. 1142-1147	<b>Exclusion reason: Adult population</b>
Melnyk, B. M. Kelly, S. Jacobson, D. Belyea, M. Shaibi, G. Small, L. O'Haver, J. Marsiglia, F. F. The COPE healthy lifestyles TEEN randomized controlled trial with culturally diverse high school adolescents: Baseline characteristics and methods. 2013. Contemporary Clinical Trials. 36. 1. 41-53	<b>Exclusion reason: Prevention</b>
Melnyk, Bernadette Kelly, Stephanie Jacobson, Diana Arcoleo, Kimberly Shaibi, Gabriel. Improving physical activity, mental health outcomes, and academic retention in college students with Freshman 5 to thrive:	<b>Exclusion reason: Adult population</b>

COPE/Healthy lifestyles. 2014. Journal of the American Association of Nurse Practitioners. 26. 6. 314-322	
Melnyk, Bernadette M. Jacobson, Diana Kelly, Stephanie Belyea, Michael Shaibi, Gabriel Small, Leigh O'Haver, Judith Marsiglia, Flavio F. Promoting healthy lifestyles in high school adolescents: A randomized controlled trial. 2013. American Journal of Preventive Medicine. 45. 4. 407-415	<b>Exclusion reason: Prevention</b>
Melnyk, Bm Jacobson, D Kelly, S O'Haver, J Small, L Mays, Mz. Improving the mental health, healthy lifestyle choices, and physical health of Hispanic adolescents: a randomized controlled pilot study. 2009. Journal of School Health. 79. 12. 575-584	<b>Exclusion reason: Prevention</b>
Melnyk, Bm Jacobson, D Kelly, Sa Belyea, Mj Shaibi, Gq Small, L O'Haver, Ja Marsiglia, Ff. Twelve-Month Effects of the COPE Healthy Lifestyles TEEN Program on Overweight and Depressive Symptoms in High School Adolescents. 2015. Journal of School Health. 85. 12. 861-870	<b>Exclusion reason: Wrong intervention</b>
Merns, K. Mood and self-esteem enhancement in different exercise modes. 1994.	<b>Exclusion reason: Wrong study design</b>
Monk, Susan V. Intensity and mastery in physical activity as related to depression and mood. 1991. Dissertation Abstracts International. 51. 9-A. 3012	<b>Exclusion reason: Adult population</b>
Morgan, W. Psychological consequences of vigorous physical activity. 1976.	<b>Exclusion reason: Wrong study design</b>
Morken, G. Sund, A. M. P.1.141 Physical activity as a protection against depressive symptoms in early adolescence. 2003. VOL 13 SUPPL 4. S234	<b>Exclusion reason: Wrong study design</b>
Motta, Robert W. Kuligowski, Jenna M. Marino, Dawn M. The Role of Exercise in Reducing Childhood and Adolescent PTSD, Anxiety, and Depression. 2010. Communique. 38. 6. 24-26	<b>Exclusion reason: Wrong study design</b>
Nabkasorn, C. Miyai, N. Sootmongkol, A. Junprasert, S. Yamamoto, H. Arita, M. Miyashita, K. Effects of physical exercise on depression, neuroendocrine stress hormones and physiological fitness in adolescent females with depressive symptoms [with consumer summary]. 2006. European Journal of Public Health 2006 Apr16(2):179-184.	<b>Exclusion reason: Adult population</b>
Nanney, Marilyn S. A programme of culturally tailored dance plus an intervention to reduce screen media use does not reduce BMI over 2 years compared with health education in preadolescent low-income African American girls but does reduce depressive symptoms and lipid. 2011. Evidence Based Medicine. 16. 3. 84-85	<b>Exclusion reason: Wrong study design</b>
Nasstasia, null Baker, A. Halpin, S. Lewin, T. Kelly, B. Callister, R. Exercising depression in young people: An exploration of symptom changes in response to exercise. 2015. Journal of Science & Medicine in Sport. 19. e55-e55	<b>Exclusion reason: Adult population</b>
Nasstasia, Y. Baker, A. L. Halpin, S. A. Hides, L. Lewin, T. J. Kelly, B. J. Callister, R. Evaluating the efficacy of an integrated motivational interviewing and multi-modal exercise intervention for youth with major depression: Healthy Body, Healthy Mind randomised controlled trial protocol. 2018. Contemporary Clinical Trials Communications. 9. 13-22	<b>Exclusion reason: Adult population</b>
Neissaar, Inga Kikas, Maris Jarvekulg, Anu Viru, Mehis Viru, Atko. Neposredan Ut Jecaj Vjezbanja Aerobike Na Smanjenje Anksioznosti I Uravnotezenje Raspolozenja: Relacije Sa Zivotnom Dobi, Crtama Licnosti I Pocetnim Raspolozenjem. 2002. Kinesiology. 34. 1. 86-93	<b>Exclusion reason: Adult population</b>

Newman, Caren L. Motta, Robert W. The effects of aerobic exercise on childhood PTSD, anxiety, and depression. 2007. International Journal of Emergency Mental Health. 9. 2. 133-158	<b>Exclusion reason: Wrong study design</b>
Newman, Caren L. The effects of aerobic exercise on childhood PTSD, anxiety, and depression. 2007. Dissertation Abstracts International: Section B: The Sciences and Engineering. 67. 10-B. 6070	<b>Exclusion reason: Wrong patient population</b>
Newnham, David. Thrills and spills. 2015. Nursing Standard. 29. 36. 27-27	<b>Exclusion reason: Wrong study design</b>
Niederer, D. Vogt, L. Staschke, V. Maulbecker-Armstrong, C. Beck, V. Banzer, W. [Activity trails in the therapy of clinical depression: A randomized controlled equivalence trial]. 2017. Zeitschrift Fuer Psychosomatische Medizin und Psychotherapie. 63. 2. 163-175	<b>Exclusion reason: Adult population</b>
Niemi, M. Kiel, S. Allebeck, P. Hoan le, T. Community-based intervention for depression management at the primary care level in Ha Nam Province, Vietnam: a cluster-randomised controlled trial. 2016. Tropical Medicine & International Health. 21. 5. 654-61	<b>Exclusion reason: Adult population</b>
NONPROFIT PROGRAM BENEFITS MENTAL HEALTH FOR CHILDREN OF WOUNDED SERVICE MEMBERS. 2012. Exceptional Parent. 42. 3. 54-54	<b>Exclusion reason: Wrong study design</b>
Norris, Richard Carroll, Douglas Cochrane, Raymond. The effects of physical activity and exercise training on psychological stress and well-being in an adolescent population. 1992. Journal of Psychosomatic Research. 36. 1. 55-65	<b>Exclusion reason: Wrong study design</b>
North, T. C. McCullagh, P. Tran, Z. V. Effect of exercise on depression. 1990. Exercise & Sport Sciences Reviews. 18. . 379-415	<b>Exclusion reason: Wrong study design</b>
Nugraha, B. Gutenbrunner, C. Evidence of exercise in management of depression. 2013. . . VOL 45 NUMB 9. IL56	<b>Exclusion reason: Wrong study design</b>
Oeland, Am Laessoe, U Olesen, Av Munk-J�rgensen, P. Impact of exercise on patients with depression and anxiety. 2010. Nordic Journal of Psychiatry. 64. 3. 210-217	<b>Exclusion reason: Adult population</b>
Oguchi, E. Ishida, H. Kashima, H. Watanabe, K. Kikuchi, T. The mental health effects of exercise (1): the effect of walking as an aerobic exercise on prolonged depression. 2009. Bulletin of St. Luke's College of Nursing. . 35. 61-67	<b>Exclusion reason: Wrong study design</b>
Oh, Cu Kim, Nc. Effects of T'ai Chi on Serotonin, Nicotine Dependency, Depression, and Anger in Hospitalized Alcohol-Dependent Patients. 2016. Journal of alternative and complementary medicine (new york, N.Y.). 22. 12. 957-963	<b>Exclusion reason: Adult population</b>
Olafsdottir, K. B. Kristjansdottir, H. Saavedra, J. M. Effects of Exercise on Depression and Anxiety. A Comparison to Transdiagnostic Cognitive Behavioral Therapy. 2018. 54. 6. 855-859	<b>Exclusion reason: Adult population</b>
Olive, L. Byrne, D. Cunningham, R. Telford, R. Depression and body image in children: Is physical activity beneficial and how is this translated into clinical practice? Lifestyle of our kids study. 2014. Journal of Science & Medicine in Sport. 18. e114-e114	<b>Exclusion reason: Wrong study design</b>
Other complementary therapies. 2006. Focus on Alternative & Complementary Therapies. 11. 2. 158-160	<b>Exclusion reason: Wrong study design</b>
Pakstis, John C. A study of the relationship between aerobic exercise and mood, attributional style and self-consciousness of depressives. 1989. Dissertation Abstracts International. 49. 8-B. 3453	<b>Exclusion reason: Adult population</b>



Pallavi, P. A randomized, single-blind, trial of yoga therapy as an adjunct to SSRI treatment for adolescent depression patients: Variations in serum cytokine and neurotrophin levels. 2014. <i>Biological Psychiatry</i> . 1).118S	<b>Exclusion reason: Wrong study design</b>
Palmer, J. A. Palmer, L. K. Michiels, K. Thigpen, B. Effects of type of exercise on depression in recovering substance abusers. 1995. <i>Perceptual &amp; Motor Skills</i> . 80. 2. 523-30	<b>Exclusion reason: Adult population</b>
Pareja-Galeano, Helios Sanchis-Gomar, Fabian Lucia, Alejandro. Physical activity and depression: type of exercise matters.. <i>JAMA Pediatr</i> . 2014 Dec168(12):1093-100. 2015. <i>JAMA Pediatrics</i> . 169. 3. 288-289	<b>Exclusion reason: Wrong study design</b>
Park, Alice. How Exercise Can Help Depression in Kids. 2017. <i>ASCA Newsletter</i> . 2017. 7. 18-19	<b>Exclusion reason: Wrong study design</b>
Parker, A. G. Hetrick, S. E. Jorm, A. F. Yung, A. R. McGorry, P. D. Mackinnon, A. Moller, B. Purcell, R. The effectiveness of simple psychological and exercise interventions for high prevalence mental health problems in young people: A factorial randomised controlled trial. 2011. <i>Trials [Electronic Resource]</i> . 12 (no pagination). 76.	<b>Exclusion reason: Wrong intervention</b>
Parker, Alexandra G. Hetrick, Sarah E. Jorm, Anthony F. Mackinnon, Andrew J. McGorry, Patrick D. Yung, Alison R. Scanlan, Faye Stephens, Jessica Baird, Shelley Moller, Bridget Purcell, Rosemary. The effectiveness of simple psychological and physical activity interventions for high prevalence mental health problems in young people: A factorial randomised controlled trial. 2016. <i>Journal of Affective Disorders</i> . 196. 200-209	<b>Exclusion reason: Prevention</b>
Pauls, J. Mitchell, K. The effect of exercise and attitude towards school on perceived depression in adolescents. 2002. <i>Journal of the Section on Women's Health</i> . 26. 2. 15-20	<b>Exclusion reason: Wrong study design</b>
PeDIATRICS electronic pages. 2007. <i>Pediatrics</i> . 119. 1. 129-149	<b>Exclusion reason: Wrong study design</b>
Petty, Karen H. Davis, Catherine L. Tkacz, Joseph Young-Hyman, Deborah Waller, Jennifer L. Exercise effects on depressive symptoms and self-worth in overweight children: A randomized controlled trial. 2009. <i>Journal of Pediatric Psychology</i> . 34. 9. 929-939	<b>Exclusion reason: Prevention</b>
Philipsson, A. Duberg, A. Moller, M. Hagberg, L. Cost-utility analysis of a dance intervention for adolescent girls with internalizing problems. 2013. <i>Cost Effectiveness &amp; Resource Allocation</i> . 11. 1. 4	<b>Exclusion reason: Wrong outcomes</b>
Pilot Study of Adjunctive Yoga for Bipolar Depression. 2015. <i>ClinicalTrials.gov</i>	<b>Exclusion reason: Adult population</b>
Pinniger, R Brown, Rf Thorsteinsson, Eb McKinley, P. Argentine tango dance compared to mindfulness meditation and a waiting-list control: a randomised trial for treating depression. 2012. <i>Complementary Therapies in Medicine</i> . 20. 6. 377-384	<b>Exclusion reason: Adult population</b>
Pinniger, Rosa Thorsteinsson, Einar Brown, Rhonda McKinley, Patricia. Tango Dance Can Reduce Distress and Insomnia in People with Self-Referred Affective Symptoms. 2013. 35. 1. 60-77	<b>Exclusion reason: Adult population</b>
Platania-Solazzo, A Field, Tm Blank, J Seligman, F Kuhn, C Schanberg, S Saab, P. Relaxation therapy reduces anxiety in child and adolescent psychiatric patients. 1992. <i>Acta Paedopsychiatrica</i> . 115-120	<b>Exclusion reason: Prevention</b>
Platania-Solazzo, Adele Field, Tiffany. Immediate effects of relaxation training in adolescent psychiatric patients. 1989. . 8922731. . 76	<b>Exclusion reason: Wrong intervention</b>
Polis, R. L. Creel, L. M. Loveless, M. B. Abraham, M. M. Hertweck, S. P. Integration of yoga therapy into traditional residential treatment for at	<b>Exclusion reason: Wrong outcomes</b>

risk adolescent females: A community-based approach. 2017. Journal of Pediatric and Adolescent Gynecology. 30 (2). 320-321	
Possel, P. Horn, A. B. Groen, G. Hautzinger, M. School-based prevention of depressive symptoms in adolescents: A 6-month follow-up. 2004. Journal of the American Academy of Child and Adolescent Psychiatry. 43. 8. 1003-1010	<b>Exclusion reason: Wrong intervention</b>
Rashidi, M. Rashidy-Pour, A. Ghorbani, R. Diyant, H. Shahvaranian, M. The comparison of aerobic and anaerobic exercise effects on depression and anxiety in students. [Persian]. 2017. Koomesh. 19. 2. 333-340	<b>Exclusion reason: Adult population</b>
Rashidi, Z. Rashidi, A. Rouzbahani, R. Rezaei, F. Effects of group exercise on women's depressive symptoms. [Persian]. 2013. Journal of Isfahan Medical School. 30. 212.	<b>Exclusion reason: Adult population</b>
Re, Pamela McConnell, John W. Reidinger, Gloria Schweit, Ronnie Hendron, Angela. Effects of Yoga on Patients in an Adolescent Mental Health Hospital and the Relationship Between Those Effects and the Patients' Sensory-Processing Patterns. 2014. Journal of Child & Adolescent Psychiatric Nursing. 27. 4. 175-182	<b>Exclusion reason: Wrong study design</b>
Reaching Depressed Teens and Young Adults With Exercise. 2014. IDEA Fitness Journal. 11. 3. 72-72	<b>Exclusion reason: Adult population</b>
Reigal Garrido, Rafael E. MÃrquez Casero, MarÃa Victoria Videra GarcÃa, Antonio MartÃn Tamayo, Ignacio Ruiz De Mier, RocÃo JuÃrez. Efecte agut de l'activitat fisicoesportiva i l'expressiÃ³ corporal sobre l'estat d'Ãnim. / Acute Effect of Physical and Sport Activity and Body Expression on Mood. 2013. Apunts: EducaciÃ³ FÃsica i Esports. 113. 30-36	<b>Exclusion reason: Prevention</b>
Rethorst, C. D. South, C. C. Rush, A. J. Greer, T. L. Trivedi, M. H. Prediction of treatment outcomes to exercise in patients with nonremitted major depressive disorder. 2017.34. 12. 1116-1122	<b>Exclusion reason: Adult population</b>
Rethorst, C. D. Sunderajan, P. Greer, T. L. Grannemann, B. D. Nakonezny, P. A. Carmody, T. J. Trivedi, M. H. Does exercise improve self-reported sleep quality in non-remitted major depressive disorder?. 2013. Psychological Medicine. 43. 4. 699-709	<b>Exclusion reason: Adult population</b>
Richards, J. Foster, C. The impact of a sport-for-development programme on the mental health of young adolescents in Gulu, Northern Uganda. 2012. Journal of Science and Medicine in Sport. 15 (SUPPL.1). S345	<b>Exclusion reason: Prevention</b>
Richards, J. Foster, C. Townsend, N. Bauman, A. Physical fitness and mental health impact of a sport-for-development intervention in a post-conflict setting: randomised controlled trial nested within an observational study of adolescents in Gulu, Uganda. 2014. BMC Public Health. 14. . 619	<b>Exclusion reason: Prevention</b>
Rief, W. Bleichhardt, G. Dannehl, K. Euteneuer, F. Wambach, K. Comparing the Efficacy of CBASP with Two Versions of CBT for Depression in a Routine Care Center: A Randomized Clinical Trial. 2018. 12. 12	<b>Exclusion reason: Adult population</b>
Robinson, T. N. Matheson, D. M. Kraemer, H. C. Wilson, D. M. Obarzanek, E. Thompson, N. S. Alhassan, S. Spencer, T. R. Haydel, K. F. Fujimoto, M. Varady, A. Killen, J. D. A randomized controlled trial of culturally tailored dance and reducing screen time to prevent weight gain in low-income African American girls: Stanford GEMS. 2010. Archives of Pediatrics & Adolescent Medicine. 164. 11. 995-1004	<b>Exclusion reason: Prevention</b>

