



Hooray

STUDY:

What works?

**Evidence-based guidance regarding
physical activity and mental health in
adolescents**

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ABOUT HOORAY PROJECT:

Youth for Youth's Mental Health through Physical Activity - HOORAY

Even before the pandemic, the mental health of young people, particularly teenagers, has been declining. The HOORAY (Youth for Youth's Mental Health through Physical Activity) project aims to address this challenge by exploring the impact and positive influence physical activity and sport can have on improving the overall well-being and mental health of young people.

Based on the EU Physical Activity Guidelines, the project team will collect good practices, and develop educational resources and an online knowledge hub for physical education teachers, youth workers, coaches, parents and other personnel working with teens that want to put more attention on mental health and health enhancing physical activity, and prioritize participation and well-being of youth over performance, pressure and results.

Those resources and activities will target both, youngsters that are already physically active or enrolled in sport activities, and those who have been inactive and/or dropping out of sport. Young people will play a key role as we will take a closer look at physical activity through the lens of teenagers and explore how they perceive sport and its impact on their well-being.

The HOORAY project started 1st of January 2023 and will continue for 30 months until 30th of June 2025. The kick-off meeting is scheduled for 16th and 17th of February 2023 in Munich, Germany.

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UNDERSTANDING THE RELATIONSHIPS BETWEEN SPORT, PHYSICAL ACTIVITY AND MENTAL HEALTH: Introduction and Commentary

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“Mens sana in corpore sano”

“a sound mind in a healthy body”

(Roman poet Juvenile, 1st Century AD)

Introduction

This document provides some background on sport and mental health and shares some of the current research discussions. It offers one perspective on the connection and sport, which is crucial given the literature's confusion. This element of the HOORAY! Project includes reviews. We have conducted three systematic reviews of the literature on depression, anxiety, and suicidal thoughts and behaviour in relation to sport and mental health. Our team also investigated stress, but we couldn't uncover adequate evidence. An additional review on community-based sports interventions will follow.

The content of this introductory document is as follows:

1. Physical Activity and Health
2. A Note on Definitions
3. Physical Activity and Well-being
4. Mechanisms

This brief document aims to provide some background for the reviews that follow and also to offer some key references to the scientific literature that may prove of interest and use to the HOORAY! Project.

Physical activity and health

Physical activity and sports are now widely accepted as beneficial for health and well-being (Kohl, Craig, Lambert, et al., 2012; Bailey, Hillman, and Arent, 2013; Gasana, Keeffe, and Withers, 2023; World Health Organisation Europe, 2015). The rise of sedentary lifestyles in industrialised and emerging nations is concerning (Hallal, Andersen, Bull, et al., 2012). The combined effects of industrial, automotive, and information technology developments have changed how people accomplish their regular jobs, contributing to this trend. Our cultures appear to get sicker as they modernise. WEIRD societies are increasingly becoming the norm!

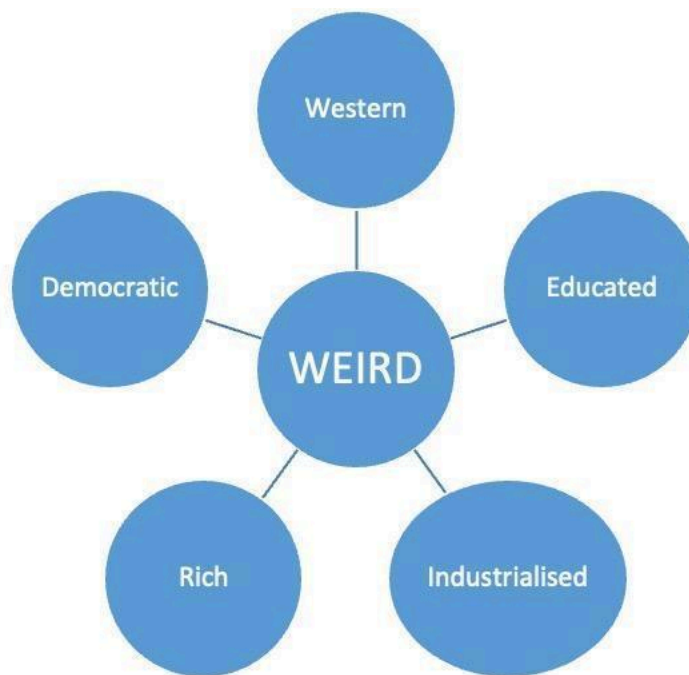


Figure 1. WEIRD - Western, Educated, Industrialised, Rich and Democratic societies (Henrich, Heine, & Norenzayan, 2010).

Televisions, computers, and electronic entertainment have indirect and unclear effects on physical activity. New technologies and their availability have worsened these physical labour and energy expenditure shifts (Guthold, Stevens, Riley, et al. 2018). Heart attacks and strokes kill

more people in developing nations than infectious diseases for the first time. So, it's understandable that exercise affects health. Cardiovascular disease, type 2 diabetes, cancer, and chronic respiratory illnesses are considered 'non-communicable diseases' that shorten life. Over 60% of developing world deaths, 20 million per year, are from non-communicable diseases (IHME, 2015). Many disorders begin in childhood and adolescence (Budreviciute, Damiati Sabir et al. 2020).

The UN Population Fund (World Population Dashboard 2023) reports that 25% of the world's population is under 25. Sedentary, WEIRD societies are particularly harmful to children and adolescents; therefore, boosting active living in this age group has a 'triple benefit' for now, adulthood, and future generations. Most youth are unhealthily inactive, according to international data (Sheikholeslami, Ghanbarian, & Azizi 2020). Young people may live the shortest (Shekar & Popkin, 2020).

Given these findings, it's clear how physical activity's non-physical health advantages were overlooked. But it's becoming clear that physical activity and inactivity affect the whole child or teen (Bailey, Hillman, Arent et al. 2013). Since mental health concerns are becoming more common and severe, they are significant. Eurostat (2018) found that Portugal, Germany, and Finland have the highest youth depression rates. The Mental Health Foundation (2018) reports that 20% of adolescents have a mental health issue in any given year, 50% by age 14, and 10% of 5- to 16-year-olds have clinically diagnosable illnesses. Most children and teens with mental health disorders will not receive early intervention (WHO 2023).

The adolescent years are crucial. To adapt to new professions, conditions, and experiences, this era entails significant biological, psychological, and social changes and increased brain plasticity and cognitive flexibility (Dahl, Suleiman, Luna et al. 2017). Thus, adolescence is valuable and perilous. The pliable adolescent brain allows amazing learning and adaptation. It also shows why it is prone to maladaptive responses to life obstacles and why this phase is most associated with mental health issues (Lee, Heimer, Giedd et al. 2014). Adolescent mental health solutions must be found and tested if the above is true.

Notes on definitions

We should always be precise about our terms to avoid confusion. Mental health and sports literatures are confusing! Since the HOORAY! Project focuses on 'what works' and

‘why’, language should be carefully considered. Spend some time establishing how some essential terminology will be used here.

Mental Health

One significant problem for those working in this area is that ‘mental health’ and ‘mental ill-health’ have no universal definitions. Actually, this is also true of ‘health’. The original definition adopted by the World Health Organisation (1948) was: “... a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity” is inspirational, but also means that almost everyone nearly all of the time is unhealthy (who is always completely and comprehensively well?)! A more modest account of health from the World Health Organisation (2023) is: “a state of well-being in which an individual realises [their] own abilities, can cope with the normal stresses of life, can work productively, and is able to make a contribution to [their] community”. Mental health problems, according to this perspective, result from an inability to cope with the stresses of life, to work, and/or to contribute. This conception seems much more plausible, as it captures what matters to people about their health in relation to their own actual lived experience. Specific mental health problems, such as depression, anxiety, and suicidal ideation (the thought process of having ideas about the possibility of ending one’s own life) indicate difficulties in coping or functioning.

Sport

Many governmental and sports agencies adopt the definition of sport in the Council of Europe’s Revised European Sports Charter (2021):

“... sport” means all forms of physical activity which, through casual or organised participation, are aimed at maintaining or improving physical fitness and mental well-being, forming social relationships or obtaining results in competition at all levels.
(Article 2)

Most individuals define sport differently, and adding jogging, gardening, folk dancing, and indoor exercise to a DVD seems to violate the concept. With a broad definition of sport, what deals with physical activity? To the Council of Europe, both expressions mean the same. Sport is

organised, competitive physical activity, per Coakley (2001). This shows sports are sociable. Naturally, 'sport' encompasses individual, couple, and team forms, contact and non-contact, strategy, chance, and physical ability. Sport almost always requires socialising. Figure 2 suggests one way of thinking about the relationships between physical activity and sport.

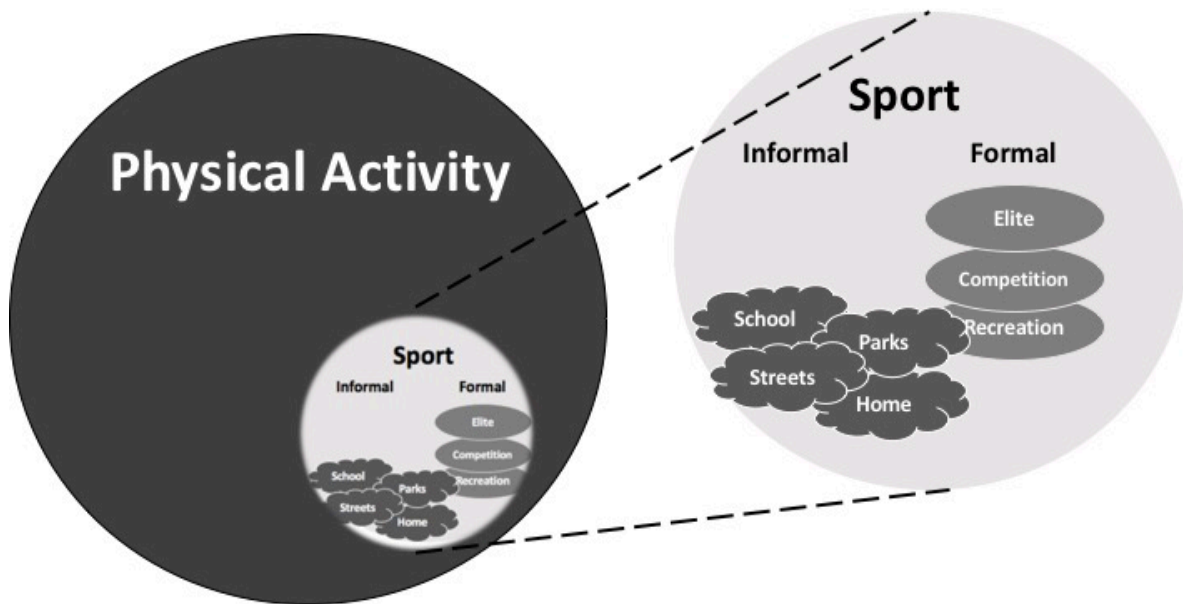


Figure 2. relationships between physical activity and sport

A distinction like this serves several important roles. Still, perhaps the most useful is that it highlights that the general term 'physical activity' is often too broad to help us judge the outcomes of specific types of activity. Sport is a special kind of physical activity with specific characteristics and settings. So, outcomes claimed for physical activity, in general, might not apply to sport, in particular, and vice versa. At the least, this suggests that we should talk about the outcomes of participation in physical activity with a little caution.

Physical Activity and Well-being

Physical activity improves mental health is nothing new, as Juvenile's citation illustrates. Scientific knowledge has just recently caught up with traditional wisdom. The complex relationship between physiological and mental processes and structures has been shown in several empirical research (Di Liegro, Schiera, Proia et al. 2019; Hillman, Erickson & Kramer,

2008; Singh, Saliassi, Van Den Berg et al. Exercise changes brain structure and function, says fMRI (Meijer, Königs, Vermeulen et al. 2020). A meta-analysis by Sibley & Etnier (2003) found that physical activity improved cognitive performance in school-age children (4–18 years) in six areas: perceptual skills, intelligence quotient, academic achievement, verbal tests, mathematical tests, and developmental level/academic readiness. Later research confirmed these findings (Gomes da Silva & Arida 2015; Shao, Tan, & He 2022). Childhood and adolescents benefit from physical and mental exercise.

Physical activity and mental health research began in the 1990s (Fox, 1999). Early studies with poor or inconsistent methods exploded in publications on the problem. The review below includes recent studies. Example: McMahon, Corcoran, O'Regan, et al. assessed European youths' health and fitness in 2017. A cross-sectional study involved 168 schools in Austria, Estonia, France, Germany, Hungary, Ireland, Italy, Romania, Slovenia, and Spain. The standard questionnaire counted the days an individual exercised 60 minutes or more in the past two weeks. WHO-5 measure subjective well-being (lifeview). Activity boosted psychological well-being. Even small increases in activity days boosted well-being at lower activity levels, peaking at 11 days for males and 13 days for girls.