Roh, H. T. Cho, S. Y. So, W. Y. Taekwondo training improves mood and sociability in children from multicultural families in South Korea: a randomized controlled pilot study. 2018. 15. 4) (no pagination.	<b>Exclusion reason: Prevention</b>
Roth, David L. An experimental comparison of the cardiovascular and self-reported health effects of aerobic exercise and progressive relaxation. 1987. Dissertation Abstracts International. 48. 5-B. 1522	<b>Exclusion reason: Adult population</b>
Roth, David L. Holmes, David S. Influence of aerobic exercise training and relaxation training on physical and psychologic health following stressful life events. 1987. Psychosomatic Medicine. 49. 4. 355-365	<b>Exclusion reason: Adult population</b>
Rueter, M. A. Effects of running on individuals who are clinically depressed. 1981.	<b>Exclusion reason: Adult population</b>
Saper, Robert. Impact of Yoga on Depression and Anxiety. 2014. Journal of Alternative & Complementary Medicine. 20. 5. A55-A55	<b>Exclusion reason: Adult population</b>
Sarubin, N. Nothdurfter, C. Schule, C. Lieb, M. Uhr, M. Born, C. Zimmermann, R. Buhner, M. Konopka, K. Rupprecht, R. Baghai, T. C. The influence of Hatha yoga as an add-on treatment in major depression on hypothalamic-pituitary-adrenal-axis activity: a randomized trial. 2014. Journal of Psychiatric Research. 53.76-83	<b>Exclusion reason: Adult population</b>
Schuch, Felipe Schoenell, Maira Tiggemann, Carlos Noll, Matias Alberton, Cristine Kruehl, Luiz. The effects of water-based strength exercise on quality of life in young women. 2016. Sport Sciences for Health. 12. 1. 105-112	<b>Exclusion reason: Adult population</b>
Schulte, Erin C. Yoga and adolescent psychological health, depressive symptoms, and flourishing. 2016. Dissertation Abstracts International Section A: Humanities and Social Sciences. 76. 10-A(E). No Pagination Specified	<b>Exclusion reason: Prevention</b>
Shallcross, A. J. Willroth, E. C. Fisher, A. Dimidjian, S. Gross, J. J. Visvanathan, P. D. Mauss, I. B. Relapse/Recurrence Prevention in Major Depressive Disorder: 26-Month Follow-Up of Mindfulness-Based Cognitive Therapy Versus an Active Control. 2018. . 49. 5. 836-849	<b>Exclusion reason: Adult population</b>
Shomaker, L. B. Guley, L. Hilkin, A. M. Clark, E. Annameier, S. Rao, S. Rockette-Wagner, B. Kriska, A. Wright, K. P. Stice, E. et al., Design of a randomized controlled trial to decrease depression and improve insulin sensitivity in adolescents: mood and INSulin sensitivity to prevent Diabetes (MIND). 2018. 75.19-28	<b>Exclusion reason: Wrong intervention</b>
Shoukri, Maysa Mohamed. Aerobics practice and how it modifies some psychological variables and weight of a sample of obese female adults. 1992. Derasat Nafseyah. 2. 4. 619-642	<b>Exclusion reason: Prevention</b>
Silverman, Scott Charles Zaichkowsky, Leonard D. The effects of exercise on mood and self-efficacy in emotionally disturbed adolescents. 1998. 156	<b>Exclusion reason: Duplicate</b>
Silverman, Scott Charles. The effects of exercise on mood and self-efficacy in emotionally disturbed adolescents. 1998. Dissertation Abstracts International: Section B: The Sciences and Engineering. 58. 9-B. 4717	<b>Exclusion reason: Prevention</b>
Smith, Jay Andrew. Effects of yoga on stress among college students in a post-Katrina population. 2008. Dissertation Abstracts International: Section B: The Sciences and Engineering. 68. 11-B. 7678	<b>Exclusion reason: Adult population</b>
Smits, Ja Berry, Ac Rosenfield, D Powers, Mb Behar, E Otto, Mw. Reducing anxiety sensitivity with exercise. 2008. Depression and Anxiety. 25. 8. 689-699	<b>Exclusion reason: Adult population</b>

Stawicki, L. Mood differences of college students with symptoms of seasonal affective disorder following aerobic and anaerobic exercise training. 1997. Dissertation: springfield college (USA).	<b>Exclusion reason: Adult population</b>
Stein, Paula N. The differential effects of aerobic and nonaerobic exercise on affect and self-concept. 1990. Dissertation Abstracts International. 51. 2-B. 1006	<b>Exclusion reason: Adult population</b>
Steiner, Naomi J. Sidhu, Tahnee K. Pop, Patricia G. Frenette, Elizabeth C. Perrin, Ellen C. Yoga in an urban school for children with emotional and behavioral disorders: A feasibility study. 2013. Journal of Child and Family Studies. 22. 6. 815-826	<b>Exclusion reason: Prevention</b>
Stella, S. Vilar, A. Lacroix, C. Fisberg, M. Santos, R. Mello, M. Tufik, S. Effects of type of physical exercise and leisure activities on the depression scores of obese Brazilian adolescent girls. 2005. Brazilian Journal of Medical and Biological Research. 38. 11. 1683-1689	<b>Exclusion reason: Prevention</b>
St-Hilaire, Annie Marcotte, Diane. L'influence de la pratique d'un sport restrictif et non restrictif sur la depression, le developpement pubertaire, l'image corporelle et les standards de performance a l'adolescence. / The influence of restricting and non restricting sports on body image, puberty, performance standards and depression in adolescence. 2005. STAPS: Revue des Sciences & Techniques des Activites Physiques & Sportives. 26. 67. 73-88	<b>Exclusion reason: Prevention</b>
Sturm, J. Ploderl, M. Fartacek, C. Kralovec, K. Neunhauserer, D. Niederseer, D. Hitzl, W. Niebauer, J. Schiepek, G. Fartacek, R. Physical exercise through mountain hiking in high-risk suicide patients. A randomized crossover trial. 2012. Acta Psychiatrica Scandinavica. 126. 6. 467-475	<b>Exclusion reason: Adult population</b>
Tang, Wen-jie Zhang, Wei. A Functional Analysis of Physical Exercises Intervention in Depressive Mood of College Students. 2008. Journal of Beijing Sport University. 31. 11. 1534-1536	<b>Exclusion reason: Adult population</b>
Taylor, Mark Gillies, Robyn M. Ashman, Adrian F. Cognitive training, conflict resolution and exercise: Effects on young adolescents' wellbeing. 2009. Australian Journal of Guidance and Counselling. 19. 2. 131-149	<b>Exclusion reason: Wrong study design</b>
Tejvani, R. Metri, K. G. Agrawal, J. Nagendra, H. R. Effect of Yoga on anxiety, depression and self-esteem in orphanage residents: A pilot study. 2016. Ayu. 37. 1. 22-25	<b>Exclusion reason: Prevention</b>
Tennant, Ruhamah G. Martin, Katie K. Rooney, Rosanna Hassan, Sharinaz Kane, Robert T. Preventing internalizing problems in young children: A randomized controlled trial of the Feelings and Friends (Year 3) program with a motor skills component. 2017. Frontiers in Psychology Vol 8 2017, ArtID 291. 8. .	<b>Exclusion reason: Prevention</b>
Terwilliger, Susan H. A study of children enrolled in a school-based physical activity program with attention to overweight and depression. 2009. Dissertation Abstracts International Section A: Humanities and Social Sciences. 69. 8-A. 3052	<b>Exclusion reason: Wrong study design</b>
Toseeb, Umar Goodyer, Ian M. Brage, Soren. Physical activity and depression: type of exercise matters-reply..JAMA Pediatr. 2014 Dec168(12):1093-100 JAMA Pediatr. 2015 Mar169(3):288-9. 2015. JAMA Pediatrics. 169. 3. 289-289	<b>Exclusion reason: Wrong study design</b>
Toulabi, T. Khosh Niyat Nikoo, M. Amini, F. Nazari, H. Mardani, M. The influence of a behavior modification interventional program on body mass index in obese adolescents. Journal of the Formosan Medical Association.	<b>Exclusion reason: Prevention</b>

Trivedi, M. H. Greer, T. L. Grannemann, B. D. Church, T. S. Galper, D. I. Sunderajan, P. Wisniewski, S. R. Chambliss, H. O. Jordan, A. N. Finley, C. Carmody, T. I. TREAD: Treatment with Exercise Augmentation for Depression: study rationale and design. 2006. <i>Clinical Trials</i> . 3. 3. 291-305	<b>Exclusion reason: Adult population</b>
Trumpeter, Nevelyn N. The role of self-efficacy in mediating the effect of physical activity on adolescent depression. 2016. <i>Dissertation Abstracts International: Section B: The Sciences and Engineering</i> . 77. 2-B(E). No Pagination Specified	<b>Exclusion reason: Prevention</b>
Trumpeter, Nevelyn N. Wilson, Dawn K. The role of self-efficacy in mediating the effect of physical activity on adolescent depression. 2015. . 3725402. 115	<b>Exclusion reason: Duplicate</b>
Tsiantoula, E. Tsiadoula, L. Patsiaouras, A. Kokaridas, D. Physical activity & depression. 2012. 4. 3. 83-90	<b>Exclusion reason: Wrong study design</b>
Tsumura, Hideki Shimada, Hironori. Effects of walking exercise on cognitive appraisal depressive mood, and attentional resources in self-focused attention. 2014. <i>Japanese Journal of Health Psychology</i> . 27. 2. 124-130	<b>Exclusion reason: Wrong study design</b>
Vancini, R. L. Rayes, A. B. R. Lira, C. A. B. Sarro, K. J. Andrade, M. S. Pilates and aerobic training improve levels of depression, anxiety and quality of life in overweight and obese individuals. 2017. <i>Arquivos de Neuro-Psiquiatria</i> . 75. 12. 850-857	<b>Exclusion reason: Adult population</b>
Velasquez, Ana Maria Lopez, Maria Adelaida Quinonez, Natalia Paba, Diana Patricia. Yoga for the prevention of depression, anxiety, and aggression and the promotion of socio-emotional competencies in school-aged children. 2015. <i>Educational Research and Evaluation</i> . 21. 5-6. 407-421	<b>Exclusion reason: Prevention</b>
Velazquez, Theresa. Health issues and the benefits of DanceSport. 2012. <i>Dissertation Abstracts International Section A: Humanities and Social Sciences</i> . 73. 4-A. 1297	<b>Exclusion reason: Wrong study design</b>
Wagener, T. L. Fedele, D. A. Mignogna, M. R. Hester, C. N. Gillaspay, S. R. Psychological effects of dance-based group exergaming in obese adolescents. 2012. <i>Pediatric Obesity</i> . 7. 5. e68-e74	<b>Exclusion reason: Prevention</b>
Wang, Chunyun. Improving health among elementary school children: A comparison of aerobic and mind-body exercise. 2013. <i>Dissertation Abstracts International Section A: Humanities and Social Sciences</i> . 74. 3-A(E). No Pagination Specified	<b>Exclusion reason: Wrong outcomes</b>
Wang, Hao. Intervene of rope skipping exercises on emotion and sleep. 2008. <i>Journal of Wuhan Institute of Physical Education</i> . 42. 6. 80-83	<b>Exclusion reason: Adult population</b>
Ware, Christine Jeuland. Yoga in a partial hospitalization program: The effects on at-risk youth. 2005. <i>Dissertation Abstracts International: Section B: The Sciences and Engineering</i> . 66. 1-B. 581	<b>Exclusion reason: Prevention</b>
Watanabe, J. Watanabe, M. Yamaoka, K. Adachi, M. Nemoto, A. Tango, T. Effect of School-Based Home-Collaborative Lifestyle Education on Reducing Subjective Psychosomatic Symptoms in Adolescents: A Cluster Randomised Controlled Trial. 2016. <i>PLoS ONE [Electronic Resource]</i> . 11. 10. 14	<b>Exclusion reason: Wrong outcomes</b>
Weintraub, D. L. Tirumalai, E. C. Haydel, K. F. Fujimoto, M. Fulton, J. E. Robinson, T. N. Team sports for overweight children: the Stanford Sports to Prevent Obesity Randomized Trial (SPORT). 2008. <i>Archives of Pediatrics &amp; Adolescent Medicine</i> . 162. 3. 232-7	<b>Exclusion reason: Prevention</b>

Williams, G. H. Effects of aerobic training and a mood control workshop on depression in male college students. 1979.	<b>Exclusion reason: Adult population</b>
Wilson, A. J. Prapavessis, H. Jung, M. E. Cramp, A. G. Vascotto, J. Lenhardt, L. Shoemaker, J. K. Watson, M. Robinson, T. Clarkson, C. L. Lifestyle modification and metformin as long-term treatment options for obese adolescents: study protocol. 2009. BMC Public Health. 9. 434	<b>Exclusion reason: Wrong outcomes</b>
Wipfli, B. Landers, D. Nagoshi, C. Ringenbach, S. An examination of serotonin and psychological variables in the relationship between exercise and mental health. 2011. Scandinavian Journal of Medicine & Science in Sports. 21. 3. 474-81	<b>Exclusion reason: Adult population</b>
Wood, C. Angus, C. Pretty, J. Sandercock, G. Barton, J. A randomised control trial of physical activity in a perceived environment on self-esteem and mood in UK adolescents. 2013. International Journal of Environmental Health Research. 23. 4. 311-320	<b>Exclusion reason: Prevention</b>
Wunram, H. L. Hamacher, S. Hellmich, M. Volk, M. Janicke, F. Reinhard, F. Bloch, W. Zimmer, P. Graf, C. Schonau, E. Lehmkuhl, G. Bender, S. Fricke, O. Whole body vibration added to treatment as usual is effective in adolescents with depression: a partly randomized, three-armed clinical trial in inpatients. 2018.	<b>Exclusion reason: Wrong comparator</b>
Wunram, Heidrun Lioba Hamacher, Stefanie Hellmich, Martin Volk, Maxi Janicke, Franziska Reinhard, Franziska Bloch, Wilhelm Zimmer, Philipp Graf, Christine Schonau, Eckhard Lehmkuhl, Gerd Bender, Stephan Fricke, Oliver. Whole body vibration added to treatment as usual is effective in adolescents with depression: A partly randomized, three-armed clinical trial in inpatients. 2017. European Child & Adolescent Psychiatry. No Pagination Specified	<b>Exclusion reason: Wrong comparator</b>
Zahn, William L. The effects of Tai Chi Chuan on mindfulness, mood, and quality of life in adolescent girls. 2009. Dissertation Abstracts International: Section B: The Sciences and Engineering. 69. 8-B. 5065	<b>Exclusion reason: Prevention</b>
Zhang, J. Qin, S. Zhou, Y. Meng, L. Su, H. Zhao, S. A randomized controlled trial of mindfulness-based Tai Chi Chuan for subthreshold depression adolescents. 2018. 14. 2313-2321	<b>Exclusion reason: Adult population</b>
Zhu, F. S. Yan, J. Effects of basketball exercise of low and moderate intensity on mental health of male college students. [Chinese]. 2006. Chinese Journal of Clinical Rehabilitation. 10. 20. 35-37	<b>Exclusion reason: Adult population</b>
Zhu, X. D. Li, Q. Y. Zhang, H. The Influence of Aerobics and Group Games for Male Teenager Compulsory Isolation Addicts' Mental Health Promotion. 2015. 48. 18-23	<b>Exclusion reason: Prevention</b>
Zwan, Je Vente, W Huizink, Ac BÃ¶lgels, Sm Bruin, Ei. Physical activity, mindfulness meditation, or heart rate variability biofeedback for stress reduction: a randomized controlled trial. 2015. Applied Psychophysiology and Biofeedback. 40. 4. 257-268	<b>Exclusion reason: Adult population</b>

## APPENDIX VI

### Risk of bias assessments of included trials

**Beffert 1993**

Overall **high risk of bias**

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	“Students who scored a 75 or higher on the second screening were then randomly assigned to either an aerobic exercise treatment group or a waitlist control group”. (p. 84).
Allocation concealment (selection bias)	Unclear risk	No description found in text
Blinding of participants and personnel (performance bias)	High risk	Owing to the nature of the intervention, it was not possible to conceal allocation to the intervention from participants or personnel.
Blinding of outcome assessment (detection bias)	High risk	Self-report outcome measurement tool (RADS)
Incomplete outcome data (attrition bias)	Unclear risk	Precise numbers for drop-out was not reported
Selective reporting (reporting bias)	Unclear risk	No published protocol for the study available.
Other bias	Unclear risk	Unclear (wait-list control).