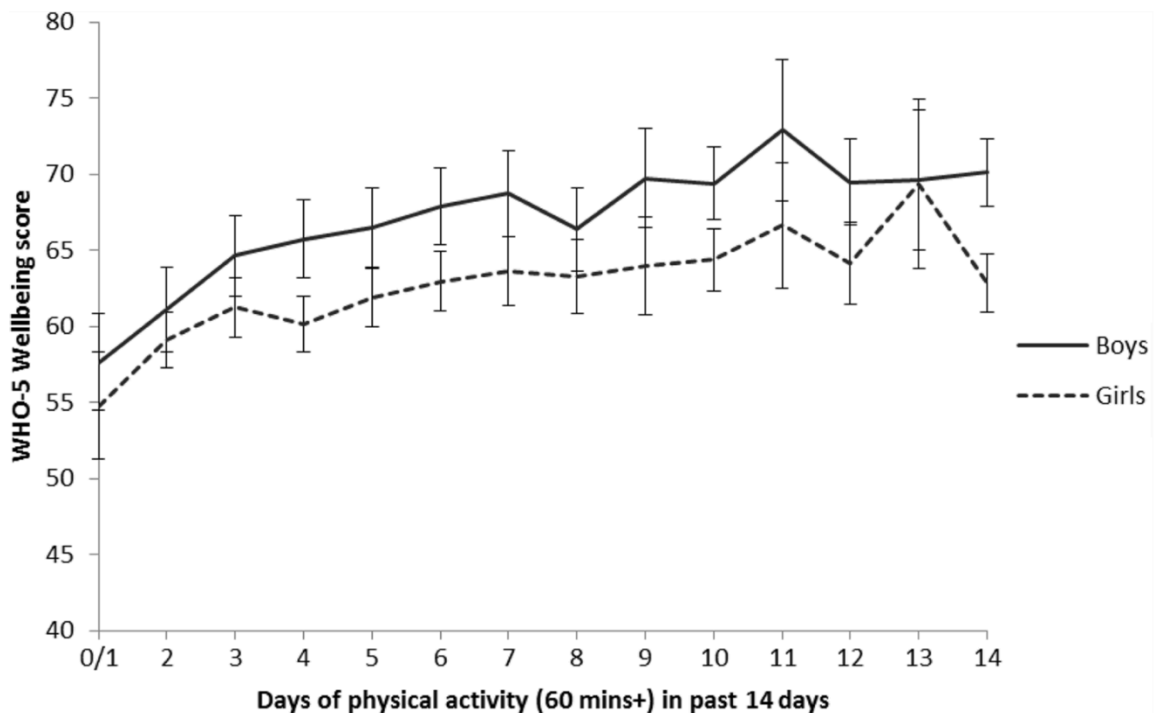


Figure 3. physical activity and subjective mental well-being (from McMahon, Corcoran, O'Regan et al. 2017)

Multinational research examined physical activity types. Sports involving girls led to the highest levels of well-being among boys and girls, indicating benefits beyond physical activity. This is intriguing given the following reviews. McMahon, Corcoran, O'Regan, et al. (2017) examined the connection between physical activity and depression among adolescents. There was a 'curvilinear' connection (Figure 4), suggesting that increased physical activity may affect already active adolescents, especially girls.

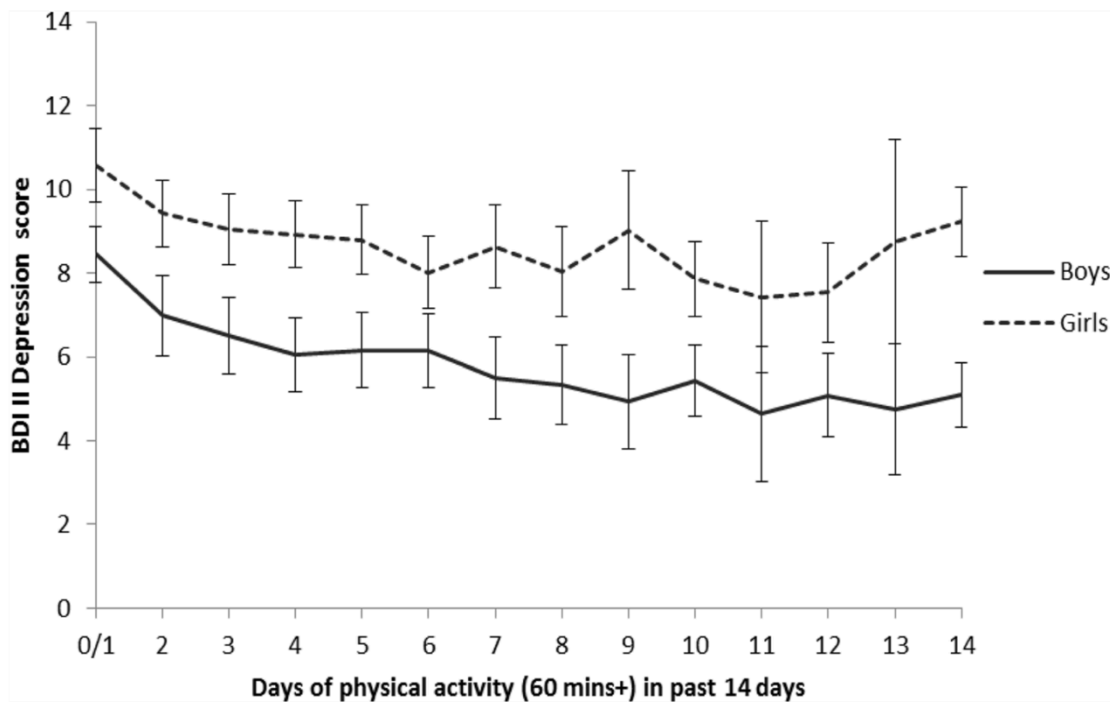


Figure 4. physical activity and depression (from McMahon, Corcoran, O'Regan et al. 2017)

This study has several qualities that mark it as significant, such as a large and multi-site sample and robustness of analysis. Our main reason for noting it is because it raises some questions in our subsequent reviews. As an example:

- Do all forms of physical activity benefit adolescents' mental health equally? Do some varieties provide advantages?
- Does increased activity lead to better mental health outcomes?

- Do young women and men react similarly to certain activity levels and types?

Our reviews revisit these topics, and readers are asked to derive only conclusions from the facts.

Mechanisms

Adolescence's mental health improves with physical activity. Many reviews (Andermo, Hallgren, Nguyen et al. 2020; Biddle, Ciaccioni, Thomas et al. 2019) and ours (without revealing too much) discovered this. We still have much to learn. Why may be most intriguing. Physical activity boosts youth's mental health. Why? Understanding such relationships could help us create and implement more focused initiatives and more successful treatments, making this issue more than academic.

The 'psychosocial', 'behavioural', and 'neurobiological' hypotheses explain why PA improves mental health (Lubans, Richards, Hillman et al. 2016). Sports and other prosocial activities help kids form good peer relationships (Shen et al., 2022). Physical self-concept, skill, and appearance may alter the link, according to Lubans and colleagues (2016). If this hypothesis holds, team sports interventions will benefit (reduce negative impacts). Behavioural theory links mental health with physical activity through behaviour changes. Physical activity improves sleep, which benefits mental health; therefore, they are related. Yes (Raudsepp and Vink, 2019). Third, neurobiological hypothesis: exercise may improve mental health and brain structure. Depressed patients have fewer hippocampus neuronal cells, which stretch in response to exercise (Rodriguez-Ayllon, Neumann, Hofman et al., 2023). Both final hypotheses suggest that exercise intensity, duration, type, and context matter. One thought rarely describes data. How psychological and physiological variables are involved is unknown. Most influential is Lubans et al.'s (2016) conceptual model (Figure 5).

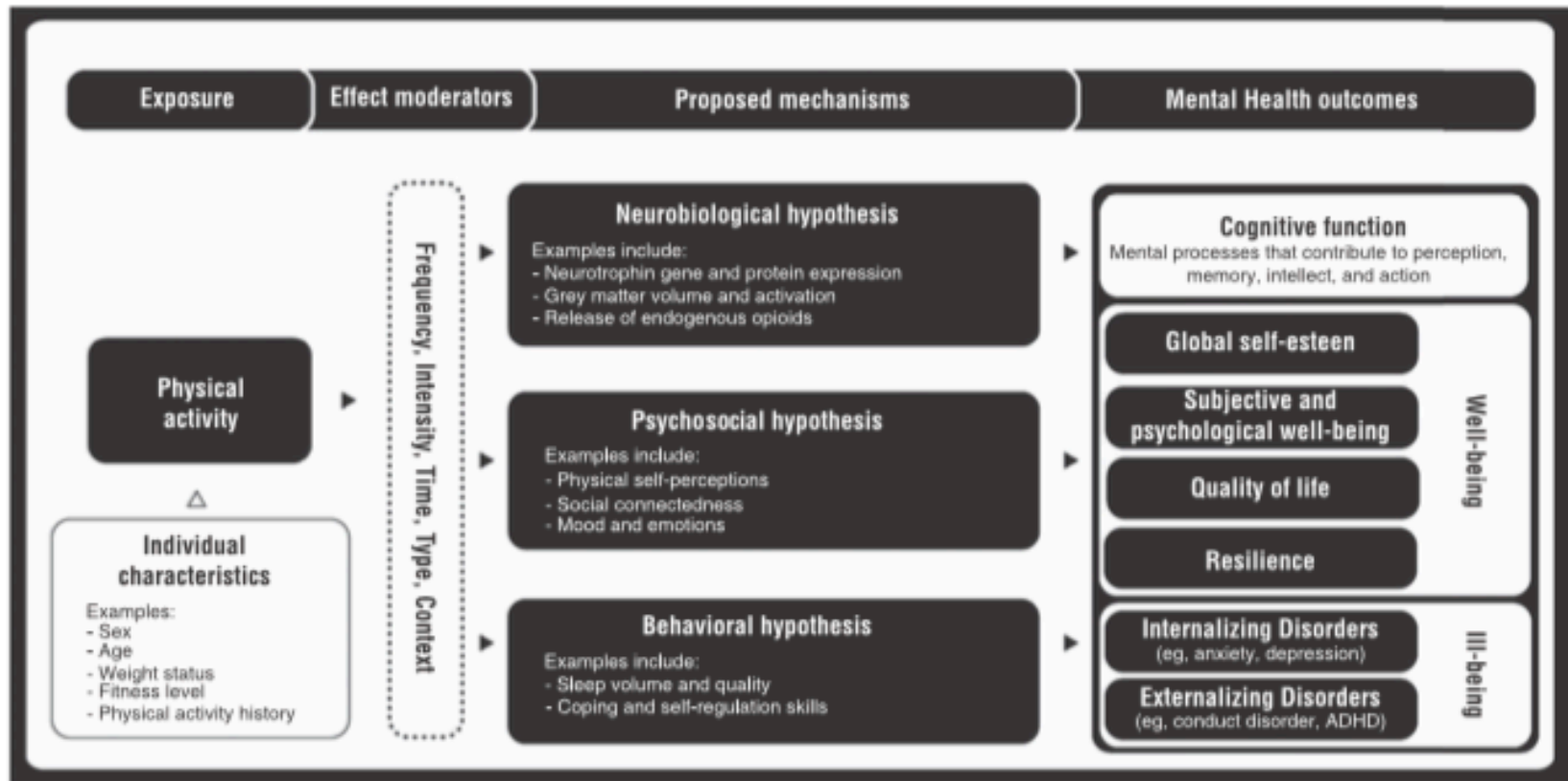


Figure 5. Conceptual model for the effects of physical activity on mental health outcomes in children and adolescents (Lubans et al., 2016)

Conclusion

As stated at the onset of this document, our aim was to introduce the reviews of literature by offering some background to the research topic. The reviews that follow focus on the three areas of adolescent mental health that have been most investigated in connection to physical activity:

- Depression
- Anxiety
- Suicidal thoughts and behaviours

A fourth potential area, stress, was judged to lack the necessary evidence base to allow a review at this time.

It will become clear whilst reading the reviews that follow that a great deal remains to be learned. As is always the case, further research is needed. Nevertheless, there are plenty of clues that should guide us in developing effective interventions for European adolescents. We look forward to readers' thoughts and suggestions for strengthening the findings of the reviews.

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Sport and Mental Health:
DEPRESSION

2023

Assessing the Impact of Physical Activity on Reducing Depressive Symptoms: A Rapid Review

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Abstract

Depression in adolescents is a global public health challenge, necessitating an in-depth examination of non-pharmacological interventions. This rapid review assesses 24 selected studies to elucidate the relationship between physical activity (PA) and depressive symptoms in adolescents, conducted following PRISMA guidelines. Diverse research designs, including longitudinal studies, surveys, and cross-sectional analyses, were employed across various countries to disentangle the complex interplay of PA, sedentary behaviors, and depressive symptoms. Data collection methods encompassed standardized questionnaires, accelerometer measurements, and self-report instruments. The review underscores the pivotal role of PA in mitigating depressive symptoms. Enhanced self-esteem consistently emerges as a key mediator between PA engagement and reduced depression rates. Participation in sports and physical exercise is a protective buffer, especially for those with limited PA exposure. Conversely, sedentary behaviour significantly heightens the likelihood of experiencing moderate to severe depressive symptoms. Gender-based disparities are evident, with females disproportionately affected by depression. Positive correlations between PA and diminished depression span diverse contexts, including team sports and leisure-time activities. In summary, this review offers a perspective on the potential of PA as a non-pharmacological intervention for adolescent depression. It underscores the transformative effects of PA, with implications for public health initiatives targeting enhanced adolescent mental well-being through PA promotion. Further research, considering gender-specific nuances and diverse PA contexts, is imperative to advance our understanding of this critical issue.

Keywords: wellness; activity impact; emotional health; fitness effects; mood enhancement

What works?