**Burrows 1984**

Overall **high risk of bias**

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	<p>"The students were assigned by a stratified [sic] random sampling procedure to a program of jogging, exercise, or Red Cross First Aid and Personal Safety." (p. 54).</p> <p>"Assignment to treatment groups was to be random. However, due to the variance found in levels of depression and levels of cardiovascular fitness, both variables were stratified and then statistically analyzed to ensure that the groups could be considered equivalent." (p. 53).</p>
Allocation concealment (selection bias)	Unclear risk	No description found in text
Blinding of participants and personnel (performance bias)	High risk	Owing to the nature of the intervention, it was not possible to conceal allocation to the intervention from participants or personnel.
Blinding of outcome assessment (detection bias)	High risk	Self-report outcome measurement tool (DACL)
Incomplete outcome data (attrition bias)	Unclear risk	<p>"...during the second week of the study, one female withdrew from the running group due to medical reasons" (p. 48). "There was an attrition of only one student who, for medical reasons, dropped out of school" (p. 58).</p>
Selective reporting (reporting bias)	Unclear risk	No published protocol for the study available.
Other bias	Unclear risk	Unclear



Carter 2015

Overall **unclear risk of bias**

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	The random allocation sequence was computer generated by the trial statistician using permuted block randomisation with varying block size.
Allocation concealment (selection bias)	Low risk	In order to ensure allocation concealment sequentially numbered opaque sealed envelopes were used.  Individuals were randomised to groups by a researcher not connected to the study team.
Blinding of participants and personnel (performance bias)	High risk	Owing to the nature of the intervention, it was not possible to conceal allocation to the intervention from participants or personnel.
Blinding of outcome assessment (detection bias)	Unclear risk	Self-rated outcome measurement tool (CDI-2) Outcome assessors, including the data input administrator, were blind to treatment group at both follow up time points. The analysis was conducted on a data set in which group allocation was unlabelled.
Incomplete outcome data (attrition bias)	Unclear risk	In total, 87 young people were recruited and randomized across the two arms of trial; intervention (n=44), control (n=43). At post intervention the total loss to follow up was 25 %, with more participants dropping out in the control arm than the intervention.»  «At six months, the total loss to follow up was 51% with a higher dropout rate in the control compared to the intervention arm.»  «... 8 participants (18.1 %) attended no exercise sessions. The reason for non-engagement of these 8 participants was mostly unknown as the majority were non-contactable. Only 3 participants gave

		reasons for non-engagement; exam pressure, high levels of anxiety and feeling too low in mood.
Selective reporting (reporting bias)	Low risk	Protocol is available, ClinicalTrials.gov Identifier: NCT01474837. All of the study's pre-specified outcomes have been reported in the pre-specified way.
Other bias	Low risk	Trial appears to be free of other problems that could put it at high risk of bias.

### Roshan 2011

Overall **high risk of bias**

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	"They were divided randomly into experimental group (12 cases) or control group (12 cases)."
Allocation concealment (selection bias)	Unclear risk	No description found in text
Blinding of participants and personnel (performance bias)	High risk	Owing to the nature of the intervention, it was not possible to conceal allocation to the intervention from participants or personnel.
Blinding of outcome assessment (detection bias)	Unclear risk	Clinician-rated outcome measurement tool (HAM-D)
Incomplete outcome data (attrition bias)	Unclear risk	No description found in text
Selective reporting (reporting bias)	Unclear risk	Retrospective registration of study protocol (2011-08-30).
Other bias	Unclear risk	Unclear (wait-list control)

# **Exercise for Depression in Children and Adolescents: A Systematic Review and Meta-analysis**

Article manuscript

Master's students: Sølvi Biedilæ and Brynhildur Axelsdóttir

Master's program: Master in Evidence-Based Practice in Health Sciences

Faculty: Faculty of Health and Social Sciences

Institution: Western Norway University of Applied Sciences

Journal for submission of the article manuscript: PLoS One

Total number of words: 4710

# **Exercise for Depression in Children and Adolescents: A Systematic Review and Meta-analysis**

Brynhildur Axelsdottir, Sølvi Biedilæ. Regional Centre for Child and Adolescent Mental Health, Eastern and Southern Norway (RBUP).

## **Abstract**

The objective of this systematic review was to examine the effects of exercise interventions as treatment of depression in children and adolescents compared to other treatments or no treatment. A study protocol was registered in PROSPERO (CRD42018101982). The bibliographic databases Cochrane Central Register of Controlled Trials (CENTRAL), Medline (Ovid), Embase (Ovid), PsycINFO (Ovid), AMED (Ovid), SPORTDiscus, PEDro, CINAHL (EBSCO), ERIC (EBSCO) and Web of Science were searched from inception to December 2018 for randomized controlled trials. Databases for grey literature, dissertations, and trials registers were also searched. The search strategy was developed using a wide range of search terms, both index terms, and text words, for depression, children and adolescents, exercise and study design and adapted to each database. Two authors independently screened references, extracted data and assessed the quality of the included trials with the Cochrane Risk of Bias tool. The certainty of the evidence was assessed using the Grading of Recommendations Assessments, Development, and Evaluation (GRADE) approach. Four trials (n=143) were included. A meta-analysis with a random effect model was performed, and a moderate effect in favour of exercise on depression severity post-intervention was identified (SMD = -0,59, 95% CI = -1.11, to -0.07,  $p=0.03$ ). However, the trials were assessed as having an unclear or high risk of bias, and the overall certainty of the evidence for this outcome was graded as low. The severity of depression at six months follow-up was reported in one trial. The overall certainty of the evidence for this outcome was graded as very low. None of the trials commented on the presence or absence of adverse events. Exercise appears to be a promising intervention for children and adolescents with depression, but large, high-quality trials with a longer follow-up time are needed.

## **Introduction**

Depression is a mental disorder, characterized by persistent sadness and a loss of interest in and ability to carry out daily activities [1]. Depression is a major public health problem and one of the most common psychiatric disorders in children and adolescents. [2, 3]. Worldwide, depression is the leading cause of years lost due to disability (YLDs) in females aged 15-24 years, and the third leading cause in adolescent males [4]. The one-year prevalence of depression in adolescents was estimated to be 5.6% in a systematic review, and for children under thirteen-year-old, the one-year prevalence was 2.8% [5]. Depression is more common in girls [5, 6].

Depression in childhood and adolescence can disturb the social and familial connections and education, with life long effects on employment and social status [7, 8]. Severe depression can lead to suicide [9].

Established treatments for depression in children and adolescents are psychological therapies, and in severe cases, antidepressant medications [2, 10, 11]. These treatments, however, have modest effects, high relapse rates, are not acceptable or available to all patients, and antidepressant medications have adverse effects [12-16]. It is therefore important to investigate alternative or adjunct treatments. Exercise is one treatment that shows promising results in adults with depression [17].

Four reviews on the effects of physical activity or exercise on depressive symptoms in children, adolescents, and young people have been published in the past few years [18-21]. Additionally, a Cochrane review was published in 2006 [22]. These reviews all found a small to moderate effect of exercise on the reduction of depression.

None of these reviews have looked at adverse events. It is vital to investigate whether exercise can be harmful to this population. Quality of life is another important outcome that is not covered in the reviews. The four recent reviews all excluded and did not search for non-English language studies and studies not published in peer-reviewed journals [18-21]. This can lead to biased results [23]. Some of these reviews have included trials on participants both with and without depression (e.g., whole school classes or at-risk participants that did not have depression). The inclusion criteria for interventions are in some of the reviews, physical activity, in others exercise (without a definition) or both. Some of the reviews have also included trials where the comparison group received another type or intensity of exercise.

In this review only trials where the participants had depression were included, the intervention was exercise, and the control groups received a non-exercise treatment or no treatment. Adverse events and quality of life as outcomes were included. Trials published in all languages, all publication types, and non-published trials were searched for, and assessed for inclusion to reduce the risk of biased results.

The objective of this systematic review was to summarize studies on the effects of exercise interventions as treatment of depression in children and adolescents compared to other treatments or no treatment.

## **Methods**

The Cochrane Collaboration methodology for conducting systematic reviews was followed [24]. The reporting is according to the PRISMA guidelines [25]. The PRISMA checklist is available in Supplementary S1. The protocol for the systematic review is registered in PROSPERO [26]. CRD42018101982  
[http://www.crd.york.ac.uk/PROSPERO/display\\_record.php?ID=CRD42018101982](http://www.crd.york.ac.uk/PROSPERO/display_record.php?ID=CRD42018101982)

### **Selection criteria**

In this systematic review only randomized controlled trials (RCTs), both parallel, cluster or individual RCTs, or the first phase of cross-over trials, were included.

The participants in the included trials must be children and adolescents between 6 and 18 years with depression. Trials, where the author defined the participants as having depression (by any method of diagnosis and with any severity of depression), were included.

Trials that include children and adolescents with psychotic or borderline conditions, autism, physical handicaps, eating disorders and/or chronic or serious somatic diseases were excluded.

Trials where the exercise intervention falls within the American College of Sports Medicine definition of exercise: “planned, structured and repetitive bodily movement done to improve and/or maintain one or more components of physical fitness” were included [27]. All types of exercise were included, both aerobic, anaerobic, resistance, flexibility, and mixed fitness training. Group-based or individual exercise and supervised or unsupervised programs were

included. The programs can be prescribed (fixed) intensity or preferred intensity (i.e., the participants choose the intensity themselves). Trials, where exercise is one component of a combination treatment, were excluded since it is not possible to separate the effect of exercise. Trials with a single exercise session and trials which provide less than a week of exercise were excluded since it is unlikely to have any lasting effects on depression. All settings were included, e.g., schools, primary care settings, hospitals, including inpatients, and the trials could be carried out in both high-, middle- and low-income countries.

The control group may receive an intervention other than exercise, e.g., psychological therapies, pharmacological treatments alone or in combination, treatment as usual or other alternative treatments, or they may receive no treatment, e.g., waiting list or a non-intervention group.

Outcomes were chosen based on the standard set of outcomes recommended by the ICHOM Depression and Anxiety Working Group [28].

The primary outcomes were:

- Depression: Any measure of depression, reported either as a continuous or dichotomous outcome. Depression should be measured by self-report, health personnel report, parent report and teacher report
- Adverse events (any unwanted effects of the intervention)

The secondary outcomes were:

- Psychological well-being
- Social functioning
- Quality of life
- Acceptability measured as dropouts

Data from the end of treatment and if possible any long-term follow-up were included.

### **Search methods for identification of studies**

The Cochrane Central Register of Controlled Trials (CENTRAL), Medline (Ovid), Embase (Ovid), PsycINFO (Ovid), AMED (Ovid), SPORTDiscus, PEDro, CINAHL (EBSCO), ERIC (EBSCO) and Web of Science were searched from inception to December 2018. Open Grey

was searched for grey literature, Dissertations and Theses (ProQuest) for dissertations and theses and Papers First (OCLC) for conference abstracts. The trial registers ClinicalTrials.gov, and WHO International Clinical Trials Registry Platform (ICTRP) were searched for ongoing and unpublished trials

The search strategy was developed using a wide range of search terms, both index terms, and text words, for depression, children and adolescents, exercise and study design. Search terms were combined using boolean operators. No limits were applied on year, language or publication type. The search strategy was peer-reviewed using the PRESS checklist [29] and adapted to each database. Full search strategies are available in Supplementary S2.

The bibliographies of all included studies and previous systematic reviews were searched for further relevant studies.

## **Data collection and analysis**

### ***Selection of studies***

The titles and abstracts of the identified references were independently screened by two authors (SB and BA) using Covidence Systematic Review Software [30]. Any references that one or both screeners included were ordered in full text and screened independently.

Disagreements were resolved by discussion and if needed a third reviewer was consulted to reach a final decision.

### ***Data extraction and management***

Data from the included studies were extracted independently by two authors (SB and BA). Participant characteristics, setting, intervention characteristics, measurement tools, effect estimates, measures of uncertainty and study design were extracted. For the description of the interventions, the web-based TIDieR template (Template for Intervention Description and Replication) was used [31].



### ***Assessment of risk of bias in included studies***

The quality of the included studies was assessed using the Cochrane Collaboration Risk of Bias Tool [32, chapter 8.5.1] by two authors (SB and BA) independently.

The following criteria were assessed: Sequence generation, allocation concealment, blinding of participants and care providers, blinding of outcome assessors, incomplete outcome data, selective outcome reporting and other sources of bias.

### ***Data analysis***

The effect sizes for depression post-intervention were pooled in a meta-analysis using RevMan [33]. A random-effects model was used since heterogeneity across the included studies was expected [23]. Statistical heterogeneity was assessed using the  $I^2$  statistic. Heterogeneity is considered moderate if  $I^2$  exceeds 50% and high if over 75% [34].

Depression was measured with different measurement tools across the included studies. To be able to pool the results standardized mean differences (SMD) was calculated using Hedges (adjusted)  $g$  in RevMan [35]. The effect size was considered to be small if SMD was between 0.2 and 0.5, medium if between 0.5 and 0.8, and large if larger than 0.8 [36]. Outcomes were reported with 95% confidence intervals (CI). The other outcomes were not possible to pool in a meta-analysis, and are therefore described narratively.

### ***Subgroup analysis and Sensitivity analysis***

Subgroup analyses for the variables of type and intensity of exercise were planned, but it was not possible due to a limited number of included trials. Sensitivity analysis for the primary outcomes by removing studies that were at high or unclear risk of bias was planned. This was not possible because none of the included trials were classified as low risk of bias.

### ***Assessment of publication bias***

There were not a sufficient number of included studies (10 or more) to check for publication bias by visually examining funnel plots for asymmetry [23, chapter 10.4].