- Encourage diverse physical activities of varying intensities to cater to adolescents' preferences.
- Recognize the mental health benefits of both low and moderate-intensity activities.
- Create inclusive, supportive social environments within sports clubs to combat isolation and bullying.
- Promote self-determined recreational activities to empower adolescents and foster autonomy.
- Educate about balanced exercise habits, emphasizing overall well-being, and establish connections with mental health professionals for support when needed.

Introduction

Adolescence represents a sensitive period in human development during which adolescents are especially vulnerable to adverse social influences and health consequences (Castel Pietra, Knudsen, Agardh et al., 2022; World Health Organization [WHO], 2017). Mental health disorders are among the leading causes of health-related burden among young people, associated with substantial personal and societal costs, both during youth and later in life (GBD 2019 Mental Disorders Collaborators, 2022). Depression is a prevalent mental health concern among young people (WHO, 2017), exacerbated during and after COVID-19 (Santomauro, Herrera, Shadid et al., 2021). It significantly impairs their quality of life and is characterized by symptoms such as sadness, loss of interest, and disruptions in sleep and appetite (Racine, McArthur, Cooke et al., 2021). It is estimated that around 14% of individuals between the ages of 10 and 19 worldwide have a mental disorder, which accounts for approximately 13% of the total disease burden in this demographic (WHO, 2021). In Europe, depression ranks as the second most significant cause of disease burden for young individuals (Castel Pietra, Knudsen, Agardh et al., 2022), and more than half of those affected continue to experience it into adulthood (Ludwig-Walz, Dannheim, Pfadenhauer et al., 2022). There is a consensus among quantitative studies in Europe that there has been an increase in depression and other mental health conditions (such as general anxiety and stress symptoms) (de Matos, Carvalho, Branquinho et al., 2023; Koper, Creemers, van Dam et al., 2022; Orgilés, Francisco, Delvecchio et al., 2022).

Qualitative findings report increased depression, anxiety, and perceptions of loneliness (Branquinho & de Matos, 2021).

Lifestyle management interventions, including PA, have been increasingly endorsed by the research literature for the prevention and treatment of mental health problems in adolescence (Hosker, Elkins, & Potter Savaglio, 2019; Pascoe, Bailey, Craike et al., 2020; O'Donnell, Hatzikiriakidis et al., 2022). Many of these studies suggest that PA may have similar or better effects to psychotherapy and pharmacological interventions while being much cheaper, having fewer side effects, and offering more comprehensive health benefits (Schuch & Stubbs 2019; Singh, Olds, Curtis et al., 2023). Certain soft law documents have supported this call, including UNESCO's (2015) 'International Charter of Physical Education, Physical Activity and Sport' and the WHO's (2018) 'Global Action Plan on Physical Activity'. However, the therapeutic use of PA to treat mental health issues among adolescents has not been generally embraced (Couture-Wilhelmy, Chaubet, & Gadais, 2021; Mias, Dittrich, & Miltenberger, 2022). This could be attributable to the lack of empirical studies and reviews, particularly those focusing on young people and adolescents rather than adults (Biddle, Ciaccioni, Thomas et al., 2001). It should also be acknowledged that the term 'physical activity' is somewhat fuzzy to the extent that it is not clearly bounded in much of the published literature. Influential early accounts, such as that of Casperson et al. (1985), might be labeled 'inclusive' insofar as they allow both exercise-based and non-exercise-based activities. The former refers to generally structured forms of PA that require relatively high energy expenditure, such as running and swimming. The latter refers to incident or chronic types of PA, such as doing household chores. Presumably influenced by the WHO's (2020) target of 60 minutes of moderate-to-vigorous intensities daily, studies of the outcomes of PA tend to privilege exercise-based levels (Gu, 2022). While we acknowledge the value of more vigorous PA levels for health, we included both forms in this review. Therefore, there is a need for studies that review the available literature on relationships between PA and mental health that summarise and appraise the state of the science. This article reports on a rapid review of recent empirical research. This study adopted a rapid reviewing methodology, which follows many of the strategies used by systematic reviewing but adapted for a faster and more variegated response (Tricco, Antony, Zarin et al., 2015). This approach allows the exploration of potential associations and contextual factors that might maximize the impact of PA interventions.

Methods and Materials

The method of conducting a rapid review follows many of the same guidelines as conducting a systematic review; however, it does so more streamlined and flexibly. Our process, established as a response to earlier PA reviews undertaken by Public Health England, entails doing a targeted search, integrating relevant information on Active Schools scenarios, and translating that knowledge into appropriate language. By taking this strategy, we can adhere to the study criteria while placing the project's interest in "what works?" as the top priority.

We searched for peer-reviewed journal articles between January 2018 and March 2023 in three databases: Web of Science, SPORTdiscus, and the Psychology and Behavioural Sciences Collection. A few of the search phrases that we used are "physical activity* OR sport*", "adolescent* OR youth*," and "depress*." Wildcard characters (*) and question marks (?) account for variations in word forms and spellings. Nevertheless, those materials that had not been peer-reviewed, were not written in English, didn't focus on sports or mental health, or were published before 2018 were not considered and thus dismissed. Articles dealing with severe mental diseases, with policy, with reviews or concepts, and those dealing primarily with formative research were also not accepted.

This review used the recently revised Active Living by Design (ALBD) Community Action Model (Bors et al., 2009) to ensure strict quality control. Preparation (community partnership, assessment data, training, and capacity-building tools), Promotion (messages and materials), Programme (activities), Policy (rules and standards), and Physical Projects (environmental changes) are the five major components of this complete framework. The theoretical frameworks used in the interventions allowed this review to get insights into the types of studies investigated and highlight gaps in existing research. Thus, selected studies were assessed according to their research quality (Hill et al., 2018). Table 1 shows the criteria for quality assurance:

Table 1. Research quality criteria

	Item	Score
Study design	Longitudinal design	2
	Cross-sectional - Adequately matched	1
	Cross-sectional - Limited information provided	0
Frequency	Multiple time points	2
	One-point	0
Objective measures	Present	2
	Not present	0
Previous validation and/or reliability noted	Studies used items from a previously validated scale	2
	Some information on reliability/validity of scales or items included	1
	Limited or no information on reliability/validity of scales or items included	0

The studies' quality was determined using a scale with a maximum score of 8. They were classified as low (scores 0 to 2), moderate (scores 3 to 6), or high (scores 7 to 8). Inter-rater reliability was assessed based on the reviewers' scoring of each aspect on the research quality evaluation scale to ensure consistency. When Cohen's kappa values ranged from = 0.81 to = 1.00, indicating 100% agreement throughout the quality evaluation category, agreement levels were deemed good.

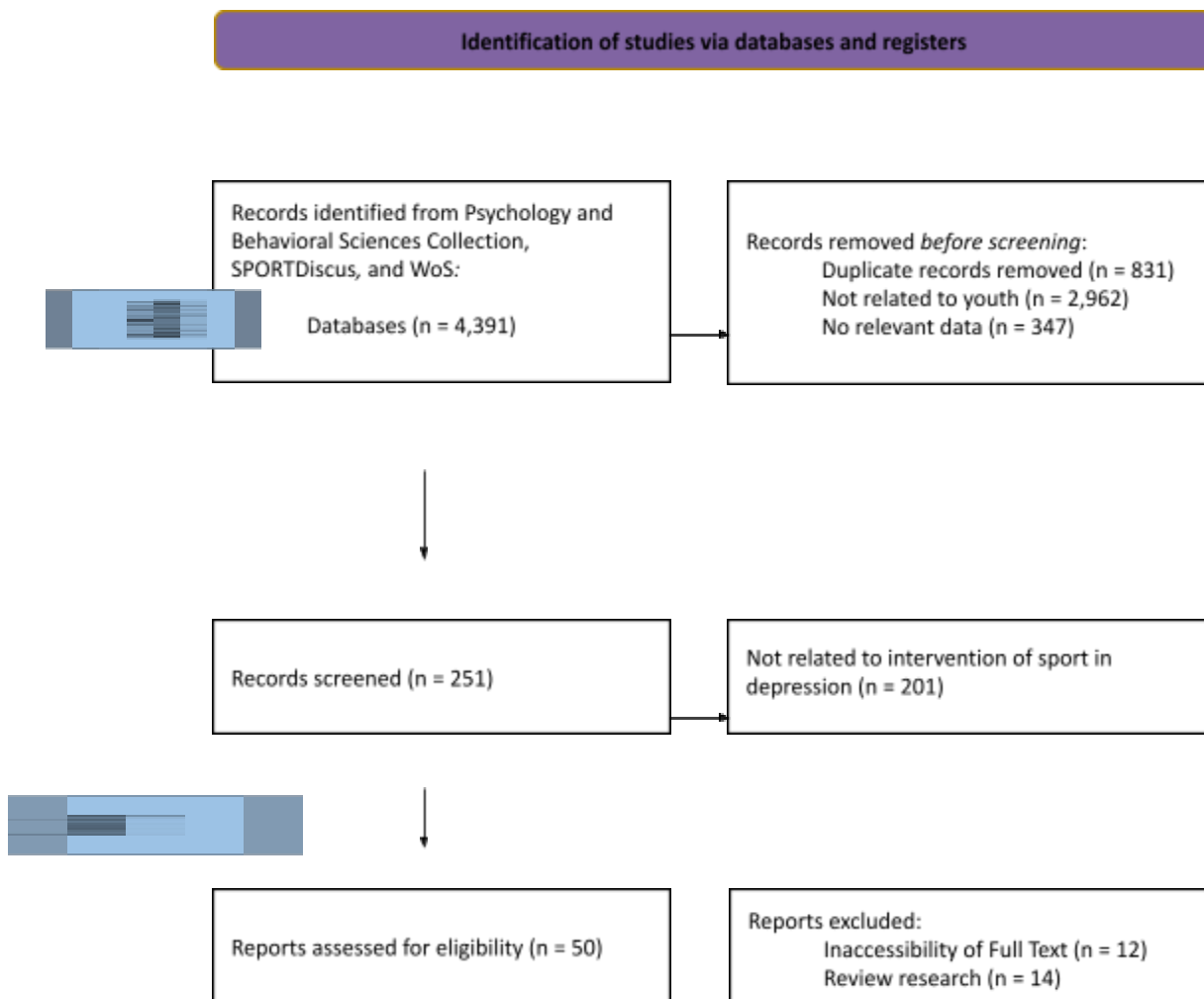
Results

This rapid review yielded 4,391 records. After screening and selection, 24 studies were included in the final review (see Figure 1). These selected studies, conducted in various

countries, provided valuable insights into the relationship between PA, sedentary behaviour, and depressive symptoms in adolescents, offering a robust foundation for understanding this critical aspect of adolescent mental health. An inclusive analysis of 24 selected studies (see Table 2) from various countries sheds light on the intricate relationship between PA, sedentary behaviour, and depressive symptoms among adolescents. One recurring theme in these studies is the profound impact of PA on mental well-being. Regular PA emerged as a consistent protective factor against depressive symptoms. Adolescents who engaged in sports or PA exhibited lower odds of experiencing depression. This positive association was observed across different countries, highlighting the universal significance of PA in promoting mental health.

Interestingly, the frequency and duration of physical exercise participation also played a significant role. Adolescents who incorporated PA into their daily, weekly, or monthly routines had substantially lower odds of experiencing frequent depressive symptoms. This finding underscores the importance of regular exercise as a preventative measure against depression during this critical developmental stage. Conversely, excessive sedentary behaviour, characterized by prolonged periods of activities such as TV watching and video game playing, was consistently linked to an increased risk of moderate and severe depressive symptoms. The sedentary lifestyle prevalent among adolescents today has raised concerns about its adverse effects on mental health. These studies highlight the importance of reducing sedentary behaviour as a potential strategy for mitigating depressive symptoms among adolescents. Moreover, the studies unveiled the intricate relationship between self-esteem, engagement in sports, volunteering activities, and depression. Higher levels of self-esteem were consistently associated with reduced rates of depression. Engaging in sports and volunteering activities positively influenced self-esteem and acted as indirect pathways to lower depressive symptoms. This suggests that interventions promoting self-esteem through participation in physical and social activities may be beneficial in reducing depression among adolescents. While PA's protective effect on depressive symptoms is evident, the optimal intensity and type of activity remain subjects of debate. Some studies highlighted the benefits of moderate PA, while others emphasized the importance of engaging in sports or exercise with higher intensity. The diversity in findings underscores the need for tailored interventions that consider individual preferences and capacities.

The findings from these 24 studies also reveal the interplay between PA, sedentary behaviour, and depressive symptoms. Excessive sedentary behaviour was not only linked to higher depressive symptomatology but also appeared to attenuate the benefits of PA. Adolescents who engaged in PA but counterbalanced it with extended periods of sedentary behaviour did not experience the same protective effect against depression. The selected studies underscore the pivotal role of PA and the detrimental impact of sedentary behaviour on depressive symptoms among adolescents. Regular engagement in PA and efforts to reduce sedentary behaviour can be essential components of mental health promotion strategies for this age group. Furthermore, fostering self-esteem through participation in sports and volunteering may provide a promising avenue to mitigate depressive symptoms. These findings collectively emphasize the importance of promoting an active and balanced lifestyle to support the mental well-being of adolescents worldwide.