### ***Certainty of the evidence (GRADE)***

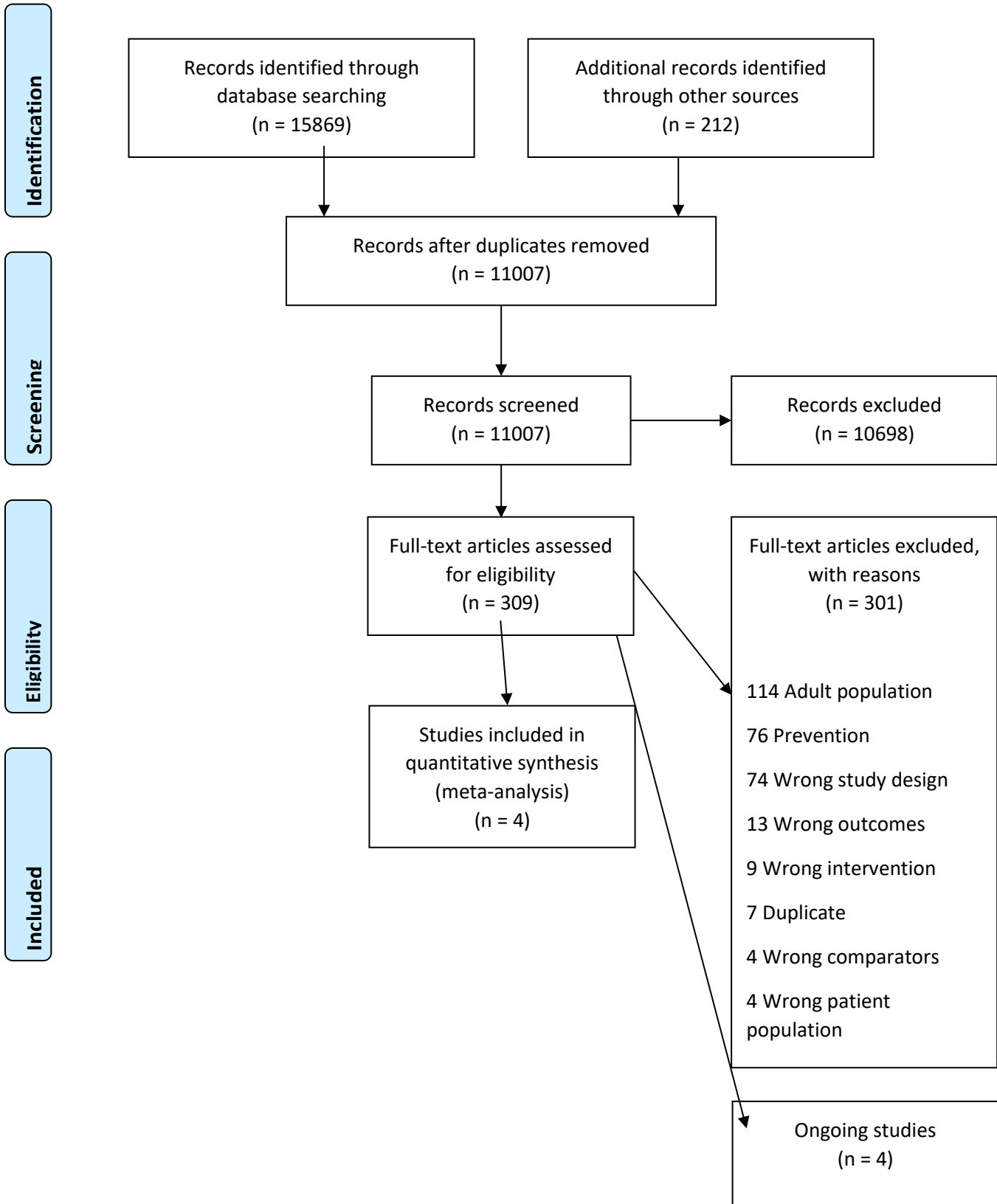
The GRADE (Grading of Recommendations, Assessment, Development, and Evaluation) approach was used to assess the certainty of the evidence [37]. The risk of bias assessments were incorporated, and additional appraisal of directness, consistency, precision, and risk of reporting bias was performed for the primary outcome, depression at post-intervention and follow-up. A “Summary of findings”-table was created using the GradePro software [38, chapter 12.2.1, 39].

### **Results**

The literature searches retrieved 15869 through database searching and 212 records through other sources. After removing duplicate records, 11007 remained for screening. 10698 records were excluded based on title and abstract. 309 full-text articles were assessed and 301 excluded. Four ongoing trials were identified [40-43]. Details of the study selection process and reasons for exclusion are in the PRISMA flow diagram (figure 1).



## PRISMA 2009 Flow Diagram



**Included studies**

Four trials were included ( $n=143$ ) [44-47]. All trials were published in English. Two were articles in peer-reviewed journals [45, 46], while two were doctoral dissertations [44, 47]. One trial was conducted in Nottingham, UK at community centres [46]. Two trials were conducted in the USA, one in a Miami, Florida high school [47], and the other in a junior high school in Cheyenne, Wyoming [44]. The fourth trial was conducted in Iran, at a swimming pool with all female high school students [45]. The characteristics of the included trials are summarized in table 1. More details of the included trials are described in Supplementary S3.

Table 1. Characteristics of included trials

Study, year	Participants	Country, Setting	Intervention (exercise component)			Outcome Measures (depression)	Baseline severity of depression Mean (SD)	Results (lower score is better) SMD (CI)
			Type	Dose	Control			
Carter <i>et al.</i> 2015	<i>n</i> =64 14-17 years M=15.4 years 78% females	UK Community centres	Circuit-training (aerobic and strengthening exercises)	45 min 2 times/wk 9 weeks	Treatment as usual	CDI-2 Self-report	I: 29.1 (9.4) C: 28.2 (6.8)	-0.19 (-0.69, 0.30)
Roshan <i>et al.</i> 2011	<i>n</i> =24 15-18 years M=16.9 years 100% females	Iran High school	Pool-walking program	3 times/wk 6 weeks	No exercise, no anti-depressant treatment	Ham-D Clinician-rated	I: 30.15 (7.62) C: 29.58 (7.25)	-1.39 (-2.30, -0.48)
Beffert 1993	<i>n</i> =26 12-15 years M=N/A 83% females	USA High school	Walking-running (aerobic exercises)	20 min 3 times/wk 6 weeks	Waitlist	RADS Self-report	I: 122.53 (6.03) C: 124.91 (6.92)	-0.85 (-1.66, -0.03)
Burrus 1984	<i>n</i> =29 15-18 years M=N/A 60% females	USA High school	Walk-jog-run (aerobic running program)	45 min 4 times/wk 9 weeks	Anaerobic treatment, Red Cross First Aid and Personal Safety Class	DACL Self-report	I: 19.14 (3.73) C: 19.33 (3.71)	-0.27 (-1.00, 0.46)

\*All trials are RCTs (Randomised Controlled Trials)

\*All interventions were group-based and supervised.

Note: CDI-2= Children's Depression Inventory; Ham-D= Hamilton Rating Scale for Depression; RADS= Reynolds Adolescent Depression Scale; DACL= Depression Adjective Checklist.

### ***Participants***

Sample sizes in the included trials ranged from 24 to 64 participants. Age ranges were twelve to 15 years, mean not reported [44]; 15 to 18 years, mean not reported [47]; 14 to 17 years, mean 15.4 [46], and 15 to 18 years, mean 16.91 [45]. All trials had a majority of female participants.

Participants were recruited from Child and Adolescent Mental Health Services in one trial [46]. In the other three trials, all students in entire high school grades were screened for depression, and students who scored above the criterion level were invited to participate in the trial [44, 45, 47].

### ***Interventions and comparisons***

The four included trials evaluated different types of exercise. All interventions were group-based training. Intervention periods ranged from 6-9 weeks, with 2-4 sessions per week. Total sessions ranged from 12-36 sessions, and the duration varied from 20-45 minutes in three trials. One trial did not report the duration of the sessions [45].

In Carter et al. [46] six weeks of interval circuit-training was compared to treatment as usual. Treatment as usual in this trial consisted of various psychological therapies and in some cases pharmacotherapy. The circuit-training had eight different exercise-stations, which consisted of both strengthening and aerobic exercises. Participants could choose the order in which they undertook the different exercises, as well as intensity. They could also choose to take rests when they wanted.

Roshan et al. [45] compared six weeks of interval pool walking to no treatment. The water height in the pool reached 70-80% of the participant's height, and the intensity was about 60-70% of maximum heart rate. The twelve participants in the experimental group walked a total of 14.850 meters during the 18 sessions.

Beffert [44] compared a six-week walking-running program to waitlist. The walking-running program was designed to increase the aerobic fitness of the participants. The intensity was about 60-85% of maximum heart rate.

In Burrus [47] a nine-week running program was compared to a first aid and personal safety course. The running program consisted of walk-jog-run for thirty-five minutes. The participants gradually increased their pace until their heart rate reached 75% of maximum

cardiac output. In this trial, there was also a second control group that received anaerobic exercise. The results from this control group were not included in the data analysis because studies comparing two types of exercise are not eligible in this systematic review.

Three trials had a certified physical education instructor or exercise therapist who supervised each session [44, 46, 47]. One trial did not report if the trainers were either certified or experienced in their respective fields [45]. For further details of the interventions see TIDieR tables in Appendix II.

### ***Primary outcomes***

The severity of depression was measured using a different measurement tool in each of the included trials. Beffert [44] used the Reynolds Adolescent Depression Scale (RADS) [48]. Burrus [47] used the Depression Adjective Checklist (DACL) [49]. Carter et al. [46] used Children's Depression Inventory 2 (CDI-2) [50]. Hamilton Rating Scale for Depression (Ham-D) was used in Roshan et al. [45]. All trials reported the severity of depression as continuous outcomes. None of the included trials commented on the presence or absence of adverse events.

### ***Secondary outcomes***

Quality of life was evaluated in one trial [46], using EQ-5D, a standardized measure of health-related quality of life [51].

Psychological well-being and social functioning as outcomes were not evaluated in any of the included trials.

### ***Timing of outcome measures***

All trials reported outcome measured at the end of the intervention period. Follow-up data beyond the end of treatment is reported in only one trial (6-month follow-up) [46].

## Risk of bias in included studies

All included trials were assessed as having a high or unclear risk of bias. The random sequence generation and allocation concealment were adequate in only one trial [46] and unclear in the other three trials. Blinding of participants and personnel in exercise trials is not possible to achieve; we, therefore, rated all the four trials as high risk of bias for that domain. Blinding of outcome assessment, selective reporting, and other bias are satisfactory reported in only one trial [46] and unclear in the other three trials. Incomplete outcome data or attrition was rated as unclear risk of bias in all the four trials. See Risk of bias graph in figure 2 and 3.

Figure 2. Risk of bias graph

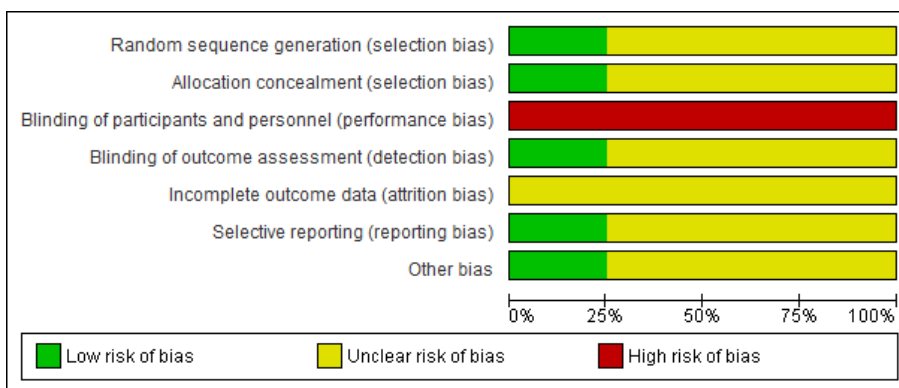
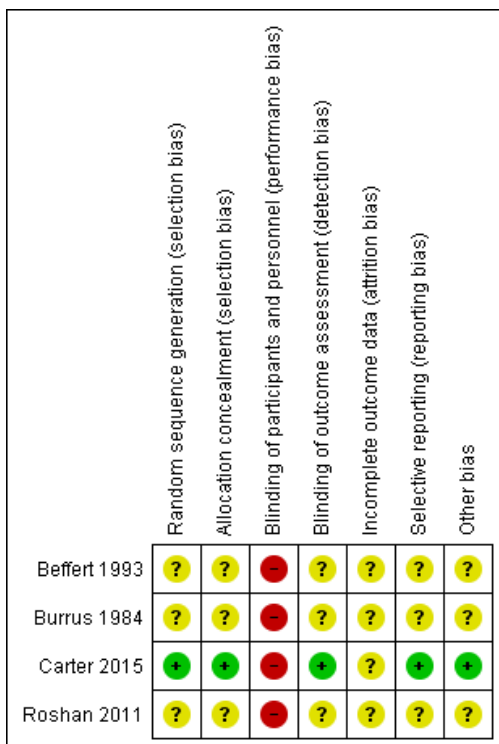


Figure 3. Risk of bias graph





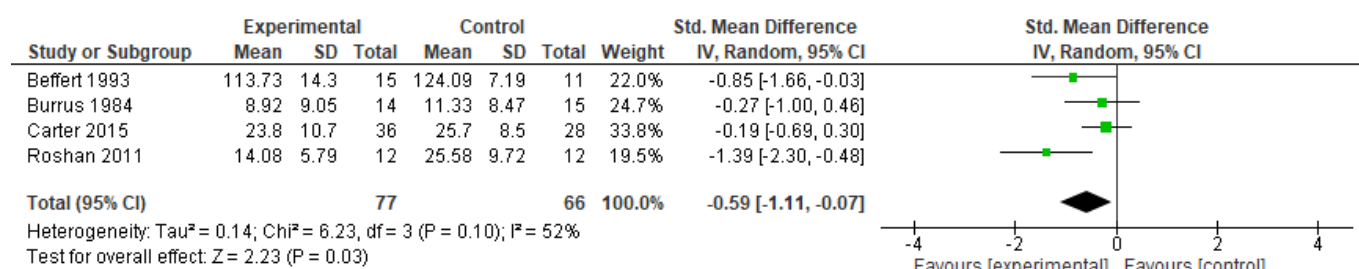
## Effects of interventions

### Depression (post-intervention)

For the primary outcome, change in depression post-intervention, the results of four trials ( $n=143$ ) were pooled in a meta-analysis, and found a moderate effect in favour of exercise (SMD = -0.59, 95% CI = -1.11, to -0.07,  $p=0.03$ ). See forest plot in figure 4.

The heterogeneity across the four trials was moderate ( $I^2=52\%$ ). The heterogeneity may be explained by different control interventions and measurement tools. However, it was decided to undertake a meta-analysis as the participants, treatments and clinical questions were similar enough to pool in a meta-analysis.

Figure 4. Forest plot of comparison: exercise versus control, outcome: change in depression post-intervention.



### Depression (follow-up)

Effects at six-month follow-up was reported in one trial ( $n=42$ , 22 were lost to follow-up from post-intervention) [46]. The trial found a moderate effect in favour of exercise (SMD = -0.59, 95% CI = -1.22, to 0.04,  $p=0.07$ ).

### Quality of Life

Quality of life at post-intervention was reported in one trial ( $n=64$ ) [46]. There were no statistically significant differences (SMD=0.27, 95% CI = -0.35, to 0.89,  $p=0.39$ ).

## Drop-out

It was not possible to pool data on this outcome. No drop-out was reported in one trial [45]. Precise numbers for drop-out was not reported in Beffert [44]. In Burrus [47] one participant withdrew from the intervention group due to medical reasons. In Carter et al. [46] “At post-intervention the total loss to follow up was 25%, with more participants dropping out in the control arm than the intervention”. “At six months, the total loss to follow up was 51% with a higher dropout rate in the control compared to the intervention arm”.

## Certainty of the evidence (GRADE)

The outcome, change in depression post-intervention, was downgraded two levels, one for risk of bias, and one for imprecision. The overall certainty of the evidence for this outcome was graded as low.

The outcome, change in depression at six months follow-up, was downgraded three levels, one for risk of bias and two for imprecision. The overall certainty of the evidence for this outcome was graded as very low. Further details of the grading are in the summary of findings table (table 2).

Table 2. Summary of findings table.

Outcomes	Anticipated absolute effects* (95% CI)		Relative effect (95% CI)	№ of participants (studies)	Certainty of the evidence (GRADE)
	Risk with control	Risk with Exercise			
Change in depression post-intervention		SMD 0.59 lower (1.11 lower to 0.07 lower)		143 (4 RCTs)	⊕⊕⊖⊖ LOW <sup>1 2</sup>
Change in depression follow-up (6 months)		SMD 0.59 lower (1.22 lower to 0.04 higher)		42 (1 RCT)	⊕⊖⊖⊖ VERY LOW <sup>1 2 3</sup>

**GRADE Working Group grades of evidence.**  
**High certainty:** we are very confident that the true effect lies close to that of the estimate of the effect.  
**Moderate certainty:** we are moderately confident in the effect estimate: the true effect is likely to be

close to the estimate of the effect, but there is a possibility that it is substantially different.

**Low certainty:** our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect.

**Very low certainty:** we have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect.

#### *Footnotes*

<sup>1</sup> *Lack of blinding probably increased effect sizes. Sequence generation was considered unclear in 3 studies.*

<sup>2</sup> *Imprecision (total number of participants less than 400). The 95% CI around the estimate of effect of all studies included in the meta-analysis was very wide.*

<sup>3</sup> *The confidence interval encompasses benefit and harm*

## **Discussion**

The purpose of this review was to systematically assess the effects of exercise interventions on children and adolescents with depression. Four trials were included, and pooling the trials found a moderate effect in favour of exercise on depression severity post-intervention. However, the trials were assessed as having an unclear or high risk of bias. The overall certainty of the evidence for this outcome was graded as low. This means that our confidence in the effect estimate is limited and the true effect may be substantially different from the estimate of the effect. The severity of depression at six months follow-up was reported in one trial. The overall certainty of the evidence for this outcome was graded as very low. This means that we have very little confidence in the effect estimate and the true effect is likely to be substantially different from the estimate of effect.

## **Strength and limitations**

A strength of this review is the use of standardized methods recommended by Cochrane and PRISMA. A comprehensive and systematic literature search was performed to identify relevant trials. In addition to published journal articles, a wide search for unpublished and ongoing trials was performed. There is however always the risk of missing trials. Systematic and transparent methods were used in the screening of references, data extraction, risk of bias assessment and evaluating the certainty of the evidence. These steps were performed by two authors independently. A limitation in this review is that it was not possible to perform a

publication bias assessment due to a low number of included trials. There is a possibility that studies with negative effects are not published.

The included trials had few participants, wide confidence intervals and low statistical power. The exercise interventions were all group-based and supervised. Therefore, we were unable to conclude about the effects of non-supervised individual exercise. Mechanisms other than the physiological or biological aspects of exercise may have accounted for the reduction in depression. The participants had social support, met new people, perhaps made some new friends, and the intervention can also be a diversion from negative thoughts and feelings. The skills of the supervisors, both professional, interpersonal, and the ability to motivate the participants might also have influenced the results.

It was not possible to make conclusions about what type of exercise has the largest benefits (e.g., aerobic, anaerobic, or team sports), or whether the intensity has any impact on the results. Intensity means how hard they exercise in each session. The duration of the exercise interventions varied from 6-9 weeks, whether the effect is different if the intervention duration is shorter or longer is not known.

None of the included trials had participants under 12 years old, and no conclusions about the effect of exercise in younger children with depression can be made.

Only one of the included trials compared an exercise intervention to established treatments [46]. It is important to find out how a new treatment compares with established treatments, and not compared to placebo. Not offering the participants in the comparison groups an established treatment can be considered unethical [52].

A limitation is that several important outcomes are not evaluated in the included trials. The severity of the depression at post-intervention was the only outcome reported in all trials. None of the trials commented on the presence or absence of adverse events. Safety should be a major focus in the evaluation of interventions. Better recording and reporting are needed to make conclusions about whether exercise can be harmful for this population. Quality of life was only measured in one of the trials, and no conclusions can be drawn. Social functioning or psychological well-being were not measured in any of the trials. Only one of the included studies measured long term effects [46]. This is unfortunate since depression is often a chronic or recurring illness, and investigating whether treatments have long-lasting effects is important [53].

## **Comparison with other systematic reviews**

The other reviews on this subject have included more trials than this systematic review, but two dissertations included in this review are not included in any of the other recent reviews [44, 47]. This is due to different inclusion criteria. Despite these differences, the result in this review, a moderate effect in favour of exercise on depression post-intervention, is consistent with the results in the previous reviews.

## **Implications for practice**

Based on the results of this systematic review exercise may reduce depression severity in adolescents with depression. However, the trials have a high risk of bias, a limited number of participants and the overall certainty of the evidence is low or very low. Exercise appears to be a promising intervention, but further trials are needed.

## **Implications for future research**

Large, high-quality trials with children and adolescents with depression are needed. Adequate numbers of participants should be recruited to detect a difference between the groups. The trials need to reduce the risk of bias. The trials need a longer follow-up time to assess long-term effectiveness. The comparison groups should be offered either treatment as usual or other recommended treatments for depression (e.g., cognitive behaviour therapy). Studies, where exercise is an add-on to other treatments are also needed since that is perhaps the most realistic in real-life situations. A wider range of outcomes should be measured in future trials, and the choice of outcome should be based on agreed standardized sets of outcomes (Core Outcome Sets). Complete reporting of adverse events is vital.

## **Declarations of interest and funding**

The authors have no known conflicts of interest to declare. The authors received no specific funding for this work, but the work on this thesis has been done as a part of our work at the Regional Centre for Child and Adolescent Mental Health, Eastern and Southern Norway (RBUP). The Centre has not influenced objectives, research question, methods or conclusions.

## **Acknowledgments**

We wish to thank Astrid Dahlgren and Åse Sagatun for feedback on the article manuscript. Information specialists Marte Ødegaard and Mari Elvsåshagen peer-reviewed the Medline

search strategy with the PRESS checklist. Researchers Simon-Peter Neumer and Parvin Kiamanesh helped with reading articles in German and Persian, and statistician Tore Wentzel-Larsen helped to assess the randomization in one of the trials.

## References

1. World Health Organization. Mental Health: Depression 2017. Available from: [http://www.who.int/mental\\_health/management/depression/en/](http://www.who.int/mental_health/management/depression/en/).
2. Pan L, Brent DA. Depression in children London, UK: BMJ; 2018 [29.04.2019]. Available from: <https://bestpractice.bmj.com/topics/en-gb/785/pdf/785.pdf>.
3. Dunn AL, Weintraub P. Exercise in the prevention and treatment of adolescent depression: A promising but little researched intervention. *Am J Lifestyle Med.* 2008;2(6):507-18. doi: 10.1177/1559827608323225.
4. Mokdad AH, Forouzanfar MH, Daoud F, Mokdad AA, El Bcheraoui C, Moradi-Lakeh M, et al. Global burden of diseases, injuries, and risk factors for young people's health during 1990–2013: a systematic analysis for the Global Burden of Disease Study 2013. *Lancet.* 2016;387(10036):2383-401. doi: 10.1016/S0140-6736(16)00648-6.
5. Costello JE, Erkanli A, Angold A. Is there an epidemic of child or adolescent depression? *J Child Psychol Psychiatry.* 2006;47(12):1263-71. doi: 10.1111/j.1469-7610.2006.01682.x.
6. Thapar A, Collishaw S, Pine DS, Thapar AK. Depression in adolescence. *Lancet.* 2012;379(9820):1056-67. doi: 10.1016/S0140-6736(11)60871-4. PubMed Central PMCID: PMC3488279.
7. Kessler RC, Bromet EJ. The epidemiology of depression across cultures. *Annu Rev Public Health.* 2013;34:119-38. doi: 10.1146/annurev-publhealth-031912-114409.
8. Sagatun A, Wentzel-Larsen T, Heyerdahl S, Lien L. Mental health in adolescence and subsequent receipt of medical benefits in young adulthood: The mediating role of upper secondary school completion. *Scand J Public Health.* 2016;44(4):431-8. doi: 10.1177/1403494815622309.
9. World Health Organization. Depression fact sheet 2018. Available from: <http://www.who.int/mediacentre/factsheets/fs369/en/>.

10. NICE. Clinical Guideline: Depression in children and young people: identification and management 2005 [10.08.2017]. Available from:  
<https://www.nice.org.uk/guidance/cg28>.
11. Cheung AH, Zuckerbrot RA, Jensen PS, Laraque D, Stein REK. Guidelines for Adolescent Depression in Primary Care (GLAD-PC): Part II. Treatment and Ongoing Management. *Pediatrics*. 2018;141(3):e20174082. doi: 10.1542/peds.2017-4082.
12. Cipriani A, Zhou X, Del Giovane C, Hetrick SE, Qin B, Whittington C, et al. Comparative efficacy and tolerability of antidepressants for major depressive disorder in children and adolescents: a network meta-analysis. *Lancet*. 2016;388(10047):881-90. doi: 10.1016/S0140-6736(16)30385-3.
13. Cox GR, Callahan P, Churchill R, Hunot V, Merry SN, Parker AG, et al. Psychological therapies versus antidepressant medication, alone and in combination for depression in children and adolescents. *Cochrane Database Syst Rev*. 2014;(11). doi: 10.1002/14651858.CD008324.pub3. PubMed PMID: CD008324.
14. Cox GR, Fisher CA, De Silva S, Phelan M, Akinwale OP, Simmons MB, et al. Interventions for preventing relapse and recurrence of a depressive disorder in children and adolescents. *Cochrane Database Syst Rev*. 2012;(11). doi: 10.1002/14651858.CD007504.pub2. PubMed PMID: CD007504.
15. Hetrick SE, McKenzie JE, Cox GR, Simmons MB, Merry SN. Newer generation antidepressants for depressive disorders in children and adolescents. *Cochrane Database Syst Rev*. 2012;(11). doi: 10.1002/14651858.CD004851.pub3. PubMed PMID: CD004851.
16. Weisz JR, Kuppens S, Ng MY, Eckshtain D, Ugueto AM, Vaughn-Coaxum R, et al. What five decades of research tells us about the effects of youth psychological therapy: A multilevel meta-analysis and implications for science and practice. *Am Psychol*. 2017;72(2):79-117. Epub 2017/02/22. doi: 10.1037/a0040360. PubMed PMID: 28221063.
17. Cooney GM, Dwan K, Greig CA, Lawlor DA, Rimer J, Waugh FR, et al. Exercise for depression. *Cochrane Database Syst Rev*. 2013;(9). doi: 10.1002/14651858.CD004366.pub6. PubMed PMID: CD004366.
18. Brown HE, Pearson N, Braithwaite RE, Brown WJ, Biddle SJH. Physical activity interventions and depression in children and adolescents: A systematic review and meta-analysis. *Sports Med*. 2013;43(3):195-206. doi: 10.1007/s40279-012-0015-8.

19. Radovic S, Gordon MS, Melvin GA. Should we recommend exercise to adolescents with depressive symptoms? A meta-analysis. *J Paediatr Child Health*. 2017;53(3):214-20. doi: 10.1111/jpc.13426.
20. Carter T, Morres ID, Meade O, Callaghan P. The Effect of exercise on depressive symptoms in adolescents: A systematic review and meta-analysis. *J Am Acad Child Adolesc Psychiatry*. 2016;55(7):580-90. doi: 10.1016/j.jaac.2016.04.016.
21. Bailey AP, Hetrick SE, Rosenbaum S, Purcell R, Parker AG. Treating depression with physical activity in adolescents and young adults: a systematic review and meta-analysis of randomised controlled trials. *Psychol Med*. 2017:1-20. Epub 2017/10/11. doi: 10.1017/s0033291717002653. PubMed PMID: 28994355.
22. Larun L, Nordheim LV, Ekeland E, Hagen KB, Heian F. Exercise in prevention and treatment of anxiety and depression among children and young people. *Cochrane Database Syst Rev*. 2006;(3). doi: 10.1002/14651858.CD004691.pub2. PubMed PMID: CD004691.
23. Sterne JAC, Egger M, Moher D. Chapter 10: Addressing reporting biases. 2011. In: *Cochrane handbook for systematic reviews of interventions Version 5.1.0* [Internet]. Available from: [www.handbook.cochrane.org](http://www.handbook.cochrane.org).
24. Higgins JPT, Green S. *Cochrane Handbook for Systematic Reviews of Interventions*. Version 5.1.0: The Cochrane Collaboration; 2011. Available from: <http://handbook.cochrane.org/>.
25. Moher D, Liberati A, Tetzlaff J, Altman DG. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *BMJ*. 2009;339:b2535. doi: 10.1136/bmj.b2535. PubMed PMID: 19622551; PubMed Central PMCID: PMC2714657.
26. Centre for Reviews and Dissemination. PROSPERO : International Prospective Register of Systematic Reviews University of York 2017 [21.11.2017]. Available from: <https://www.crd.york.ac.uk/prospero/>.
27. American College of Sports Medicine. *ACSM's guidelines for exercise testing and prescription*. 10th ed. Philadelphia, PA: Wolters Kluwer; 2017.
28. Obbarius A, van Maasackers L, Baer L, Clark DM, Crocker AG, de Beurs E, et al. Standardization of health outcomes assessment for depression and anxiety: recommendations from the ICHOM Depression and Anxiety Working Group. *Qual Life Res*. 2017;26(12):3211-25. doi: 10.1007/s11136-017-1659-5.



29. McGowan J, Sampson MS, D.M., Cogo E, Foerster V, Lefebvre C. PRESS Peer Review of Electronic Search Strategies : 2015 Guidelines Explanation and Elaboration (PRESS E&E). Ottawa, Canada: Canadian Agency for Drugs and Technologies in Health; 2016.
30. Veritas Health Innovation. Covidence Systematic Review Software [Computer Software]. Melbourne, Australia.2017.
31. Hoffmann TC, Glasziou PP, Boutron I, Milne R, Perera R, Moher D, et al. Better reporting of interventions: template for intervention description and replication (TIDieR) checklist and guide. *BMJ*. 2014;348:g1687. doi: 10.1136/bmj.g1687. PubMed PMID: 24609605.
32. Higgins JPT, Altman DG, Sterne JAC. Chapter 8: Assessing risk of bias in included studies. 2011 [cited 8.11.2017]. In: *Cochrane handbook for systematic reviews of interventions Version 510* [Internet]. [cited 8.11.2017]. Available from: [www.handbook.cochrane.org](http://www.handbook.cochrane.org).
33. The Cochrane Collaboration. Review Manager (RevMan) 5.3 [Computer Software]. 2014. p. Computer Software.
34. Higgins JPT, Thompson SG, Deeks JJ, Altman DG. Measuring inconsistency in meta-analyses. *BMJ*. 2003;327(7414):557-60. doi: 10.1136/bmj.327.7414.557. PubMed PMID: 12958120.
35. Deeks JJ, Higgins JPT, Altman DG. Chapter 9: Analysing data and undertaking meta-analyses. 2011. In: *Cochrane handbook for systematic reviews of interventions Version 510* [Internet]. Available from: [www.handbook.cochrane.org](http://www.handbook.cochrane.org).
36. Cohen J. *Statistical power analysis for the behavioral sciences*. 2nd ed. Hillsdale, N. J.: Lawrence Erlbaum; 1988.
37. Guyatt GH, Oxman AD, Akl EA, Kunz R, Vist G, Brozek J, et al. GRADE guidelines: 1. Introduction-GRADE evidence profiles and summary of findings tables. *J Clin Epidemiol*. 2011;64(4):383-94. doi: 10.1016/j.jclinepi.2010.04.026. PubMed PMID: 21195583.
38. Schünemann HJ, Oxman AD, Vist GE, Higgins JPT, Deeks JJ, Glasziou PP, et al. Chapter 12: Interpreting results and drawing conclusions. 2011. In: *Cochrane handbook for systematic reviews of interventions Version 510* [Internet]. Available from: [www.handbook.cochrane.org](http://www.handbook.cochrane.org).
39. McMaster University and Evidence Prime Inc. GRADEpro GDT 2015. [Computer Software]. Available from: <https://gradepr.org/>.