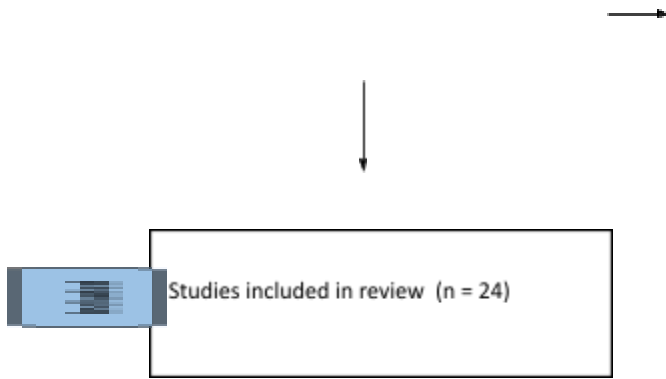


Figure 1. PRISMA output

Source / Country	Type of Study / Design	Objective / Sample	Methods / Measures	Key Findings	Rating Score
Bang, Won, & Park (2020) / USA	Longitudinal study / Cohort	To examine the relationships between school engagement, self-esteem, and depression and concurrently evaluate the effects of covariates, including sports participation, volunteering activity, and gender, on the study variables.	Seven items derived from the RES measured school engagement and self-esteem. Depressive symptoms were measured by five items derived from the General Well-being Scale of the Current Health Insurance Study Mental Health Battery. Volunteering activity was coded “1” if a respondent participated in any volunteer activity.	Higher levels of self-esteem were linked to lower rates of depression. Higher levels of sport participation positively influenced self-esteem and was linked to low levels of depression. Volunteering activity enhanced school engagement, which predicted self-esteem. Volunteering activity was not directly associated with self-esteem that predicted lower depressive symptoms.	Moderate
Bélair, Kohen, Kingsbury et al. (2018) / Canada	Survey / Longitudinal study	To analyze the association between PA, sedentary activity, and symptoms of depression and anxiety. 9,702 students aged 14 – 15 years old.	The symptoms of depression and anxiety were measured with seven items taken from the Ontario Child Health Study. LTPA was measured regarding the frequency of participation. Sedentary activity was measured with the following question: ‘On average, how much time per day does he/ she watch T.V., videos or DVDs or play video games?’	Participants with less than 1 day / week LTPA were at higher risk for being in higher depression and anxiety symptoms categories. Sedentary activity was associated with increased odds of moderate and severe symptoms of depression and anxiety.	High

Bohr, Boardman, & McQueen (2019) / USA	Longitudinal study / Cohort	To analyze adverse effect of actual/intended participation in contact sports during adolescence on cognition or depressive symptoms in early adulthood. 10,951 students aged 16 years old (wave I) and 29 years old (wave IV).	A subsample from the representative prospective cohort study Add Health was used to collect data through four waves (1994 – 2008). Modified CES-D scale was used to assess depression, suicide ideation, and suicide attempts at wave IV as a function of sport participation during wave I.	Actual/intended participation in contact sports during adolescence did not adversely affect cognition or depressive symptoms in young adulthood.	High
Cecchini, Fernandez-Rio, Mendez-Gimenez et al. (2020) / Spain	Survey	To examine the associations between PA levels, sedentary behaviors, self-determined motivation, and depressive symptoms. 714 students (girls) aged 15 – 18 years old.	Depressive symptoms were assessed using the six-item CES-D; PA with the Spanish version ‘seven-day recall’ of IPAQ, and situational (state) motivation towards an activity with SIMS scale.	A strong association between MET-minutes/week and depressive symptoms, regardless of confounding factors such as age, smoking habits, and body mass index, was found.	Moderate
Chi & Wang (2022) / China	Survey / Cross-sectional study	To investigate the associations between sports participation and depression and anxiety. 1,714 students aged 12 – 17 years old.	Depressive symptoms were assessed using PHQ-9. GAD-7 was used for assessing anxiety disorder. Sport participation was assessed using a single question. Sociodemographic factors were assessed using a self-reported questionnaire.	Students with less participation in sport-related activities were more likely to report depressive symptoms.	High

Farren, Zhang, Gu et al. (2018) / USA	Survey	To investigate whether sedentary behaviour and fitness-producing activity predicted depression in active adolescents over and above gender and fitness attributes. 249 students aged 12 – 13 years old.	Accelerometers were used to assess SB and PA. Fitnessgram test items were used to assess HRF attributes.	SB, fitness-producing activity, and attributes of HRF were all significant predictors of depression in active adolescents. Fitness-producing activity significantly predicted depression in active adolescents beyond gender and achieved HRF.	Moderate
Forte, McDowell, MacDonncha et al. (2020) / Ireland	Survey	To examine differences in depressive symptoms between adolescents reporting low, moderate, and high PA status and if depressive symptoms differed across PA status based on comorbidity status. 481 students ($M_{age} = 15.1 \pm 1.7$ years).	The trait subscale of STAI assessed anxiety symptoms, and QIDS the depressive symptoms. PA was measured by the PACE+ (Patient-Centred Assessment and Counselling for Exercise Plus Nutrition)	Depressive symptoms were highest for low PA and lowest for high PA. Among those with comorbid anxiety, compared to moderate PA, depressive symptoms were significantly higher for low and high PA. Respondents with comorbid anxiety reported worse depressive symptoms.	Moderate
Frömel, Jakubec, Groffik et al. (2020) / Czech Republic	Survey / Cohort	To study the associations between depressive symptoms, well-being, and different types of PA. 596 students aged 15 – 19 years old.	IPAQ-LF was used to identify the students' PA; BFW in the modified and standardized Czechoslovak version was used to analyze the depression symptoms. The index of emotional well-being was also calculated. Weekly PA was objectively measured by pedometer.	The adolescents who were primarily involved in team sports showed fewer depression symptoms than those involved in other sports. Neither boys nor girls with the most DS and the lowest well-being compensate for this emotional condition by engaging	Moderate

Gu (2022) / China	Survey / Cohort	To examine the relationship between PA (including exercise activities and housework) and risk of depression.	CES-D was used to measure the individuals' level of depression. Frequency, duration, and intensity of physical exercise were also assessed.	in PA in their after-school time or on the weekends. The frequency and duration of physical exercise participation are significantly and negatively associated with depression in adolescents. Excessive exercise increases the likelihood of depression in adolescents.	High
Holbrook, Voller, Castellini et al. (2022) / Italy	Survey	To explore whether gender, exercise frequency, and sports participation exerted a protective effect on the association between bullying and depressive symptoms. 4,829 students aged 13 – 21 years old.	The data from the EDIT project (Italy) was used. Exercise was assessed as the number of days in a typical week during which the respondent exercised at least one hour. Depressive symptoms were questioned via six separate items (hopeless, depressed, useless, nervous, restless, and feeling as though everything was too hard).	A greater prevalence of bullying emerged among females with respect to males, with a greater tendency towards the phenomenon of social exclusion. Significant interaction between bullying and gender was found in predicting depressive symptoms. Exercise and depressive symptoms are significantly associated.	High
Kirklewski, Watson, & Lauckner (2023) / USA	Survey / Cohort	To examine the moderating effect of PA on the relationship between bullying and mental health among sexual and gender minority youth (LGBTQ).	Data from the LGBTQ National Teen Survey was analyzed. PA was measured using the Godin Leisure-Time Exercise Questionnaire. Depression was measured using the Kutcher Adolescent Depression Scale 11.	Depression was positively related to bullying. Self-esteem was negatively related to bullying.	High

		9,890 students aged 13 – 17 years old.	Self-esteem was measured using 18 items from 3 scales (Rosenburg Self-Esteem Scale, Pearlman Mastery Scale, and Levenson Multidimensional Locus of Control Scale) Bullying was measured with 2 items.	PA levels were negatively related to depression and positively associated with self-esteem. As PA increased, the relationships between bullying and depression and bullying and self-esteem became stronger.	
LaRocca, James, Rosenberg et al. (2022) / USA	Survey / Cohort	To examine the relationship between team sports participation, depression, and suicidal ideation. 46,537 students aged 14 – 18 years old.	Students were enquired about team sports participation, depression, suicidal ideation, sexual orientation, and gender identity. Depression and suicidal ideation were assessed.	A statistically significant association between team sports participation and reduced likelihood for depression and suicidal ideation was found.	Moderate
Liu, Zhang, Hu et al. (2019) / China	Survey / Cohort	To identify combined patterns of MVPA and SSB, and to analyze the prevalence of different combined patterns and their correlations with depression, anxiety, and self-injurious behaviour. 13,659 students ($M_{age} = 15.18 \pm 1.89$ years) from NAEWIM-YRB.	The YRBS questionnaire assessed MVPA and SSB, symptoms of depression by the 20-item CES-D scale, and anxiety symptoms using the 39-item MASC-2. Self-injurious behaviour was measured using a 5-item subscale extracted from the HBICA inventory.	Significantly different probabilities of depression, anxiety, and self-injurious behaviors were found, with boys being more at risk than girls. High MVPA/ low SSB subgroup showed significantly lower depression, anxiety, and self-injurious behaviors.	High

Løvheim, Hartz, Thurston et al. (2018) / Norway	Survey / Cross-sectional study	To analyze the association between PA and symptoms of depression. 5,531 students aged 15 – 16 and 11,655 students aged 13 – 14 years old.	Symptoms of depression were measured, and the participants were asked how often they exercised or competed with a sports club, went to the gym, kept fit, or had other organized PA.	The strength of the association between PA and symptoms of depression depends on the PA context. Participation in PA in a sports club setting was related to fewer depressive symptoms.	Moderate
Ma, Hagquist, & Løvheim (2020) / Sweden	Longitudinal survey	To explore how LTPA was associated with depressive symptoms among adolescents. 3,787 students aged 14 – 15 years old.	The Swedish data collected as part of the Children of Immigrants: Longitudinal Survey in Four European Countries was analyzed using binary logistic regression.	Adolescents (both boys and girls) with LTPA daily, weekly, or monthly had substantially lower odds of often feeling depressed than those who were physically inactive. Girls had significantly higher odds of often feeling depressed.	High
Ogawa, Kitagawa, Fukushima et al. (2019) / Japan	Survey / Cross-sectional study	To examine the interactive effect of daily sleep duration and amount of PA on anxiety/depression in adolescents. 983 students aged 12 – 17 years old.	Sleep duration was assessed in duration in hours and minutes. PA was estimated by using the level of participation in sports club activities at school. The GHQ-12 scale assessed anxiety and depressive symptoms in the previous 1 month.	The main effects were statistically significant with positive impacts on anxiety/depression. Anxiety/depression in adolescents with adequate sleep and adequate PA may be similar to that of adolescents with only one.	Moderate
Raudsepp & Vink (2019) / Estonia	Survey / Longitudinal study	To explore associations between PA, SD, and depressive symptoms.	PA was assessed using the 3DPAR. Depressive symptoms were measured using CES-D.	Initial levels of depressive symptoms predicted increase in SD and decrease in PA, and initial levels of SD predicted decrease in PA.	Moderate

Shen, Gu, Zhang, et al. (2022) / China	Survey / Cross-sectional design	To test a path model of TPB variables with PA and depressive symptoms. 792 students aged 15-18 years old.	Participants completed questionnaires for TPB variables, PA for adolescents PAQ-A, and the short form of the Depression scale - CES-D).	PA intention/behaviour has a mediating effect on the TPB–depression relationship among adolescents. TPB model can be used for designing and implementing PA interventions to prevent depressive symptoms.	Moderate
Singh, Sharma, Raj et al. (2018) / India	Survey / Cross-sectional study	To examine a possible association between LTPA and depression. 370 students aged under 25 years old.	Mental health was assessed by CES-DC. LTPA was assessed by one item “How many hours a week do you usually exercise or play sports where you become breathless or have to sweat?”	LTPA was found to be associated with lower rates of depression.	Moderate
Slykerman, Thompson, Coomarasamy et al. (2019) / New Zealand	Prospective cohort study	To examine early adolescent PA and risk of later depressive symptoms. Mothers and their children: 467 students aged 16 years old.	Depression at 16 was assessed using the CES-DC. Accelerometer measures of PA and sleep were measured at 11 years of age.	PA and sleep measured objectively and prospectively did not predict depressive symptoms at 16 years. While PA and sleep may have health benefits, they did not reduce the risk of developing depression symptoms later in adolescence.	Moderate
Sun & Zhan (2021) / China	Online survey	To investigate the associations of PA, ST, and SLP with depressive symptoms. 1,331 students aged 12 – 14 years old.	Days of MVPA were assessed by HBSC questionnaire and ST and SLP. Depressive symptoms were measured using CDI.	Only ST was significantly and positively correlated with depressive symptoms. Excessive ST may be detrimental to depression symptoms in adolescents.	Moderate

Velazquez, Petresco, Pereira et al. (2022) / Brazil	Survey / Cohort	To explore associations between self-reported weekly PA and depressive symptoms. 7,405 students aged 14 – 16 years old.	Participants assessed were enrolled in the 8th through 11th grades in 101 public schools. PHQ-A and two items from PACE + were completed.	Participants with lower PACE+ scores reported higher PHQ-A scores, indicating that teenagers who do not exercise frequently may have more depressive symptoms – with pronounced scores for both variables among girls.	High
Xiao, Doig, Wu, et al. (2021) / China	Survey / Cross-sectional design	To analyze associations of sports participation with anxiety and depressive symptoms. 1,452 students aged 9 – 16 years old.	Frequency of sport participation was self-reported, and PHQ-9 was used to measure the presence and severity of depression symptoms. Anxiety symptoms were measured using the seven-item GAD scale.	Engaging in sports participation was negatively associated with depression and anxiety.	High
Xiang, Gu, Zhang et al. (2020) / China	Survey / Cross-sectional study	To examine the relations between different doses of PA, academic self-efficacy, and depression, and the direct and indirect associations of various doses of PA to depression through academic self-efficacy. 428 students ($M_{age} = 13.7 \pm 1.5$ years).	PA was assessed using the LTPA scale. A 5-item academic self-efficacy scale was adapted to assess academic self-efficacy. The Chinese version of CES-D was used to assess the depressive symptoms.	The different doses of PA had significant indirect effects on depression through academic self-efficacy. MVPA but not LPA were significantly correlated with depression. All forms/types of PA may contribute to adolescents' mental health and perceived academic self-efficacy.	High

Table 2. Characteristics and quality assessment of eligible studies *Note:* PA = Physical activity; SB = sedentary behaviour; HRF = health related fitness; RES = Rosenberg self-esteem scale; TPB = Theory of Planned Behaviour; PAQ-A= Physical Activity Questionnaire for Adolescents; CED-D = Center for Epidemiological Studies-Depression scale; Add Health = National Longitudinal Study of Adolescent to Adult Health; ST = daily hours of screen-time; SLP = daily hours of sleep; MVPA = moderate-to-vigorous PA; HBSC = Health Behavior in School-aged Children; CDI = Children’s Depression Inventory; PHQ-9 = nine-item Patient Health Questionnaire; GAD-7 = Generalized Anxiety Disorder Scale; SD = sleep disturbance; 3DPAR = 3-Day Physical Activity Recall; ISI = Insomnia Severity Index; SSB = screen-based sedentary behavior; NAEWIM-YRB = National Assessment, Early-Warning and Intervention Model research on Youth Risk Behavior; YRBS = Youth Risk Behavior Survey; MASC-2 = Multidimensional Anxiety Scale for Children; HBICA = Health-Risk Behavior Inventory for Chinese Adolescents; IPAQ = International Physical Activity Questionnaire; MET = The Metabolic Equivalent of Task; SIMS = Situational Motivation Scale; BMI = body mass index; STAI = State-Trait Anxiety Inventory; QIDS = Quick Inventory of Depressive Symptomatology; PACE+ = Patient-Centred Assessment and Counselling for Exercise Plus Nutrition; CAMHS = child and adolescent mental healthcare services; CES-DC = Center for Epidemiological Studies Depression Scale for Children; GHQ-12 = General Health Questionnaire; LTPA = Leisure Time Physical Activity; PHQ-A = Patient Health Questionnaire Adolescent; IPAQ-LF = The International Physical Activity Questionnaire—Long Form; BFW = Bern Questionnaire on Subjective Well-being; EDIT = Epidemiologia dell’Infortunistica Stradale; PHQ-9 = Patient Health Questionnaire

Discussion

Depression is the mood disorder with the highest incidence of psychological problems during adolescence (Diener et al., 2021). Its association with teen suicide has led to it being labeled a “silent killer” that targets vulnerable youth (Kroning & Kroning, 2016). Recent years have seen an increased incidence, and many international and national agencies have expressed the urgent need for interventions to support the prevention and treatment of depression in adolescence (Ghandour et al., 2019; UNICEF, 2021; WHO, 2021). The current review is presented within the context of an increasing awareness of the potentially positive impact of PA on adolescent mental health. However, the causes and extent of such affects remain somewhat ambiguous, even controversial (Gu, 2022; Shaphe & Chahal, 2020). The discrepancy between claims and the somewhat dated nature of some influential accounts suggests further study.

The type and intensity of PA emerged as an important factor in many of the studies in this review. Interestingly, heightened risk was identified at the lowest and highest activity intensity levels. For example, Gu’s (2022) analysis of data in the China Family Panel Studies revealed that the risk of depression was significantly higher among those reporting lower frequency and duration of exercise. However, it was also reported that the risk of depression was also higher among those reporting intensely strenuous levels. Similar findings were reported by Forte et al. (2020) and are consistent with the findings of Gergelyfi et al. (2021), which were not included in this review. Carter et al.’s (2016) review and meta-analysis of randomized controlled trials among adults showed that light and moderate, but not vigorous, levels of PA yielded positive effects for people with depression. However, other studies found that any intensity of PA benefits depression prevention (Lui et al., 2019; Xiang et al., 2020). This suggests that participating in even relatively low-intensity PA can be useful in lowering the risk of depression among adolescents. This is significant as several studies report that adolescents prefer lower-intensity PA. (Carter et al., 2015). Since depressed teenagers spend more time being inactive (Farren et al., 2018; Frömel et al., 2020), lower intensities present a more attainable (and still worthwhile) goal for depressed young people. It also nullifies sedentariness’sotherwise harmful effects on depressive symptoms (Farren et al. 2018). Such findings might also be interpreted as lending support for providing social and recreational (rather than serious and competitive) activity experiences (Frömel et al., 2020). Self-determined recreational activities provide greater freedom

to decide the form of participation, as well as its duration and intensity. This might help explain the finding from one of the studies in the review that goes with high levels of self-determined motivation at the lowest levels of depressive symptoms (Cecchini et al., 2020).

Explaining precisely why certain studies have reported adverse mental health outcomes associated with higher levels of PA poses a challenge. However, it is imperative to recognize that the literature extensively acknowledges the risks of excessive exercise, including the potential development of eating disorders (Forte et al., 2020). Additionally, perceived pressure stemming from excessive competitiveness and time commitments can have detrimental effects (Cardinal et al., 2013). It is crucial to underscore that certain forms of competitive sports can lead to adverse mental health outcomes due to bullying and other harmful social behaviors (Easterlin et al., 2019). Consequently, one must exercise caution when making simplistic claims that uniformly assert the positive effects of sports on the mental well-being of young individuals (Bailey, 2018).

Studies reported the benefits of sports clubs' (potentially) social settings (Bang, Won, & Park, 2020; Bohr, Boardman, & McQueen, 2019; LaRocca et al., 2023). In some cases, participation in sports buffers against the effects of bullying and may prove a helpful strategy for increasing exercise, positive peer interactions, and mood in adolescents (Hollbrook et al., 2019). Of course, not all settings are the same, and Kleppang et al. (2018) contribute a useful addition to this line of research by introducing the concept of 'physical activity, modalities'. They just dished between 16 categories of participation, such as 'sportsclub', 'gym', 'independently', and combinations of these. Suppose it is accepted that the context of PA is a vital mediator of mental health outcomes. In that case, differentiating between participation modalities is likely to be very useful for future research. Kleppang et al. (2018) reported that adolescents who exercised independently (for example, swimming, running, or cycling alone) had a higher incidence of depressive symptoms than those participating in an organized sports club. As a cross-sectional study, it is not possible to determine the direction of correlation. However, the categorization of PA context deserves further research.

What becomes evident from the research is that consistent engagement in exercise-based PA appears to be most beneficial for supporting mental health (Xiang et al., 2020; Xiao et al., 2022). For instance, Chi and Wang (2022) employed ordinal logistic regression to explore the link between sports participation and depressive symptoms, revealing that individuals with the lowest participation had the highest likelihood of reporting depression. Nevertheless, the

connection between PA and mental well-being is intricate, influenced by factors such as the nature of the activity, its intensity, and the social context in which it occurs (Brière et al., 2018). Nevertheless, it is reasonable to conclude that promoting regular PA among adolescents could substantially prevent and alleviate depressive symptoms (Shen et al., 2022).

There are several explanations for why PA supports mental health, in general, and depression, in particular. They can be summarised as the ‘psychosocial’, ‘biological’, and ‘behavioral’ hypotheses (cf. Lubans et al., 2016). The psychosocial hypothesis prioritizes the interpersonal benefits of many forms of PA, and young people who regularly engage in sports and other prosocial tasks are more likely to form positive and sustainable relationships with their peers (Gu, 2022; Kleppang et al., 2018; Shen et al., 2022). Lubans et al. (2016) proposed that various variables, such as perceived physical self-concept, perceived competence, and physical appearance, might mediate the relationship. Two Chinese adolescent studies have tested this hypothesis (Shen et al., 2022; Xiang et al., 2020). Xiang et al.’s (2020) findings, in particular, support the claim that different intensities of PA significantly indirectly affect depression by enhancing academic self-efficacy. The researchers interpreted this result as endorsing the importance of PA for students’ academic achievement, which would positively impact their mental health. Likewise, Shen et al.’s (2022) study (framed by the Theory of Planned Behaviour) supported psychosocial variables, including self-efficacy and positive attitudes. These findings also strengthen claims for the benefits of team-based activities, such as sports. Research from the Czech Republic also found adolescents who were involved in team sports reported fewer depressive symptoms than their peers participating in other forms of physical activity (Frömel et al., 2020), corroborating earlier studies from other regions (Arat et al., 2017; Chekroud et al., 2018). As has already been noted, sports participation may even buffer against the effects of bullying, and this seems to happen in a more marked way than with generic PA (Holbrook et al., 2020). Of course, presenting sport as a panacea would be foolish, and any effects should be understood within the broader context of adolescent development. This is a lesson to be learned from a study of bullying associated with sexual and gender minority youth (Kirklewski et al., 2023). The researchers found a negative relationship between PA and depressive symptoms and a positive relationship to self-esteem. However, further data analysis revealed that these effects may only have been limited to individuals who were not bullied. In this study, PA has a negligible effect on those who were bullied. This highlights the vital importance of establishing a

climate in which minority or marginalized groups accepted and in which bullying is not tolerated. When such measures are in place, there are reasons to believe potentially vulnerable youth experience similar mental health benefits associated with sports participation as anyone else (LaRocca et al., 2023).

A second account, the behavioral hypothesis, also received support in the review findings. The claim is that changes to certain behaviors mediate associations between mental health and PA. Raudsepp and Vink (2019) examined longitudinal associations between PA, depressive symptoms, and sleep, finding that the three variables were interrelated, with initial levels of depressive symptoms predicting sleep problems and reduced PA and initial levels of sleep disorders predicting decreased PA. Why these associations might present is unclear.

A third possible explanation for inverse associations between PA and depressive symptoms is that participation protects adolescents via neurological pathways (Brière et al., 2018; Lubans et al., 2016). This was not discussed in the articles in this review.

Conclusion

Consistent with many earlier studies, this review found that depressive symptoms related to PA status, with symptoms being worse in relatively inactive adolescents. Appropriate PA improves adolescent mental and physical health (Schuch & Stubbs 2019). Notably, several characteristics of PA cannot be replicated by medication or other therapies. Several studies in this review supported the “psychosocial hypothesis” which capitalizes upon the psychological and social benefits of participating in many forms of PA, especially sports. This illustrates the value of ensuring access and affordable opportunities for regular and varied movement experiences. Furthermore, these findings endorse the WHO’s (2020) target of encouraging 60 minutes of daily PA. However, it is essential to acknowledge that moderate-to-vigorous intensities may be challenging for some adolescents grappling with depression. Thus, focusing on lower PA levels may serve as an initially more attainable goal. Regrettably, several studies indicate that even these more modest targets are falling short of attainment (Currie et al., 2012; WHO Europe, 2016).

In summary, the evidence presented in this review adds to the compelling case for promoting PA among adolescents of all backgrounds. A vital conclusion from several studies in

this review is that it is not just PA, per se, that yields protection against depressive symptoms, but the social context in which these activities occur. We can strive to improve our young population's mental health and overall well-being by fostering an environment that encourages regular and varied physical movement. Pursuing a healthier and happier adolescent future is worth pursuing with vigor and commitment.

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Sport and Mental Health:

ANXIETY

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Elevating Mental Health: A Systematic Review of Physical Activity's Impact on Anxiety Management

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Abstract

Introduction: Anxiety is a prevalent mental health concern among adolescents, which has prompted an increase in research examining the potential benefits of physical activity interventions. In this systematic review, we analyzed 12 research studies conducted between 2018 and 2023 to investigate the complex relationship between physical activity and anxiety in adolescents. *Methods:* An exhaustive search of English-language articles was conducted in accordance with the standards for systematic reviews. The studies utilized a variety of methodologies, including surveys, cross-sectional analyses, and intervention-based research, and provided valuable insights into the topic. *Results:* The results of a meta-analysis of 12 studies indicate that physical activity plays a crucial role in the anxiety management of adolescents. Notably, higher levels of physical activity were linked to lower anxiety scores and a lower prevalence of anxiety-related symptoms. Despite the fact that some studies revealed gender- and age-dependent differences in anxiety outcomes, a consistent trend highlighted the overall beneficial effects of physical activity. *Conclusion:* Thus, these studies demonstrate that physical activity interventions may be an effective method for reducing anxiety in adolescents. Encouragement of physical activity, particularly in school and community contexts, emerges as an effective and accessible strategy for promoting the mental health of adolescents. These results support the incorporation of physical activity initiatives into larger mental health promotion and management programmes aimed at this vulnerable population.

Keywords: anxiety; adolescents; physical activity; mental health; systematic review; anxiety management.

What works?