40. De Volder AG. Move and Feel Good : Effects of Intensive Physical Training on Brain Plasticity, Cognition and Psychological Well-being. (Move&FG). *Trials* NCT02970825. 2018.
41. Dopp RR. Exercise as Treatment for Adolescents With Depressive Disorders. *Trials* NCT00964054. 2018.
42. Lin K. A Study of Aerobic Exercise for Adolescents With Subthreshold Mood Syndromes. *Trials* NCT03300778. 2018.
43. Oberste M, Grossheinrich N, Wunram HL, Graf JL, Ziemendorff A, Meinhardt A, et al. Effects of a 6-week, whole-body vibration strength-training on depression symptoms, endocrinological and neurobiological parameters in adolescent inpatients experiencing a major depressive episode (the "Balancing Vibrations Study"): study protocol for a randomized placebo-controlled trial. *Trials*. 2018;19(1):347. doi: 10.1186/s13063-018-2747-8. PubMed PMID: 29970142.
44. Beffert JW. Aerobic exercise as treatment of depressive symptoms in early adolescents. Greeley, CO: University of Northern Colorado; 1993.
45. Roshan DV, Pourasghar M, Mohammadian Z. The Efficacy of intermittent walking in water on the rate of MHPG sulfate and the severity of depression. *Iran J Psychiatry Behav Sci*. 2011;5(2):26-31. PubMed PMID: 24644444.
46. Carter T, Guo B, Turner D, Morres I, Khalil E, Brighton E, et al. Preferred intensity exercise for adolescents receiving treatment for depression: a pragmatic randomised controlled trial. *BMC Psychiatry*. 2015;15(1):247. doi: 10.1186/s12888-015-0638-z.
47. Burrus MJ. The effects of a running treatment program on depressed adolescents. Coral Gable, FL: University of Miami; 1984.
48. Reynolds W. Reynolds Adolescent Depression Scale: Professional manual. Odessa, FL: Psychological Assessment Resources; 1987.
49. Lubin B. Manual for the Depression Adjective Check Lists. San Diego, CA: Educational and Industrial Testing Service; 1981.
50. Kovacs M. Children's depression inventory. Toronto, Canada; New York, NY: Multi-Health Systems, Inc.; 1992.
51. Herdman M, Gudex C, Lloyd A, Janssen M, Kind P, Parkin D, et al. Development and preliminary testing of the new five-level version of EQ-5D (EQ-5D-5L). *Qual Life Res*. 2011;20(10):1727-36. doi: 10.1007/s11136-011-9903-x.

52. Stang A, Hense H-W, Jöckel K-H, Turner EH, Tramèr MR. Is it always unethical to use a placebo in a clinical trial? *PLoS Med.* 2005;2(3):e72-e. doi: 10.1371/journal.pmed.0020072. PubMed PMID: 15783259.
53. Wesselhoeft R, Sorensen MJ, Heiervang ER, Bilenberg N. Subthreshold depression in children and adolescents - a systematic review. *J Affect Disord.* 2013;151(1):7-22. Epub 2013/07/17. doi: 10.1016/j.jad.2013.06.010. PubMed PMID: 23856281.



# PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
<b>TITLE</b>			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
<b>ABSTRACT</b>			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	2
<b>INTRODUCTION</b>			
Rationale	3	Describe the rationale for the review in the context of what is already known.	3-4
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	4
<b>METHODS</b>			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	4
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	4-5
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	5-6
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	Supplementary S2
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	6
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	6
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	6
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	7
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	7



# PRISMA 2009 Checklist

Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., $I^2$ ) for each meta-analysis.	7
----------------------	----	---	---

Page 1 of 2

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	7
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	7
<b>RESULTS</b>			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	8-9
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	11
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	14
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	15
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	15
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see item 15).	14
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see item 16]).	N/A
<b>DISCUSSION</b>			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	17
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	17-18
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	19
<b>FUNDING</b>			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	20



## PRISMA 2009 Checklist

From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(7): e1000097.  
doi:10.1371/journal.pmed1000097

For more information, visit: [www.prisma-statement.org](http://www.prisma-statement.org).

Page 2 of 2



## Supplementary S2

### Search strategies

Date for search: 23<sup>rd</sup> of March 2018

Date for update search December 18<sup>th</sup> 2018

Date for search insources for grey literature and ongoing trials 5<sup>th</sup> of February 2019

Search strategies developed by: Sølvi Biedilæ and Brynhildur Axelsdóttir

Peer-reviewed with PRESS Checklist (McGowan et al 2016) by two librarians: Marte Ødegaard and Mari Elvsåshagen.

Total number of results in bibliographic databases from all searches with duplicates: **15.869**

Total number of results in sources for grey literature and ongoing trials in manual screening: **212**

Total number of results in bibliographic databases from all searches without duplicates: **11.007**

**Database: Ovid MEDLINE(R) Epub Ahead of Print, In-Process & Other Non-Indexed Citations, Ovid MEDLINE(R) Daily, Ovid MEDLINE and Versions(R) <1946 to March 14 2018> (Ovid SP)**

Date: 23.03.2018 Results: 2043

Date: 18.12.2018 Results: 486

#	Searches
1	Depression/
2	depressive disorder/ or depressive disorder, major/ or depressive disorder, treatment-resistant/ or dysthymic disorder/ or seasonal affective disorder/
3	(depress* or dysthymi* or melanchol* or dysphori* or sadness or low mood*).ti,ab.
4	(seasonal adj3 (affect* or mood*) adj3 disord*).ti,ab.
5	or/1-4
6	Adolescent/ or exp Child/ or Minors/ or exp Puberty/ or exp Pediatrics/ or exp Schools/
7	(child* or kid or kids or minors* or juvenil* or adoles* or youth* or youngster* or teen* or preteen* or midteen* or pubert* or prepube* or pubescen* or school* or highschool* or student* or boy or boys or boyhood* or girl* or underag* or under-ag* or pediatri* or paediatr* or peadiatr*).ti,ab,hw,kf,jw.
8	(young* adj (person* or people* or individual* or male* or female* or man or mans or men* or woman* or women*)).ti,ab.
9	or/6-8



10	exp Exercise/ or exp Exercise Therapy/ or Exercise Movement Techniques/ or exp Sports/ or "Physical Education and Training"/ or Tai ji/ or Yoga/ or Physical Exertion/ or exp Physical Endurance/ or exp Physical Fitness/ or Dancing/ or "Play and playthings"/ or games, recreational/
11	(exercis* or exertion* or (physical* adj3 (train* or education* or fit* or effort* or activ* or endur* or strength* or condition*)) or fitness or sport* or gymnastic* or athletic* or workout* or work out* or cycling* or cycle* or bicycl* or bike* or biking* or walk* or run* or jog* or treadmill* or tread-mill* or jumping* or hopping* or plyometric* or aerobic* or anaerobic* or calisthenic* or isometric* or yoga or tai ji or tai chi or thai chi or taiji or taichi or thaichi or taijiquan or ai chi or pilates or dance* or dancing* or ((weight* or power*) adj3 lift*) or weightlift* or powerlift* or musc* strength* or ((weight* or resistance or strength* or circuit*) adj3 train*) or cardiopulmonary conditioning* or exergam* or climbing* or bouldering* or hiking* or hike* or swim* or row* or skate* or skating* or football* or soccer* or volleyball* or basketball* or baseball* or handball* or cricket* or rugby* or tennis* or badminton* or stretching*).ti,ab.
12	or/10-11
13	5 and 9 and 12
14	randomized controlled trial.pt.
15	controlled clinical trial.pt.
16	randomized.ab.
17	placebo.ab.
18	drug therapy.fs.
19	randomly.ab.
20	trial.ab.
21	groups.ab.
22	or/14-21
23	exp animals/ not humans.sh.
24	22 not 23
25	13 and 24

**Database: PsycINFO <1806 to March Week 3 2018> (Ovid SP)**

Date: 23.03.2018 Results: 3207

Date: 18.12.2018 Results: 145

#	Searches
1	"depression (emotion)"/ or major depression/ or dysthymic disorder/ or endogenous depression/ or reactive depression/ or recurrent depression/ or treatment resistant depression/ or atypical depression/ or seasonal affective disorder/ or sadness/
2	(depress* or dysthymi* or melanchol* or dysphori* or sadness or low mood*).ti,ab.
3	(seasonal adj3 (affect* or mood*) adj3 disord*).ti,ab.
4	or/1-3
5	(adolescence 13 17 yrs or school age 6 12 yrs).ag.
6	puberty/ or pediatrics/ or schools/ or elementary schools/ or high schools/ or junior high schools/ or middle schools/
7	(child* or kid or kids or minors* or juvenil* or adoles* or youth* or youngster* or teen* or preteen* or midteen* or pubert* or prepube* or pubescen* or school* or highschool* or student* or boy or boys or boyhood* or girl* or underag* or under-ag* or pediater* or paediatr* or peadiatr*).ti,ab,id,hw,jx.
8	(young* adj (person* or people* or individual* or male* or female* or man or mans or men* or woman* or women*).ti,ab.
9	or/5-8
10	exp Exercise/ or exp Sports/ or physical education/ or physical endurance/ or Physical Fitness/ or Dance/ or childrens recreational games/ or jumping/ or running/ or walking/ or physical strength/ or recreation/ or athletic participation/ or athletic performance/ or athletic training/ or physical activity/
11	(exercis* or exertion* or (physical* adj3 (train* or education* or fit* or effort* or activ* or endur* or strength* or condition*)) or fitness or sport* or gymnastic* or athletic* or workout* or work out* or cycling* or cycle* or bicycl* or bike* or biking* or walk* or run* or jog* or treadmill* or tread-mill* or jumping* or hopping* or plyometric* or aerobic* or anaerobic* or calisthenic* or isometric* or yoga or tai ji or tai chi or thai chi or taiji or taichi or thaichi or taijiquan or ai chi or pilates or dance* or dancing* or ((weight* or power*) adj3 lift*) or weightlift* or powerlift* or musc* strength* or ((weight* or resistance or strength* or circuit*) adj3 train*) or cardiopulmonary conditioning* or exergam* or climbing* or bouldering* or hiking* or hike* or swim* or row* or skate* or skating* or football* or soccer* or volleyball* or basketball* or baseball* or handball* or cricket* or rugby* or tennis* or badminton* or stretching*).ti,ab.
12	or/10-11

13	4 and 9 and 12
14	exp treatment effectiveness evaluation/ or clinical trials/ or followup studies/ or exp program evaluation/ or empirical methods/ or exp experimental methods/ or experimental design/ or between groups design/ or repeated measures/ or exp treatment outcomes/ or placebo/
15	(clinical trial or empirical study or followup study or quantitative study or treatment outcome).md.
16	(random* or trial* or control or (control* adj3 (study or studies)) or crossover* or cross-over* or allocat* or assign* or factorial* or volunteer* or (quasi adj experimental) or ((waitlist* or wait* list* or treatment as usual or TAU) adj3 (control or group*)) or placebo*).ti,ab.
17	or/14-16
18	13 and 17

**Database:** Embase <1974 to 2018 March 22> (Ovid SP)

Date: 23.03.2018 Results: 1401

Date: 18.12.2018 Results: 180

#	Searches
1	depression/ or adolescent depression/ or agitated depression/ or atypical depression/ or chronic depression/ or dysphoria/ or dysthymia/ or endogenous depression/ or major depression/ or melancholia/ or minor depression/ or organic depression/ or reactive depression/ or recurrent brief depression/ or seasonal affective disorder/ or treatment resistant depression/ or sadness/
2	(depress* or dysthymi* or melanchol* or dysphori* or sadness or low mood*).ti,ab.
3	(seasonal adj3 (affect* or mood*) adj3 disord*).ti,ab.
4	or/1-3
5	child/ or exp adolescent/ or exp adolescence/ or childhood/ or exp puberty/ or pediatrics/ or child psychiatry/ or school/ or high school/ or middle school/ or primary school/ or elementary student/ or high school student/ or middle school student/ or school child/
6	(child* or kid or kids* or minors* or juvenil* or adoles* or youth* or youngster* or teen* or preteen* or midteen* or pubert* or prepube* or pubescen* or school* or highschool* or student* or boy or boys* or boyfriend* or boyhood* or girl* or under 18* or under eighteen* or underag* or under-ag* or pediater* or paediatr* or peadiatr*).ti,ab,kw,hw,jx.
7	(young* adj (person* or people* or individual* or male* or female* or man or mans or men* or woman* or women*)).ti,ab.
8	or/5-7
9	exp Exercise/ or exp Sport/ or Training/ or Dancing/ or exp Physical activity/ or Physical education/ or Endurance/ or Fitness/ or Play/ or Recreational game/
10	(exercis* or exertion* or (physical* adj3 (train* or education* or fit* or effort* or activ* or endur* or strength* or condition*)) or fitness or sport* or gymnastic* or athletic* or workout* or work out* or cycling* or cycle* or bicycl* or bike* or biking* or walk* or run* or jog* or treadmill* or tread-mill* or jumping* or hopping* or plyometric* or aerobic* or anaerobic* or calisthenic* or isometric* or yoga or tai ji or tai chi or thai chi or taiji or taichi or thaichi or taijiquan or ai chi or pilates or dance* or dancing* or ((weight* or power*) adj3 lift*) or weightlift* or powerlift* or musc* strength* or ((weight* or resistance or strength* or circuit*) adj3 train*) or cardiopulmonary conditioning* or exergam* or climbing* or bouldering* or hiking* or hike* or swim* or row* or skate* or skating* or football* or soccer* or volleyball* or basketball* or baseball* or handball* or cricket* or rugby* or tennis* or badminton* or stretching*).ti,ab.
11	or/9-10
12	randomized controlled trial/ or crossover procedure/ or double blind procedure/ or single blind procedure/

13	(crossover* or cross over* or placebo* or allocat* or random*).ti,ab.
14	(doubl* adj blind*).ti,ab.
15	trial*.ti.
16	or/12-15
17	4 and 8 and 11 and 16

**Database: AMED (Allied and Complementary Medicine) <1985 to March 2018> (Ovid SP)**

Date: 23.03.2018 Results: 98

Date: 18.12.2018 Results 8

#	Searches
1	depression/ or depressive disorder/
2	(depress* or dysthymi* or melanchol* or dysphori* or sadness or low mood*).ti,ab.
3	(seasonal adj3 (affect* or mood*) adj3 disord*).ti,ab.
4	or/1-3
5	exp Adolescent/ or Child/ or Child Hospitalized/ or Puberty/ or Pediatrics/ or Schools/
6	(child* or kid or kids or minors* or juvenil* or adoles* or youth* or youngster* or teen* or preteen* or midteen* or pubert* or prepube* or pubescen* or school* or highschool* or student* or boy or boys or boyhood* or girl* or underag* or pediater* or paediatr* or peadiatr*).ti,ab,hw,et,jx.
7	(young* adj (person* or people* or individual* or male* or female* or man or mans or men* or woman* or women*).ti,ab.
8	or/5-7
9	exp Exercise/ or exp Exercise Therapy/ or exp Sports/ or exp physical education/ or yoga/ or exp exertion/ or Physical Fitness/ or Dancing/ or "play and playthings"/
10	(exercis* or exertion* or (physical* adj3 (train* or education* or fit* or effort* or activ* or endur* or strength* or condition*)) or fitness or sport* or gymnastic* or athletic* or workout* or work out* or cycling* or cycle* or bicycl* or bike* or biking* or walk* or run* or jog* or treadmill* or tread-mill* or jumping* or hopping* or plyometric* or aerobic* or anaerobic* or calisthenic* or isometric* or yoga or tai ji or tai chi or thai chi or taiji or taichi or thaichi or taijiquan or ai chi or pilates or dance* or dancing* or ((weight* or power*) adj3 lift*) or weightlift* or powerlift* or musc* strength* or ((weight* or resistance or strength* or circuit*) adj3 train*) or cardiopulmonary conditioning* or exergam* or climbing* or bouldering* or hiking* or hike* or swim* or row* or skate* or skating* or football* or soccer* or volleyball* or basketball* or baseball* or handball* or cricket* or rugby* or tennis* or badminton* or stretching*).ti,ab.
11	or/9-10
12	4 and 8 and 11