- Encourage a variety of physical activities with different intensity levels to cater to adolescents' preferences and abilities.
- Create a supportive and inclusive environment within sports clubs to foster positive peer interactions, leveraging social connections as a defense against stress and anxiety.
- Recognize that the setting in which physical activity occurs can affect its impact on anxiety, with socially embedded sports activities often providing better mental health support.
- Tailor support and programs to account for potential gender disparities in anxiety-related conditions, addressing the unique needs and challenges of both male and female participants

Introduction

Mental health is fundamental for development and well-being (WHO, 2021). There is evidence, however, that mental health disorders are prevalent during the adolescent phase when young people enter a pivotal period during which they are especially vulnerable to adverse social influences and health consequences (Castel Pietra et al., 2022; World Health Organization. 2017), and when fluctuations in health can establish health trajectories that will be felt for many years (Biswas et al., 2020). Like most mental health problems, anxiety disorders typically originates during childhood or adolescence (Merikangas et al., 2009). Anxiety disorders, which entail excessive perceptions of fear or threat, evident, for instance, in social and generalised anxiety disorders (GAD), are among the most common mental disorders for adolescents, often beginning during childhood and following a chronic course (Antony & Stein, 2009). The most recent Global Burden of Health project (Institute for Health Metrics and Evaluation 2019) estimates anxiety disorders to be the most prevalent mental health problem globally. There is, however, substantial variation, with reported figures for anxiety among adolescents ranging from 17.0% (Eastern Mediterranean Region) to 4.0% (European Region). Considering the prevalence of mental disorders, it is important to identify activities and interventions that support adolescent mental health (Biswas et al., 2020).

Anxiety is a normal human emotion characterized by various responses (e.g., behavioural, affective, and cognitive) to perceived threat. However, it can be considered excessive or pathological when such responses cause significant distress or are out of proportion to the perceived source of stress (Bhatia & Goyal 2018). Anxiety disorders are common among youth (Polanczyk et al., 2015), with the prevalence of anxiety symptoms among European children and adolescents ranging between 5.5–19% and 14.75–21.5%, respectively (Moffitt et al., 2010; Moreira de Sousa et al., 2018; Ormel et al., 2015), rising to 26.41% (8–17 years) in Spain (Orgilés et al. 2012). A part of the risk of anxiety disorders is that they often remain undetected and untreated during childhood and adolescence, which may affect well-being in adulthood (Membride, 2016). Another concern is that anxiety can be expressed in many different contexts, forms, and intensities (for example, it might be generalized anxiety disorders or panic attack disorder and combined with other psychopathological symptoms (most commonly depression; Thibaut, 2022)). Such variability might help explain the absence of previous reviews of relationships between anxiety and physical activity. It also means that any findings should be taken with a degree of caution and that the present review should be considered a coping study of an under-researched area.

A growing evidence base supports the claim that sporting activities may protect against mental disorders, including anxiety (D'Angelantonio et al., 2022; McMahon et al., 2017; Panza et al., 2020). In addition, adolescents who engage in the WHO-recommended 60 min or more of moderate-to-vigorous activity (WHO 2020) – to which sporting activities can make a significant contribution (Bailey 2017) - experience fewer anxiety and depression symptoms (Biddle et al., 2019; Hale et al., 2021; Rodriguez-Ayllon et al., 2019). For example, a meta-analysis investigating the association between physical activity and panic/anxiety demonstrated a small significant effect of physical activity intervention reducing panic attack disorder and a middle effect reducing anxiety (Wang & Liu, 2023). A systematic review and meta-analysis concluded that physical activity might be a useful approach to addressing anxiety symptoms in children and young people based on a moderate improvement in state anxiety, compared to no intervention or minimal intervention control conditions and significantly superior effects on state anxiety when compared to a time and attention-controlled group (Carter et al., 2021). It has been suggested that organised sporting and other forms of physical activity offer a combination of potentially

valuable factors that are independently established to be protective of anxiety disorders: physical activity (D'Angelantonio et al., 2022) and social connectedness (Eime et al., 2013). In addition, these activities are typically low-cost, widespread dissemination without significant side-effects and stigma (Vancampfort et al., 2017).

This review examines relationships between sports participation and anxiety disorders. Participation is understood here in terms used by the Council of Europe's European Sports Charter (CoE, 2001): "all forms of physical activity which, through casual or organised participation, aim at expressing or improving physical fitness and mental well-being, forming relationships or obtaining results in competitions at all levels" (Article 2). In other words, sport is considered a community and/or recreational activity available to many young people. Our usage explicitly does not include elite or sub-elite youth populations who, we suggest, ought to be treated as a discrete sub-population. It has been suggested these players often face significant and atypical pressures and expectations, including high training loads, stress of competition and insufficient recovery (Küttel & Larsen 2020; Nicholls et al., 2020). Several systematic reviews and meta-analyses have reported that playing top-level youth sport is associated with heightened symptoms of mental ill-health, including anxiety, depression, and eating disorders (Kegelaers et al., 2022; Perry et al., 2022; Rice et al., 2019; Walter et al., 2022).

Methodology

Our methodology for anxiety research is grounded in the principles of rapid reviewing, which combines established systematic reviewing strategies with adaptations designed to deliver quicker and more diverse insights (Tricco et al, 2015). This approach is inspired by previous work carried out by Public Health England in the realm of physical activity reviews (Chalkley et al, 2015). It entails a purposive search, comprehensive integration, and careful translation of pertinent literature concerning contexts relevant to Active Schools.

A paramount advantage of this approach lies in its ability to maintain the rigor of established research procedures while affording the flexibility to prioritize our project's core question: 'what works?' This delicate balance ensures both thorough data gathering and the pursuit of practical outcomes.

Data Gathering: Our data gathering process revolves around a search of three specialized databases: Google scholar, SPORTdiscus and Psychology & Behavioral Sciences Collection. We will focus on peer-reviewed journal articles published from January 2018 to March 2023. To comprehensively cover our topic, we will utilize the following search terms: sport* OR physical activit* AND adolescent* OR youth OR teenage* AND anxiety. These search terms were refined through multiple experiments to ensure the retrieval of the most relevant results.

Exclusion Criteria: Given the anticipated volume of documents, all records will be meticulously organized using a specialized referencing system. Duplicates will be eliminated by our research team. The ensuing list of documents will undergo scrutiny based on exclusion criteria:

a) Not peer-reviewed journal articles b) Not in English c) Not related to sport and mental health d) Not an intervention, trial, evaluation, or 'what works' study e) Not related to adolescents (ages 10 to 19) f) Involving adolescents diagnosed with severe mental disorders g) Policy-related articles h) Review/conceptual articles i) Articles with only formative research j) Articles published before 2018.

The checking process unfolds as follows:

1. Documents are randomly allocated to team members
2. Each document undergoes blind and independent assessment (keep, reject, unsure)
3. Discrepancies are resolved by a third member
4. 'Unsure' ratings are also reviewed by a third member

Study summarization includes aspects such as sample size, age, objectives, methods, key findings, and quality rating.

Quality Assurance: Research evidence is analyzed in two ways. First, we apply the Active Living by Design (ALBD) Community Action Model (Bors et al, 2009), featuring five components: Preparation, Promotion, Programme, Policy, and Physical Projects. This framework helps categorize studies and identify research gaps (Bailey et al, n.d). Additionally, studies are assessed for research quality according to the following rubric (Hill et al, 2018):

- Study design

- Longitudinal design
- Cross-sectional (adequately matched)
- Cross-sectional (limited information)
- Frequency of measurements
- Objective measures
- Previous validation/reliability noted

Quality is scored on a scale of 0 to 8, categorizing studies as low (0-2), moderate (3-6), or high (7-8) quality. Inter-rater reliability is established using Cohen's kappa values. Our methodology aligns with the Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA) (Moher et al, 2009) statement, and our research is registered with the Prospero international database for systematic reviews.

Results

A comprehensive review of the intricate relationship between physical activity (PA) and anxiety across diverse contexts and groups is provided by the 12 selected studies. These studies examine PA and anxiety-induced sleep disturbances, PA and premenstrual syndrome (PMS) in adolescent girls, and screen-related sedentary behaviors and anxiety in adolescents. Numerous research examine the psychological components of anxiety, including competitive anxiety in young athletes, and the role of resilience, coping strategies, and motivation in the complicated relationship between PA and anxiety. These studies show gender and age differences in anxiety reactions, such as somatic anxiety levels between boys and girls. Studies show that sports experience boosts resilience and reduces anxiety. Nutrition habits and PA are examined together to show how important a balanced diet is in minimizing social anxiety. Research on academic anxiety shows a direct correlation between exam anxiety and sports anxiety, as well as links between academic achievement and sports-related anxiety. The studies also examine motivation in PA and its link with anxiety, highlighting their dynamic nature, particularly across age and gender. Finally, other research study the effects of exercise and music therapy on stress and anxiety, providing practical anxiety treatment ideas. These studies illuminate the many subtleties

of PA and anxiety relationships and their applicability across demographic groups and environments.

Table 1. Characteristics and quality assessment of eligible studies

Source / Country	Type of Study / Design	Objective / Sample	Methods / Measures	Key Findings	Rating Score
Werneck et al., (2020) / Brazil	Survey / multi-stage, stratified, clustered probability design	To analyze the association between different contexts of PA and anxiety-induced sleep disturbance. 100,648 students aged 11-18 years	Anxiety-induced sleep disturbance was assessed using the GSHS survey. An adaptation of GSHS was used to assess PA, including nine questions about PE classes, transportation to school, and after school exercise/sports practice. Total time watching TV per day and the consumption of ultra-processed food was assessed over the previous 7 days through a self-report questionnaire.	<ul style="list-style-type: none"> - Higher PA during transportation was associated with higher AISD. - PA during PE classes showed lower odds for AISD. - Outside school PA was associated with reduced AISD among boys. - The association between PA and AISD seems to be context dependent. 	High
Armini et al., (2022) / Indonesia	Survey / cross-sectional study	To analyze the relationship between PA and anxiety with PMS. 143 adolescent girls aged 13-14 years	PA was assessed using the PAQ-A questionnaire. Anxiety was measured using the Z-SAS questionnaire (anxiety characteristics, attitudes, and somatic symptoms).	<ul style="list-style-type: none"> - No significant association between PA and PMS was found. - A significant correlation between anxiety and PMS was discovered. 	Moderate
Wen et al., (2019) / China	Survey / cross-sectional study	To investigate the association between PA, screen-related sedentary behaviors, and anxiety. 900 adolescents aged 12-16 years	LPA was employed to identify homogenous subtypes of anxiety. The 100-item MHT scale was used to assess mental health (learning and interpersonal anxieties, lonely and remorse tendencies, allergic tendency, physical symptoms, terror, and impulsive tendencies).	<ul style="list-style-type: none"> - High screen-related sedentary behaviors were associated with higher odds of anxiety. - High prevalence of moderate and severe anxiety was accounting for 56% and 24.78%, respectively. 	Low

González-Hernández et al., (2021) / Spain	Survey / cross-sectional study	<p>To examine the levels of resilience and competitive anxiety by sex and years of sports experience.</p> <p>To analyze the relationship between resiliency resources and competitive anxiety, and the variables that predict both resiliency resources and self-confidence.</p> <p>241 handball and basketball players aged 14-17 years</p>	<p>The YRBSS questionnaire items assessed PA and screen-related sedentary behaviors.</p> <p>Differential and multivariate descriptive, correlation, and multiple regression analyses were performed.</p> <p>The Spanish version of the RS-14 scale was used to assess the level of individual resilience. An abbreviated version of the CSAI-2R questionnaire was employed to assess competitive state anxiety.</p>	<ul style="list-style-type: none"> - Anxiety was negatively related to resilience in its acceptance dimension. - Girls showed higher levels of somatic anxiety, while boys had higher levels of acceptance. - Statistically significant differences were found in the resources for acceptance in favor of boys, while significantly different indicators in somatic anxiety and self-confidence in favor of girls were found. - The sports experience was positively related to resilience and negatively to anxiety. 	Moderate
Pons et al., (2020) / Spain	Survey / cross-sectional study	<p>To examine how coping mediates the relationship between competitive anxiety and sport commitment.</p> <p>500 team athletes aged 13-21 years (basketball, soccer volleyball, handball, roller hockey and water polo)</p>	<p>The measurement model was defined using CFA and exploratory SEM, and two different models of mediation (total and partial) were compared using SEM.</p> <p>The 15-item Spanish version of the SAS-2 scale was used to assess the competitive anxiety.</p> <p>Coping was assessed through the 31-item Spanish version of ISCCS scale.</p>	<ul style="list-style-type: none"> - Cognitive anxiety factors predicted sport commitment. - Somatic anxiety had a weak influence on sport commitment. Worry showed a positive influence on sport commitment. - Concentration disruption showed a negative impact on sport commitment through mediated effects only, showing a negative path on task-oriented coping and a positive path on disengagement-oriented coping. 	High

Muftuoglu, & Bayram (2020) / Turkey	Survey / descriptive cross-sectional study	To analyze the relationship between nutritional habits, social anxiety and PA levels. 300 students aged 14-18 years	Sport commitment was measured using the commitment subscale of the SCQ questionnaire. The KIDMED Index assessed the students' healthy eating habits. The IPAQ questionnaire collected PA levels. The SPAS inventory assessed social anxiety levels.	<ul style="list-style-type: none"> - Task coping efforts undertaken by adolescent athletes were identified as a key element in the relationship between competitive anxiety and sport commitment. - No statistically significant differences between KIDMED, IPAQ, or SPAS were found for sex. - Students confirming healthy diet showed higher KIDMED scores and lower SPAS scores than those who had an unhealthy diet. - A positive correlation was found between KIDMED and IPAQ, and negative correlation between KIDMED and SPAS and BMI for age. - A negative but insignificant correlation was shown between IPAQ and SPAS scores. 	Moderate
Indrieş, & Bochiş (2019) / Romania	Survey / descriptive cross-sectional study	To identify the levels of anxiety and test anxiety in sports. To investigate the influences of the academic performances, and test anxiety on anxiety in sports. 65 students aged 9-11 years	<p><i>The 30-item CTAS scale assessed students' thoughts (e.g. I think I will get a lower score), distracting = (e.g. I move my legs under the bench) and automatic reactions.</i></p> <p><i>Additionally, SAS-2 was used to measure anxiety in sports.</i></p>	<ul style="list-style-type: none"> - The results showed an average level of anxiety in sports. Above average levels for the whole group were obtained in the global score of CTAS. - A direct or positive relationship between sport anxiety and test anxiety, and a negative association with the academic performances of the students in the disciplines of Romanian language and 	Moderate

Navarro et al., (2023) / Spain	Survey / cross-sectional study	<p>To validate the psychometric structure of the BREQ-2 scale to confirm the existence of five levels of motivation toward physical exercise.</p> <p>To analyze the differences in motivation according to sex and age, and the role of age and sex in the relationship between motivation and enjoyment.</p> <p>666 students aged 10-16 years</p>	<p>BREQ-2 questionnaire was used to assess the different types of motivations.</p> <p>PASAS evaluated the social anxiety in sports.</p> <p>PACES assessed enjoyment of PE.</p> <p>SPAS measured the degree of anxiety a person experiences when he/she perceives that others are or may be negatively evaluating his/her physical aspect.</p>	<p>literature, and sport, but not mathematics were found.</p> <ul style="list-style-type: none"> - The CFA of the BREQ-2 showed a five-factor structure. A more parsimonious four-factor structure with a single intrinsic-identified regulation emerged through an EFA. - The more self-determined types of motivation were positively associated with enjoyment and negatively with anxiety. - The type of physical exercise motivation fluctuated depending on age and sex, and the age moderated the relationship between motivation and enjoyment. 	Moderate
Klizenė et al., (2022) / Lithuania	Survey / pre-test/post-test experimental design	<p>To analyze the effects of an 8-months exercise intervention programme on PA and decrease of anxiety.</p> <p>Experimental group of 70 students aged 6-7 years, control group of 68 students aged 6-7 years</p>	<p>8 months intervention: A pre-test/post-test experimental design was used to avoid any interference with educational activities due to the random selection of children into the groups.</p> <p>Children's PA was assessed by the CPAQ scale.</p> <p>The RCMAS scale was used to measure anxiety and children's level of defensiveness.</p>	<ul style="list-style-type: none"> - The exercise intervention programme led to the statistically significant changes in the dependent variables: increased PA and decreased anxiety for the experimental group. 	Moderate

Aktağ, & Çelebi (2019) / Turkey	Survey / cross-sectional study	To analyze the relationship between leisure time exercise and social appearance. 247 students aged 18-30 years	Social appearance and anxiety were assessed by the SAAS scale. A Turkish adaptation of LTEQ was found valid and a reliable instrument to determine leisure time PA levels.	- No significant correlations among social appearance anxiety, anxiety and leisure time exercise duration were found.	Low
Çelik et al., (2021) / Turkey	Survey / cross-sectional study	To analyze the relationship between anxiety levels and exercise addiction during Covid-19 pandemic period. 184 students of sport science degree aged more than 18 years	In order to assess anxiety and exercise addiction levels of students, CAS and EAS scales were used.	- Practicing regularly exercise and active sports and its duration showed an impact on hyper-focus and mood swings. - The postponement of individual social needs and conflict had negative impacts on the person's anxiety level, drowsiness, loss of appetite, and nausea.	Low
George et al., (2020) / India	Intervention/ Pre-test-post-test experimental design	To evaluate the effect of aerobic exercise in reducing stress and anxiety. Experimental group and control group of 15 students each, aged 14-19 years	Experimental group received an exercise programme including 10 minutes of warm up and cool down exercise and 20 minutes of aerobic dance programme. Music therapy was given for 15 minutes. Control group was given only music therapy programme for 30 minutes.	- Both groups showed reductions in stress and anxiety. While comparing between the groups in case of stress and anxiety there was significant reduction in stress only. - Both aerobic exercise and music therapy are effective in reducing stress and anxiety	Moderate

Note: PA = Physical Activity; PE = Physical Education; GSHS = Global School-Based Student Health; AISD = Anxiety-Induced Sleep Disturbance; PMS = Premenstrual syndrome; PAQ-A = Physical Activity Questionnaire for Adolescents; Z-SAS = Zung Self-Rating Anxiety Score Questionnaire; LPA = Latent Profile Analysis; MHT = Mental Health Test; YRBSS = Youth Risk Behavior Surveillance System; RS-14 = Resilience Scale; CSAI-2R = Competitive State Anxiety Inventory-2R; SAS-2 = Sport Anxiety Scale-2; ISCCS = Inventaire des Stratégies de Coping en Compétition Sportive [Coping Inventory for Competitive Sport]; SCQ = Sport Commitment Questionnaire; CFA = Confirmatory Factorial Analysis; SEM = Structural Equation Modeling; KIDMED = Mediterranean Diet Quality Index; IPAQ = International Physical Activity Questionnaire; SPAS = Social Physique Anxiety Inventory; BMI = Body Mass Index; CTAS = Child Test Anxiety Scale; BREQ-2 = Behavioral Regulation in Exercise Questionnaire; PASAS = Physical

Activity and Sport Anxiety Scale; PACES = Physical Activity Enjoyment Scale-Short Version; RCMAS = Revised Children's Manifest Anxiety Scale; CPAQ = Children's Physical Activity Questionnaire; SAAS = Social Appearance Anxiety Scale; LTEQ = Leisure Time Exercise Questionnaire; CAS = Coronavirus Anxiety Scale; EAS = Exercise Addiction Scale;

Discussion

Anxiety disorders, including panic attack disorder with or without agoraphobia, generalized anxiety disorder, social anxiety disorder, specific phobias, and separation anxiety disorder, are the most prevalent mental disorders. They are associated with significant distress and impairment, significant health care costs, and a high burden of disease. According to population-based surveys, up to 33.7% of the population are affected by an anxiety disorders during their lifetime (e.g., Bandelow & Michaelis, 2015).

The identified studies were still somewhat heterogeneous, often examining anxiety in connection with other health concerns, such as premenstrual syndrome (Armini et al. 2022), sleep disturbance (Wreck et al. 2020), and appearance anxiety, as a subclinical indicator of body dysmorphic disorder (Aktağ & Çelebi, 2018). The quality of the publications, as a whole, was relatively low, with the precedent of some articles somewhat questionable (e.g., Aktağ & Çelebi 2018; George et al., 2021; Klizienė et al., 2018). Only one paper directly researched the relationship between physical activity and anxiety (as well as screen-related sedentary behaviours; Wen et al., 2022). Physical activity was measured based on the days young people spent 60 minutes or more daily during the last week. The result was somewhat ambiguous, with statistical significance reporting among different subgroup of physical activity when the χ^2 statistic method was used, but no significance emerging following multivariate logistic regression. Perhaps shared variance between self-reports of sedentariness and physical activity might explain this finding, which was found to be the case in a Canadian study with adolescents' screen time anxiety (Kim et al., 2020). It certainly stands in contrast with earlier studies, which have indicated a negative association between physical activity and anxiety (McMahon et al., 2017; Stubbs et al., 2017).

Two papers reported relatively simple quasi-experimental studies in which some form of physical intervention was tested against a control (George et al., 2021; Klizienė et al., 2018). One study based in India (George et al., 2021) examined the effectiveness of aerobic exercise in reducing stress and anxiety among high school students who attended a boarding (residential) school. The intervention group was given what was described as “aerobic exercise (dance)” (p. 1) (and also music therapy); the control group was given music therapy (listening to relaxing music). After 3 days per week for 4 weeks, stress and anxiety levels among the students in the

intervention reduced significantly compared with the control group. The authors of this study conclude that their results show the effectiveness of aerobic exercise in reducing stress and anxiety. This conclusion can be questioned on at least one issue. It is claimed that “The aerobic exercise included basic muscle stretching, walking, jogging and aerobic dance moves like hip roll, squatting, calf raises, side knee crunches, kickbacks, overhead reaches, body twists, bicycle crunches etc.”. However, most of these exercises are not aerobic. In addition, it is not clear how most of them counter as “dance” either. Therefore, the authors’ description of their intervention seems inaccurate. A more accurate label is ‘a variety of exercises’. A more robust study came from Lithuania (Klizienė et al., 2018). It involved eight months of exercises (dynamic exercise, intense motor skill repetition, differentiation, physical activity in the classroom) with elementary-aged students. Physical activity was measured using validated questionnaires. Findings show that the students in the intervention group experienced statistically significant changes in the dependent variables: increased physical activity and decreased anxiety. Insofar as these studies add to a surprisingly limited evidence base for the effects of physical activity interventions to combat childhood and adolescent anxiety, they have some value. However, their methodological and quality limitations highlight the need for further research.

Appearance anxiety is a potentially relevant topic for researchers of physical activity. On the one hand, exercise is frequently proposed as a method of enhancing physical appearance (Corazza et al., 2019); on the other, appearance norms can exclude those young people who fall outside of socially acceptable standards (Scotto di Luzio et al., 2023). A study in Turkey (Aktağ & Çelebi, 2018) examined this phenomenon, finding that the gender of students was not a significant variable, which is somewhat surprising in light of earlier research findings (Alemdağ & Erman, 2015). However, differences between females and males did emerge when physical activity levels were considered, especially membership in sports clubs. Those students associated with sports clubs had both higher levels of physical activity and lower social appearance anxiety than those who were not. That the participants in this study attended a physical education college is, perhaps, not irrelevant. A second study from Turkey (Muftuoglu & Bayram 2020) explored relationships between physical activity and social physique anxiety (as well as nutritional behaviour). Social physique anxiety (the anxiety experienced when a person believes they are being observed or judged on their appearance) is related to appearance anxiety (Aktağ & Çelebi 2018) as they both refer to concerns about physical appearance and other body characteristics

which are central to adolescents' sense of self-worth. Consistent with earlier studies (e.g., Deshmukh-Taskar et al., 2010), a negative correlation between physical activity and social physique anxiety was reported.

Another anxiety-related condition included in the sample of publications discussed physical activity and anxiety-induced sleep disturbance (Werneck et al., 2020). This study drew on a substantial sample of more than 100,000 11-18 year olds) and found that physical activity was associated with reduced anxiety among adolescents. Interestingly, the reported effects seemed to be context-dependent. There was a negative correlation between physical activity and anxiety when that activity took place during physical education lessons or physical activity practice outside school. However, there was a positive association between physical activity and anxiety during physically active transport. It might be the case that the levels of physical activity intensity are lower during active travel than in team sports (Bailey et al., 2023). However, it is difficult to generalize such claims. The authors argue persuasively that a plausible explanation for these differences is that physical education lessons and out-of-school activities are more likely to take place in social groups than transport, and socially situated sporting activities are a protective factor for mental health indicators (Doré et al., 2020; Rastogi et al., 2023). A corollary of social activities is the association with social connectedness, competence, and autonomy, which are indicative of intrinsic motivation and associated with mental health (Stanley & Schutte 2023). Social connectedness and support are often characteristic of sporting activities (Bailey 2018) and can act as buffers against the stresses and strains of adolescent lives (Singh et al., 2020).

The buffering function of social connectedness and support that is often characteristic of sporting activities is one of the most widely endorsed hypotheses for explaining why much of the empirical literature corroborates the claim that physical activity supports mental health (Arat & Wong 2017; Bang et al., 2020; Biddle et al., 2019). An alternative hypothesis is that physical activity develops psychological competencies that support mental health. One study in our collection tested this hypothesis, focusing on resilience (González-Hernández et al., 2020). The results showed that anxiety was negatively related to resilience, and participation in sports was positively related to resilience and negatively to anxiety. There were statistically significant differences by gender, with girls reporting higher levels of somatic anxiety (physiological

activation that a person perceives when faced with a stressful situation) and boys showing higher levels of acceptance.

Conclusion

Physical activity is associated with reduced anxiety symptoms among adolescents (although the precise mechanisms remain unclear (Werneck et al., 2020)). Extrapolating from studies with adults, we might hypothesize that this pattern might be related to the regulation of the circadian cycle, especially through the regulation of melatonin release (Dolezal et al., 2017; Santos et al., 2023). However, a more plausible (but not mutually exclusive) explanation comes from findings suggesting that associations between physical activity and mental health are context-dependent and highlight social and contextual potential mechanisms (Doré et al., 2020). In other words, and with a due sense of caution that reflects the small number and relatively low quality of the identified studies in this review, our findings highlight the value of the distinctively social character of most sporting and physical activities. We do not rule out other mechanisms. However, based on the available evidence, it seems reasonable to emphasize the social dimension of sport in any programme aspiring to support young people's mental health.

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Sport and Mental Health:

SUICIDE

2023

Physical Activity Interventions for Adolescent Suicide Ideation and Behaviour: a Rapid Review

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Abstract

Background: Low levels of physical activity, sedentary behaviour and mental health problems are issues that have received considerable attention in the last decade. The aim of this rapid review was to investigate relationships between physical activity, sedentary behaviour, and suicide ideation or/and behaviours during adolescent.

Methods: English-language scientific articles published between January 2018 to March 2023 were included in the search if they related to physical activity / sport and mental health for adolescents (defined as ages 10 to 19). Selection followed standard systematic reviewing protocols, with analysis adapted for the rapid reviewing approach.

Results: Adolescents with low levels of physical activity or high sedentariness are more likely to consider suicide than their peers. Moderate-to-vigorous physical activity was not associated with self-harm or mental health issues. The mental benefits of physical activity and especially socially orientated sports are evident, but certain details remain unknown.