**Database: Cochrane Library Central Database**

Date: 23.03.2018 Results: 1031

Date: 18.12.2018 Results: 330

- | ID  | Search Hits   |
|-----|---|
| #1  | MeSH descriptor: [Depression] this term only  |
| #2  | MeSH descriptor: [Depressive Disorder] this term only   |
| #3  | MeSH descriptor: [Depressive Disorder, Major] this term only  |
| #4  | MeSH descriptor: [Depressive Disorder, Treatment-Resistant] this term only  |
| #5  | MeSH descriptor: [Dysthymic Disorder] this term only  |
| #6  | MeSH descriptor: [Seasonal Affective Disorder] this term only   |
| #7  | (depress* or dysthymi* or melanchol* or dysphori* or "sadness" or "low mood*"):ti,ab,kw   |
| #8  | ("seasonal" near/3 (affect* or mood*) near/3 disord*):ti,ab,kw  |
| #9  | #1 or #2 or #3 or #4 or #5 or #6 or #7 or #8  |
| #10 | MeSH descriptor: [Adolescent] this term only  |
| #11 | MeSH descriptor: [Child] explode all trees  |
| #12 | MeSH descriptor: [Minors] this term only  |
| #13 | MeSH descriptor: [Puberty] explode all trees  |
| #14 | MeSH descriptor: [Pediatrics] explode all trees   |
| #15 | MeSH descriptor: [Schools] explode all trees  |
| #16 | (child* or "kid" or "kids" or minors* or juvenil* or adoles* or youth* or youngster* or teen* or preteen* or midteen* or pubert* or prepube* or pubescen* or school* or highschool* or student* or "boy" or "boys" or boyhood* or girl* or underag* or "under-ag*" or pediater* or paediatr* or peadiater*):ti,ab,kw 215839 |
| #17 | (young* near/1 (person* or people* or individual* or male* or female* or "man" or "mans" or men* or woman* or women*)):ti,ab,kw   |
| #18 | #10 or #11 or #12 or #13 or #14 or #15 or #16 or #17  |
| #19 | MeSH descriptor: [Exercise] explode all trees   |
| #20 | MeSH descriptor: [Exercise Therapy] explode all trees   |
| #21 | MeSH descriptor: [Exercise Movement Techniques] this term only  |
| #22 | MeSH descriptor: [Sports] explode all trees   |
| #23 | MeSH descriptor: [Physical Education and Training] this term only   |
| #24 | MeSH descriptor: [Tai Ji] this term only  |
| #25 | MeSH descriptor: [Yoga] this term only  |
| #26 | MeSH descriptor: [Physical Exertion] this term only   |

- #27 MeSH descriptor: [Physical Endurance] explode all trees
- #28 MeSH descriptor: [Physical Fitness] explode all trees
- #29 MeSH descriptor: [Dancing] this term only
- #30 MeSH descriptor: [Play and Playthings] this term only
- #31 MeSH descriptor: [Games, Recreational] this term only
- #32 (exercis\* or exertion\* or (physical\* near/3 (train\* or education\* or fit\* or effort\* or activ\* or endur\* or strength\* or condition\*)) or "fitness" or sport\* or gymnastic\* or athletic\* or workout\* or "work out\*" or cycling\* or cycle\* or bicycl\* or bike\* or biking\* or walk\* or run\* or jog\* or treadmill\* or "tread-mill\*" or jumping\* or hopping\* or plyometric\* or aerobic\* or anaerobic\* or calisthenic\* or isometric\* or "yoga" or "tai ji" or "tai chi" or "thai chi" or "taiji" or "taichi" or "thaichi" or "taijiquan" or "ai chi" or "pilates" or dance\* or dancing\* or ((weight\* or power\*) near/3 lift\*) or weightlift\* or powerlift\* or "musc\* strength\*" or ((weight\* or "resistance" or strength\* or circuit\*) near/3 train\*) or "cardiopulmonary conditioning\*" or exergam\* or climbing\* or bouldering\* or hiking\* or hike\* or swim\* or row\* or skate\* or skating\* or football\* or soccer\* or volleyball\* or basketball\* or baseball\* or handball\* or cricket\* or rugby\* or tennis\* or badminton\* or stretching\*):ti,ab,kw
- #33 #19 or #20 or #21 or #22 or #23 or #24 or #25 or #26 or #27 or #28 or #29 or #30 or #31 or #32
- #34 #9 and #18 and #33 in Trials



**Database: Web of Science (Core Collection)**

Date: 23.03.2018 Results: 2152

Date: 18.12.2018 Results: 243

# 6	#5 AND #4 Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=All years
# 5	TS=(random* or trial* or "control" or (control* NEAR/3 ("study" or "studies"))) or crossover* or "cross-over*" or allocat* or assign* or factorial* or volunteer* or ("quasi" NEAR/1 "experimental") or ((waitlist* or "wait* list*" or "treatment as usual" or "TAU") NEAR/3 ("control" or group*)) or placebo*) Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=All years
# 4	#3 AND #2 AND #1 Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=All years
# 3	TS=(exercis* or exertion* or (physical* NEAR/3 (train* or education* or fit* or effort* or activ* or endur* or strength* or condition*)) or "fitness" or sport* or gymnastic* or athletic* or workout* or "work out*" or cycling* or cycle* or bicycl* or bike* or biking* or walk* or run* or jog* or treadmill* or "treadmill*" or jumping* or hopping* or plyometric* or aerobic* or anaerobic* or calisthenic* or isometric* or "yoga" or "tai ji" or "tai chi" or "thai chi" or "taiji" or "taichi" or "thaichi" or "taijiquan" or "ai chi" or "pilates" or dance* or dancing* or ((weight* or power*) NEAR/3 lift*) or weightlift* or powerlift* or "musc* strength*" or ((weight* or "resistance" or strength* or circuit*) NEAR/3 train*) or "cardiopulmonary conditioning*" or exergam* or climbing* or bouldering* or hiking* or hike* or swim* or row* or skate* or skating* or football* or soccer* or volleyball* or basketball* or baseball* or handball* or cricket* or rugby* or tennis* or badminton* or stretching*) Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=All years
# 2	TS=(child* or "kid" or "kids" or minors* or juvenil* or adoles* or youth* or youngster* or teen* or preteen* or midteen* or pubert* or prepube* or pubescen* or school* or highschool* or student* or "boy" or "boys" or boyhood* or girl* or underag* or "under-ag*" or pediatri* or paediatric* or peditri* or (young* NEAR/1 (person* or people* or individual* or male* or female* or "man" or "mans" or men* or woman* or women*))) Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=All years
# 1	TS=(depress* or dysthymi* or melanchol* or dysphori* or "sadness" or "low mood*" or ("seasonal" NEAR/3 (affect* or mood*) NEAR/3 disord*)) Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=All years

**Database: SportDiscus (EBSCO)**

Date: 23.03.2018 Results: 773

Date: 18.12.2018 Results: 38

#	Query
S1	<p>TI (depress* or dysthymi* or melanchol* or dysphori* or "sadness" or "low mood*" or ("seasonal" N3 (affect* or mood*) N3 disord*)) OR AB (depress* or dysthymi* or melanchol* or dysphori* or "sadness" or "low mood*" or ("seasonal" N3 (affect* or mood*) N3 disord*)) OR SU (depress* or dysthymi* or melanchol* or dysphori* or "sadness" or "low mood*" or ("seasonal" N3 (affect* or mood*) N3 disord*))</p>
S2	<p>TI (child* or "kid" or "kids" or minors* or juvenil* or adoles* or youth* or youngster* or teen* or preteen* or midteen* or pubert* or prepube* or pubescen* or school* or highschool* or student* or "boy" or "boys" or boyhood* or girl* or underag* or "under-ag*" or pediatri* or paediatr* or peadiatr* or (young* N1 (person* or people* or individual* or male* or female* or "man" or "mans" or men* or woman* or women*))) OR AB (child* or "kid" or "kids" or minors* or juvenil* or adoles* or youth* or youngster* or teen* or preteen* or midteen* or pubert* or prepube* or pubescen* or school* or highschool* or student* or "boy" or "boys" or boyhood* or girl* or underag* or "under-ag*" or pediatri* or paediatr* or peadiatr* or (young* N1 (person* or people* or individual* or male* or female* or "man" or "mans" or men* or woman* or women*))) OR SU (child* or "kid" or "kids" or minors* or juvenil* or adoles* or youth* or youngster* or teen* or preteen* or midteen* or pubert* or prepube* or pubescen* or school* or highschool* or student* or "boy" or "boys" or boyhood* or girl* or underag* or "under-ag*" or pediatri* or paediatr* or peadiatr* or (young* N1 (person* or people* or individual* or male* or female* or "man" or "mans" or men* or woman* or women*)))</p>
S3	<p>TI (exercis* or exertion* or (physical* N3 (train* or education* or fit* or effort* or activ* or endur* or strength* or condition*)) or "fitness" or sport* or gymnastic* or athletic* or workout* or "work out*" or cycling* or cycle* or bicycl* or bike* or biking* or walk* or run* or jog* or treadmill* or "tread-mill*" or jumping* or hopping* or plyometric* or aerobic* or anaerobic* or calisthenic* or isometric* or "yoga" or "tai ji" or "tai chi" or "thai chi" or "taiji" or "taichi" or "thaichi" or "taijiquan" or "ai chi" or "pilates" or dance* or dancing* or ((weight* or power*) N3 lift*) or weightlift* or powerlift* or "musc* strength*" or ((weight* or "resistance" or strength* or circuit*) N3 train*) or "cardiopulmonary conditioning*" or exergam* or climbing* or bouldering* or hiking* or hike* or swim* or row* or skate* or skating* or football* or soccer* or volleyball* or basketball* or baseball* or handball* or cricket* or rugby* or tennis* or badminton* or stretching*) OR AB (exercis* or exertion* or (physical* N3 (train* or education* or fit* or effort* or activ* or endur* or strength* or condition*)) or "fitness" or sport* or gymnastic* or athletic* or workout* or "work out*" or cycling* or cycle* or bicycl* or bike* or biking* or walk* or run* or jog* or treadmill* or "tread-mill*" or jumping* or hopping* or plyometric* or aerobic* or anaerobic* or calisthenic* or isometric* or "yoga" or "tai ji" or "tai chi" or "thai chi" or "taiji" or "taichi" or "thaichi" or "taijiquan" or "ai chi" or "pilates" or dance* or dancing* or ((weight* or power*) N3 lift*) or weightlift* or powerlift* or "musc* strength*" or ((weight* or "resistance" or strength* or circuit*) N3 train*) or "cardiopulmonary conditioning*" or exergam* or climbing* or bouldering* or hiking* or hike* or swim* or row* or skate* or skating* or football* or soccer* or volleyball* or basketball* or baseball* or handball* or cricket* or rugby* or tennis* or badminton* or stretching*) OR SU (exercis* or exertion* or (physical* N3 (train* or education* or fit* or effort* or activ* or endur* or strength* or condition*)) or "fitness" or sport* or gymnastic* or athletic* or workout* or "work out*" or cycling* or cycle* or bicycl* or bike* or biking* or walk* or run* or jog* or treadmill* or</p>

	"tread-mill*" or jumping* or hopping* or plyometric* or aerobic* or anaerobic* or calisthenic* or isometric* or "yoga" or "tai ji" or "tai chi" or "thai chi" or "taiji" or "taichi" or "thaichi" or "taijiquan" or "ai chi" or "pilates" or dance* or dancing* or ((weight* or power*) N3 lift*) or weightlift* or powerlift* or "musc* strength*" or ((weight* or "resistance" or strength* or circuit*) N3 train*) or "cardiopulmonary conditioning*" or exergam* or climbing* or bouldering* or hiking* or hike* or swim* or row* or skate* or skating* or football* or soccer* or volleyball* or basketball* or baseball* or handball* or cricket* or rugby* or tennis* or badminton* or stretching*)
S4	S1 AND S2 AND S3

**Database: CINAHL (Ebsco)**

Date: 23.03.2018 Results: 1574

Date: 18.12.2018 Results: 993

#	Query
S1	(MH "Depression") OR (MH "Depression, Reactive") OR (MH "Dysthymic Disorder") OR (MH "Seasonal Affective Disorder")
S2	TI (depress* or dysthymi* or melanchol* or dysphori* or "sadness" or "low mood*")
S3	AB (depress* or dysthymi* or melanchol* or dysphori* or "sadness" or "low mood*")
S4	TI ("seasonal" N3 (affect* or mood*) N3 disord*)
S5	AB ("seasonal" N3 (affect* or mood*) N3 disord*)
S6	S1 OR S2 OR S3 OR S4 OR S5
S7	(MH "Adolescence+") OR (MH "Child") OR (MH "Child, Hospitalized") OR (MH "Child, Institutionalized") OR (MH "Minors (Legal)")
S8	(MH "Puberty")
S9	(MH "Pediatrics")
S10	(MH "Schools") OR (MH "Schools, Elementary") OR (MH "Schools, Middle")OR (MH "Schools, Secondary")
S11	TI (child* or "kid" or "kids" or minors* or juvenil* or adoles* or youth* or youngster* or teen* or preteen* or midteen* or pubert* or prepube* or pubescen* or school* or highschool* or student* or "boy" or "boys" or boyhood* or girl* or underag* or "under-ag*" or pediater* or paediatr* or peadiater*)
S12	AB (child* or "kid" or "kids" or minors* or juvenil* or adoles* or youth* or youngster* or teen* or preteen* or midteen* or pubert* or prepube* or pubescen* or school* or highschool* or student* or "boy" or "boys" or boyhood* or girl* or underag* or "under-ag*" or pediater* or paediatr* or peadiater*)
S13	TI (young* N1 (person* or people* or individual* or male* or female* or "man" or "mans" or men* or woman* or women*))

S14	AB (young* N1 (person* or people* or individual* or male* or female* or "man" or "mans" or men* or woman* or women*))
S15	S7 OR S8 OR S9 OR S10 OR S11 OR S12 OR S13 OR S14
S16	(MH "Exercise+") OR (MH "Aerobic Exercises+")
S17	(MH "Sports+")
S18	(MH "Physical Education and Training+")
S19	(MH "Physical Endurance") OR (MH "Exertion")
S20	(MH "Physical Fitness")
S21	(MH "Physical Activity")
S22	(MH "Yoga") OR (MH "Tai Chi")
S23	(MH "Dancing+") OR (MH "Exergames") OR (MH "Play and Playthings")
S24	TI (exercis* or exertion* or (physical* N3 (train* or education* or fit* or effort* or activ* or endur* or strength* or condition*)) or "fitness" or sport* or gymnastic* or athletic* or workout* or "work out*" or cycling* or cycle* or bicycl* or bike* or biking* or walk* or run* or jog* or treadmill* or "tread-mill*" or jumping* or hopping* or plyometric* or aerobic* or anaerobic* or calisthenic* or isometric* or "yoga" or "tai ji" or "tai chi" or "thai chi" or "taiji" or "taichi" or "thaichi" or "taijiquan" or "ai chi" or "pilates" or dance* or dancing* or ((weight* or power*) N3 lift*) or weightlift* or powerlift* or "musc* strength*" or ((weight* or "resistance" or strength* or circuit*) N3 train*) or "cardiopulmonary conditioning*" or exergam* or climbing* or bouldering* or hiking* or hike* or swim* or row* or skate* or skating* or football* or soccer* or volleyball* or basketball* or baseball* or handball* or cricket* or rugby* or tennis* or badminton* or stretching*)
S25	AB (exercis* or exertion* or (physical* N3 (train* or education* or fit* or effort* or activ* or endur* or strength* or condition*)) or "fitness" or sport* or gymnastic* or athletic* or workout* or "work out*" or cycling* or cycle* or bicycl* or bike* or biking* or walk* or run* or jog* or treadmill* or "tread-mill*" or jumping* or hopping* or plyometric* or aerobic* or anaerobic* or calisthenic* or isometric* or "yoga" or "tai ji" or "tai chi" or "thai chi" or "taiji" or "taichi" or "thaichi" or "taijiquan" or "ai chi" or "pilates" or dance* or dancing* or

	((weight* or power*) N3 lift*) or weightlift* or powerlift* or "musc* strength*" or ((weight* or "resistance" or strength* or circuit*) N3 train*) or "cardiopulmonary conditioning*" or exergam* or climbing* or bouldering* or hiking* or hike* or swim* or row* or skate* or skating* or football* or soccer* or volleyball* or basketball* or baseball* or handball* or cricket* or rugby* or tennis* or badminton* or stretching*)
S26	S16 OR S17 OR S18 OR S19 OR S20 OR S21 OR S22 OR S23 OR S24 OR S25
S27	S6 AND S15 AND S26

**Database: ERIC (Ebsco)**

Date: 23.03.2018 Results: 715

Date: 18.12.2018 Results: 30

#	Query
S1	DE "Depression (Psychology)"
S2	TX (depress* or dysthymi* or melanchol* or dysphori* or "sadness" or "low mood*")
S3	TX ("seasonal" N3 (affect* or mood*) N3 disord*)
S4	S1 OR S2 OR S3
S5	DE "Adolescents" OR DE "Early Adolescents" OR DE "Late Adolescents"
S6	DE "Children" OR DE "African American Children" OR DE "Hospitalized Children" OR DE "Minority Group Children" OR DE "Preadolescents" OR DE "Young Children"
S7	DE "Youth" OR DE "Disadvantaged Youth" OR DE "Out of School Youth" OR DE "Rural Youth" OR DE "Urban Youth"
S8	DE "Puberty"
S9	DE "Pediatrics"
S10	DE "Schools" OR DE "Elementary Schools" OR DE "Middle Schools" OR DE "Secondary Schools" OR DE "Elementary School Students" OR DE "Middle School Students" OR DE "Secondary School Students" OR DE "High School Students"
S11	TX (child* or "kid" or "kids" or minors* or juvenil* or adoles* or youth* or youngster* or teen* or preteen* or midteen* or pubert* or prepube* or pubescen* or school* or highschool* or student* or "boy" or "boys" or boyhood* or girl* or underag* or "under-ag*" or pediater* or paediatr* or peadiater*)
S12	TX (young* N1 (person* or people* or individual* or male* or female* or "man" or "mans" or "men*" or woman* or women*))
S13	S5 OR S6 OR S7 OR S8 OR S9 OR S10 OR S11 OR S12
S14	DE "Exercise"

S15	DE "Athletics" OR DE "Aquatic Sports" OR DE "Extramural Athletics" OR DE "Intramural Athletics" OR DE "Racquet Sports" OR DE "Team Sports" OR DE "Track and Field" OR DE "Womens Athletics"
S16	DE "Physical Activities" OR DE "Dance"
S17	DE "Physical Fitness" OR DE "Health Related Fitness" OR DE "Physical Recreation Programs" OR DE "Physical Education"
S18	DE "Play"
S19	TX exercis* or exertion* or (physical* N3 (train* or education* or fit* or effort* or activ* or endur* or strength* or condition*)) or "fitness" or sport* or gymnastic* or athletic* or workout* or "work out*" or cycling* or cycle* or bicycl* or bike* or biking* or walk* or run* or jog* or treadmill* or "tread-mill*" or jumping* or hopping* or plyometric* or aerobic* or anaerobic* or calisthenic* or isometric* or "yoga" or "tai ji" or "tai chi" or "thai chi" or "taiji" or "taichi" or "thaichi" or "taijiquan" or "ai chi" or "pilates" or dance* or dancing* or ((weight* or power*) N3 lift*) or weightlift* or powerlift* or "musc* strength*" or ((weight* or "resistance" or strength* or circuit*) N3 train*) or "cardiopulmonary conditioning*" or exergam* or climbing* or bouldering* or hiking* or hike* or swim* or row* or skate* or skating* or football* or soccer* or volleyball* or basketball* or baseball* or handball* or cricket* or rugby* or tennis* or badminton* or stretching*)
S20	S14 OR S15 OR S16 OR S17 OR S18 OR S19
S21	S4 AND S13 AND S20



**Database: PEDro Physiotherapy Evidence Database**

Date: 23.03.2018 Results: 80

Date: 18.12.2018 Results: 11

depress\* and child\* - in clinical trial

depress\* and adoles\* - in clinical trial

## Search strategies in sources for grey literature and ongoing trials in bibliographic databases

**Database: Papers First (OCLC)**

Date: 05.02.2019

Results: 43

PapersFirst results for: kw: depress\* n10 exercise\*

Records found: 22

PapersFirst results for: kw: depress\* n10 physical w activity

Records found: 21

**Database: ProQuest Dissertations & Theses A&I**

Date: 05.02.2019

Results: 283

noft(depress\*) AND noft(exercise\* or "physical activity") AND noft(child\* or adolescen\* or youth or teen\*)

283 results

## Search strategies in sources for grey literature and ongoing trials screened manually

**Database: OpenGrey**

Date: 05.02.2019

Results: 50

[http://www.opengrey.eu/search/request?q=depress\\*+AND+exercise](http://www.opengrey.eu/search/request?q=depress*+AND+exercise) (35 hits)

[http://www.opengrey.eu/search/request?q=depress\\*+AND+%22physical+activity%22](http://www.opengrey.eu/search/request?q=depress*+AND+%22physical+activity%22) (15 hits)

**Database: ClinicalTrials.gov**

Date: 05.02.2019

Results: 72

23 Studies found for: **(depression or depressive or depressed) | exercise | Child**

<https://clinicaltrials.gov/ct2/results/details?term=%28depression+or+depressive+or+depressed%29&intr=exercise&age=0>

49 Studies found for: **(depression or depressive or depressed) | physical activity | Child**

<https://clinicaltrials.gov/ct2/results?term=%28depression+or+depressive+or+depressed%29&intr=physical+activity&age=0>

**Database: WHO International Clinical Trials Registry Platform**

Date: 05.02.2019

Results: 90

Both searches are limited to children

57 records for 57 trials found for: depress\* AND exercise

33 records for 33 trials found for: depress\* AND physical activity

<http://apps.who.int/trialsearch/default.aspx>

## Supplementary S3

### Detailed characteristics of included studies

#### Beffert 1993

<b>Methods</b>	Randomized controlled trial (RCT).
<b>Participants</b>	<p>N=26 randomized Number analyzed: completed first stage of study n=26 Drop-out: No reporting of drop-out</p> <p>Age: 12-15 years old.</p> <p>Gender:83% female</p> <p>Recruitment: All seventh and eight-grade students in a public junior high school were screened twice using the RADS. Baseline of severity of depression: I: 122.53 (6.03) C: 124.91 (6.92)</p> <p>Inclusion criteria:</p> <ol style="list-style-type: none"><li>1. High school students who ranged in age from 12-15 years.</li><li>2. Scoring 75 or above on RADS on both screenings</li></ol> <p>Exclusion criteria:</p> <ol style="list-style-type: none"><li>1. Severe level of depression. Students who scored four or more of the six critical items on the RADS were viewed as possibly being too seriously depressed to be included</li><li>2. Currently receiving antidepressant medication or any other treatment for depression</li><li>3. Restricted from participating in aerobic exercise</li><li>4. Not received written parental permission to participate</li></ol> <p>Location: Cheyenne, Wyoming USA</p>

<b>Interventions</b>	<p>1. Aerobic exercise (walking-running program) Heart rate between 60-85% of maximum capacity. The instructor was a certified physical education instructor. Group-based training.</p> <ul style="list-style-type: none"> <li>• 6 weeks</li> <li>• 3 sessions per week</li> <li>• 18 sessions in total</li> <li>• Duration of each session was 20 minutes</li> </ul> <p>Setting: Medium-sized urban junior high school</p> <p>2. Waitlist</p>
<b>Outcomes</b>	<p>1. The severity of depressive symptoms as measured by the Reynolds Adolescent Depression Scale (RADS), measured at end of treatment: 6 weeks</p> <p>2. Cardiovascular fitness measured using the time required for them to complete a 1.5-mile walk-run (female students) or 2-mile run (male students).</p>
<b>Notes</b>	<p>PhD dissertation</p> <p>Funding: Greg Hannah research fund</p> <p>Conflict of interest: N/A</p> <p>Trial registration: N/A</p> <p>Intention to treat analysis: N/A</p> <p>Sample size calculation: N/A</p>

## Burrus 1984

<b>Methods</b>	Randomized controlled trial (RCT). Stratified
<b>Participants</b>	<p>N=46 randomized</p> <p>Number analyzed: 45 (29 included in meta-analysis) (Red Cross group N=15 was not included in the analyses of the systematic review).</p> <p>Drop-out: 1</p> <p>Age: 15-18 years old</p> <p>Gender: 60% female</p>

	<p>Recruitment: Recruitment: 700 senior high school students (grades 10, 11, 12) were screened twice for depression using the Depression Adjective Checklist (DACL), Form A.</p> <p>Baseline of severity of depression: I: 19.14 (3.73) C: 19.33 (3.71)</p> <p>Inclusion criteria:</p> <ol style="list-style-type: none"> <li>1. Scored at or above the 93<sup>rd</sup> percentile on two administrations at an interval of from one to six months on the DACL.</li> </ol> <p>Exclusion criteria:</p> <ol style="list-style-type: none"> <li>1. Not resided in the United States during the previous 5 years</li> <li>2. In psychotherapeutic treatment</li> <li>3. Exempt from physical education for medical reasons</li> <li>4. Involved in a running or regular exercise program</li> </ol> <p>Location: Miami, Florida USA</p>
<p><b>Interventions</b></p>	<ol style="list-style-type: none"> <li>1. Aerobic running program (high physiological activity). The program included a walk-jog-run. Heart rate at a maximum 75%. All instructors were highly trained and experienced in their respective fields. Group-based training. <ul style="list-style-type: none"> <li>• 9 weeks</li> <li>• 4 sessions per week</li> <li>• 36 sessions in total</li> <li>• Duration of each session was 45 minutes (35 spent on exercise)</li> </ul> <p>Setting: High school</p> </li> <li>2. Anaerobic treatment (medium physiological activity). 15 minutes weight training program using universal equipment, bar bells and exercise bars, and 20 minutes of anaerobic team activities including volleyball, softball, archery and melon ball. <ul style="list-style-type: none"> <li>• 9 weeks</li> <li>• 4 sessions per week</li> <li>• 36 sessions in total</li> <li>• Duration of each session was 45 minutes (35 spent on exercise)</li> </ul> </li> <li>3. Red Cross treatment (low physiological activity). Learned first aid and personal safety in a classroom. <ul style="list-style-type: none"> <li>• 9 weeks</li> </ul> </li> </ol>

	<ul style="list-style-type: none"> <li>• 4 sessions per week</li> <li>• 36 sessions in total</li> <li>• Duration of each session was 45 minutes</li> </ul>
<b>Outcomes</b>	<ol style="list-style-type: none"> <li>1. The severity of depressive symptoms as measured by the Depression Adjective Checklist (DAACL), measured at end of treatment: 9 weeks</li> <li>2. Weight</li> <li>3. Blood pressure</li> <li>4. Cardiovascular fitness measured using the One Minute Step Test</li> </ol>
<b>Notes</b>	<p>PhD dissertation</p> <p>Funding: N/A  Conflicts of interest: N/A  Trial registration: N/A  Intention to treat analysis: N/A  Sample size calculation: N/A</p>

### Carter 2015

<b>Methods</b>	Pragmatic Randomized Controlled Trial (RCT) (parallel design)
<b>Participants</b>	<p>N=87 randomized  Number analyzed: at six-week N=64, at six months N=42  Drop-out: At post-intervention the total loss to follow up was 25%, with more participants dropping out in the control arm than the intervention</p> <p>Age: mean 15.4 (SD 1.0) (intervention group), 15.4 (SD 0.9) (control group).  Gender: 78% female  Recruitment: referred by general practitioners (GPs), Child and Adolescent Mental Health Services (CAMHS) and school nurses.  Baseline severity of depression: I: 29.1 (9.4) C: 28.2 (6.8)</p> <p>Inclusion criteria:</p> <ol style="list-style-type: none"> <li>1. Adolescents aged 14-17 years</li> </ol>

	<p>2. Receiving treatment from a health or social care professional for depression</p> <p>3. Scoring above 14 on the Children’s Depression Inventory-2 (CDI-2).</p> <p>Exclusion criteria:</p> <p>1. Presence of a medical condition that would make exercise participation unsafe</p> <p>Location: East Midlands area, England</p>
<b>Interventions</b>	<p>1. Circuit-training at preferred intensity alongside treatment as usual. The circuit training comprised of an interval pattern with eight separate exercise-stations. Preferred intensity. The stations consisted of strengthening and aerobic exercises. A qualified exercise therapist supervised each session. Group-based training.</p> <ul style="list-style-type: none"> <li>• 6 weeks</li> <li>• 2 sessions per week</li> <li>• 12 sessions in total</li> <li>• Duration of each session was one hour (approximately 45 min of exercise and stretching).</li> </ul> <p>Setting: Community centres</p> <p>2. Treatment as usual</p>
<b>Outcomes</b>	<p>Primary outcome:</p> <p>1. The severity (change) of depressive symptoms as measured by the Children’s Depression Inventory 2 (CDI-2). Measured at the end of treatment: 9 weeks</p> <p>Secondary outcomes:</p> <p>1. Health-related quality of life as measured by the EuroQol group EQ-5D-5 L and EQ-VAS</p> <p>2. Leisure time physical activity as measured by the Leisure Time Exercise Questionnaire (LTEQ).</p> <p>Participants were assessed at baseline, six week (post-intervention) and six-month follow-up.</p>
<b>Notes</b>	Journal article

	<p>Funding: National Institute of Mental Health, Research for Patient Benefit Programme</p> <p>Conflicts of interest: None reported</p> <p>Trial registration: ClinicalTrials.gov NCT01474837</p> <p>Intention to treat analysis: Yes</p> <p>Sample size calculation: A medium effect size of 0.50 using Cohen's d parameters was anticipated. To detect such a difference between two groups at a two tailed 0.05 significance level using 80 % power, 64 participants were required in each arm. After adjusting for 20 % anticipated attrition rates, the required sample size was inflated to 158. They were unable to recruit to the required sample size.</p>
--	---

## Roshan 2011

<b>Methods</b>	Randomized controlled trial (RCT).
<b>Participants</b>	<p>N=24 randomized  Number analyzed: 24  Drop-out: no reporting of drop-out.</p> <p>Age: mean 16.91 (SD 1.03) (intervention group), 16.83 (SD 0.82) (control group).  Gender: 100% female.  Recruitment: 152 female high school students were assessed for presence of major depressive disorder.  Baseline severity of depression: I: 30.15 (7.62) C: 29.58 (7.25)</p> <p>Inclusion criteria:</p> <ol style="list-style-type: none"> <li>1. Age range 15-18 years</li> <li>2. Presence of major depressive disorder (MDD) according to DSM-IV-TR criteria</li> <li>3. Scoring <math>\geq 18</math> on the Hamilton Rating Scale for Depression (Ham-D)</li> </ol> <p>Exclusion criteria:</p> <ol style="list-style-type: none"> <li>1. Other simultaneous psychiatric disorders such as anxiety disorders, psychotic disorders, substance abuse or dependency, personality disorders, and bipolar mood disorder in depressive phase</li> </ol>



	Location: Iran
<b>Interventions</b>	<p>1. A pool walking exercise program. 60-70% of maximum heart rate. Group-based training. Provider of intervention N/A</p> <ul style="list-style-type: none"> <li>• 6 weeks</li> <li>• 3 sessions per week.</li> <li>• 18 sessions in total</li> <li>• Duration of each session N/A</li> </ul> <p>Setting: high school</p> <p>2. No exercise and no anti-depressant treatment</p>
<b>Outcomes</b>	<p>1. Severity of depression as measured by the Hamilton Rating Scale for Depression (Ham-D), measured at the end of treatment: 6 weeks</p> <p>2. MHPG Urine Sulfate</p> <p>3. Maximum Oxygen Uptake (VO2 Max)</p> <p>Participants were assessed at baseline and after six weeks (post-intervention).</p>
<b>Notes</b>	<p>Journal article</p> <p>Funding: University of Mazandaran, Iran. (listed in clinical trials registration).</p> <p>Conflicts of interests: N/A</p> <p>Trial registration: Retrospective registration (2011-08-30). IRCT201104251457N8 <a href="https://www.irct.ir/trial/726">https://www.irct.ir/trial/726</a></p> <p>Intention to treat analysis: N/A</p> <p>Sample size calculation: N/A</p>