Conclusion: Physical activity and sport are affordable, effective, and generally popular ways of buffering adolescents against the risk of suicidal ideation and behaviours. Given the very severity of suicide for young people, they deserve a place in mental health promotion and management policies and practices.

Keywords: mental health; sedentary lifestyle; adolescent; suicidal thoughts; physical activity; sport

What works?

- Encourage involvement in team sports, which have demonstrated a link to reduced depression and suicidal ideation, especially among LGBTQ and transgender youth.
- Create an inclusive, socially supportive atmosphere within sports clubs to harness the protective aspects of social connectivity and peer interactions.
- Raise awareness about mental health and the potential benefits of physical activity in preventing suicidal ideation and behaviors.
- Address the specific mental health needs of vulnerable populations, such as LGBTQ and transgender youth, through tailored sports programs.

Introduction

Although the specific causes of suicide are complex and remain somewhat elusive (Glenn, Kieman, Kellerman, et al., 2020; Turecki & Brent 2016), it is clear that suicide has become a serious public health concern globally, with more than 700,000 people ending their lives prematurely each year (WHO, 2021), and country-level estimates suggest that the suicide rate among adolescents has increased in recent years (Roh et al., 2018). While suicidal thoughts are rare during childhood, they increase significantly during adolescence (Wasserman et al., 2021). This period is also associated with escalating suicidal thoughts into behaviours (Glenn et al. 2017). Suicide rates are higher among males than females. Despite the fact that rates tend to increase with age, it is the second most common cause of death for adolescents in Europe (UNICEF, 2021). A recent meta-analysis (Van Meter et al., 2022) found the prevalence of suicidal ideation among 6-21-year-olds to vary by region, from 14.3% to 22.6%, and two stamps ranged from 4.6% to 16.9%. Another meta-analysis of global data found the prevalence of suicidal ideation, planning, and attempts to be 18%, 9.9%, and 6%, respectively (Lim et al., 2019). In light of the inherent difficulty of identifying and recording suicide as the cause of

death, each of those figures likely underestimates the actual severity of the situation (Glenn, Kleiman, Kellerman, et al., 2020).

Adolescent suicide has biological, psychological, and social risk factors (Bilsen, 2018), and there is some evidence that developmental characteristics may strengthen the impact of some factors, such as decision-making style, coping strategies, family and peer relationships, and victimization (Wasserman et al., 2021). However, suicidal behaviours are also modifiable (Walsh, 2023), and several strategies have been examined as potential protective factors (Barzilay & Apter, 2022; Posamentier et al., 2023). In this regard, sport and physical activity (PA) have been proposed as an important social setting for the promotion of mental health, in general, and prevention of suicide, in particular (Schweickle et al., 2023; Swann et al., 2018), following early findings that the prevalence of suicide-related behaviours among youth was lower among active sports participants than non-participants (Hu & Tang 2022; Leseter 2014; Taliaferro et al., 2011). PA has several benefits, including low-cost, widespread dissemination without significant side effects and stigma (Vancampfort et al., 2017). There is robust evidence that PA reduces several risk factors for suicide, including depression (Schuch & Stubbs, 2019), anxiety (McDowell et al., 2019), disturbed sleep (Wang & Boros, 2021), alcohol and other substances abuse (Ashdown-Franks et al., 2020), and symptoms of psychosis (Brokmeier et al., 2020). Participation in team sports has been proposed as a protective factor against plans of suicide and suicide attempts for high school students (Li et al., 2021; Michael et al., 2020; Southerland et al., 2016).

As the risk of suicide varies across the lifespan, this review focuses on adolescents, understood to be between 10 and 19 years of age. It aims to explore cross-sectional and prospective associations between PA and suicide-related behaviours and investigate the effect of PA interventions on this age group.

Methodology

Methodology for Suicide Research. We combined established systematic review techniques with adaptations designed to provide rapid yet insightful findings. This methodological framework was inspired by previous work conducted by Public Health England (Chalkley, Milton & Foster, 2015), particularly in practice-orientated PA reviews. It encompassed a systematic and focused

search, integration, and translation of relevant literature on PA and its impact on adolescent suicide prevention. This balance sought to balance the thoroughness of data collection and the practical relevance of our findings, with a direct focus on actionable outcomes for suicide prevention efforts among adolescents.

Data Gathering. Our data collection process was planned to ensure comprehensive coverage of the topic. We searched in three specialized databases: SPORTdiscus, Psychology & Behavioural Sciences Collection, and Google Scholar. We focussed on peer-reviewed journal articles published within a specific timeframe, from January 2018 to March 2023. To ensure the retrieval of the most pertinent results, we refined our search terms as follows: sport* OR physical activity* AND adolescent* OR youth OR teenage* AND suicide.

Given the anticipated volume of documents, we implemented a stringent process for organizing and reviewing records. Duplicates were identified and removed by our research team. Subsequently, the remaining documents underwent rigorous scrutiny based on the following exclusion criteria:

- a) Documents that were not peer-reviewed journal articles;
- b) Documents not written in English;
- c) Documents not directly related to the intersection of PA / sport and mental health, particularly in the context of suicide prevention;
- d) Documents that did not constitute interventions, trials, evaluations, or ‘what works’ studies;
- e) Documents that did not directly relate to adolescents (defined as ages 10 to 19);
- f) Documents involving adolescents diagnosed with severe mental disorders, which may confound the primary focus of this study;
- g) Documents that primarily pertained to policy discussions or formulation;
- h) Review or conceptual articles that did not provide original research findings;
- i) Documents that only contained formative research with no empirical outcomes;
- j) Documents published before 2018 to ensure relevance to the contemporary context.

Quality Assurance. We employed a dual-pronged approach to ensure the reliability and validity of the research evidence. Firstly, we applied the Active Living by Design (ALBD) Community Action Model, which comprises five key components: Preparation, Promotion, Programme, Policy, and Physical Projects. This framework allowed categorization of studies into

meaningful contexts and identified gaps in the existing research landscape. Secondly, we assessed the quality of each study using a comprehensive rubric, as outlined by Hill et al. (2018). Our assessment encompassed several critical dimensions, including study design, longitudinal considerations, adequacy of cross-sectional comparisons, frequency of measurements, utilization of objective measures, and the acknowledgment of previous validation and reliability assessments. Quality scores were assigned on a scale of 0 to 8, classifying studies as low (0-2), moderate (3-6), or high (7-8) quality.

We employed Cohen's kappa values for regular cross-checks and consensus-building to ensure inter-rater reliability. Our research methodology strictly adhered to the Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA) statement, ensuring transparency and completeness in reporting.

Results

Seven articles were selected from the extensive review of studies that examined the association between PA and suicidal ideation among adolescents that provide intriguing conclusions (see Figure 1). Notably, researchers discovered a link between high levels of sedentary behaviour and an elevated risk of suicidal thoughts and behaviours (see Table 1). Inadequate PA also revealed a strong positive link with suicidal planning and attempts among males, highlighting the significance of regular PA for adolescents' mental health. In addition, studies have shown that a relationship exists between PA and various risk variables, such as gender, bullying, and substance use, in the process of moulding the vulnerability of adolescents to suicidal ideation. The studies all pointed to an antidepressant and antianxiety effect that is reversed when one engages in physical exercise, and this was found to be especially true for young men. Furthermore, having a healthy mental state was found to be a key protective factor against the outcomes of suicide attempts, and a positive association was found between engaging in PA and one's level of subjective well-being. Overall, these findings highlight the multidimensional nature of the association between PA and adolescent mental health. As a result, they urge tailored treatments and policies that promote regular PA as an essential component of efforts to prevent suicide.

Identification of studies via databases and registers

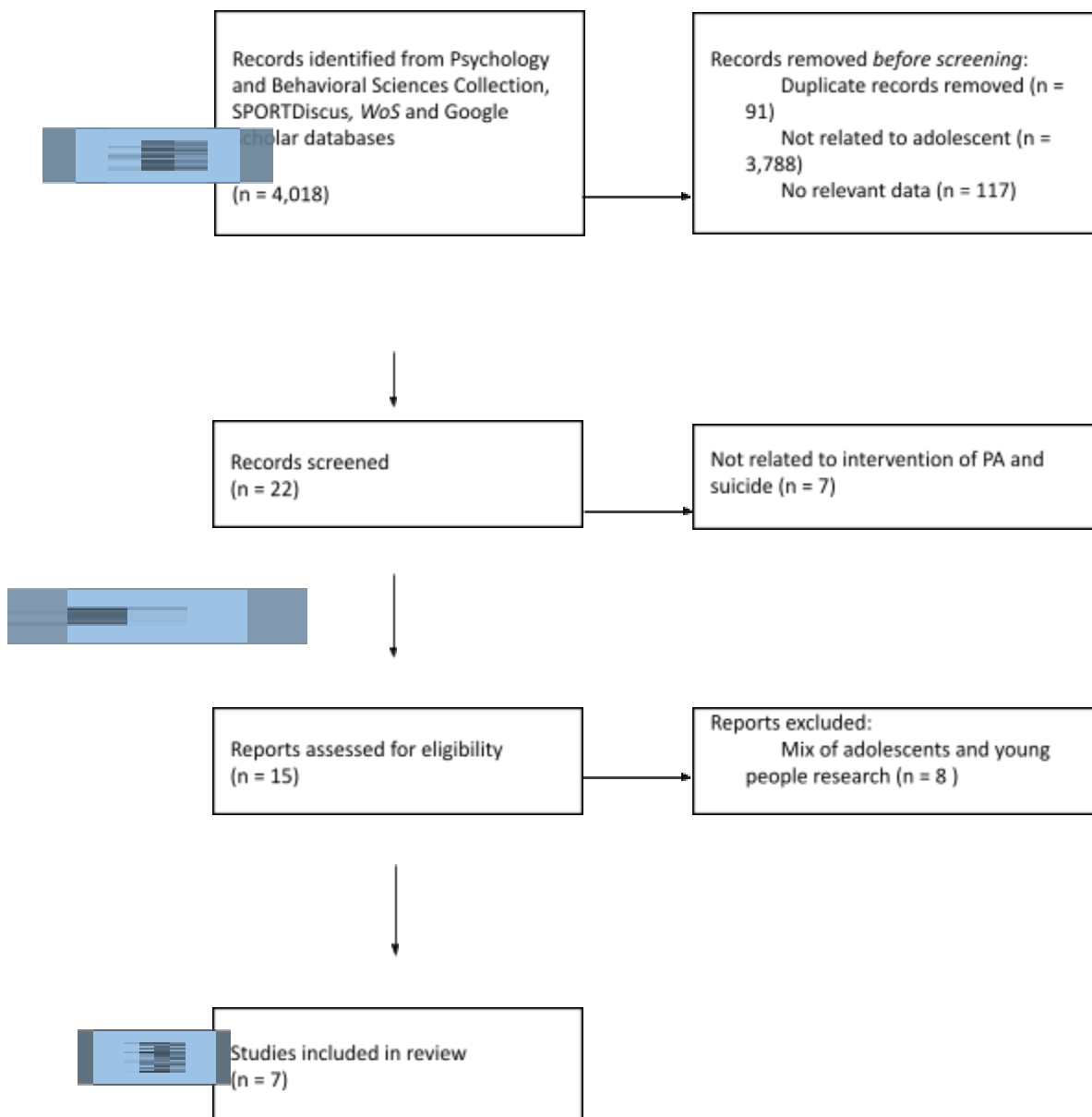


Figure 1. Selected studies in the review

Table 1. Summary of selected studies

Source / Country	Type of Study/Design	Objective / Sample	Methods / Measures	Key Findings	Rating Score
Uddin, Burton, Maple, et al. (2019) / Australia	Survey / Cross-sectional study	To analyse the relationships of PA and SB with suicidal thoughts and behaviour among adolescents in LMICs. 206,357 students aged 13-17 years who had participated in the GSHS Survey 2003 – 2015.	Suicidal ideation, planning, and attempts were measured by corresponding questions. Overall PA and leisure-time sedentary behaviour for the past 7 days were assessed.	<ul style="list-style-type: none"> - High SB was associated with suicidal vulnerability. - Insufficient PA was positively associated with suicide planning and attempts among boys but not girls. 	High
Baiden, Tadeo, Tonui et al (2019) / USA	Survey / Cross-sectional study	To analyse the association between insufficient sleep and suicidal ideation Data for this study came from the 2017 Youth Risk Behaviour Surveillance System. 13,659 students aged 14–18 years (51.8% female)	Suicidal ideation was assessed by response to the question, “During the past 12 months, did you ever seriously consider attempting suicide?” Insufficient sleep was measured by one item: “On an average school night, how many hours of sleep do you get?” Other potential risk factors for suicidal ideation, such as traditional and cyberbullying victimization, feeling sad or hopeless, overweight, cigarette smoking,	<ul style="list-style-type: none"> - 17.6% of the participants had experienced suicidal ideation during the past 12 months, and 75.2% had insufficient sleep on an average school night. - Suicidal ideation was 1.35 times higher for adolescents with insufficient sleep than those with sufficient sleep on a normal school night. - Female gender, sexual minority, traditional bullying and cyberbullying 	High

			alcohol use, marijuana use, and illicit drug use were also registered.	victimization, feeling sad or hopeless, being slightly or very overweight, and substance use was also associated with suicidal ideation.	
			PA was considered a protective factor that could reduce the likelihood of experiencing suicidal ideation.	- PA was inversely associated with suicidal ideation.	
Liu, Zhang, Kamper-DeMarco et al. (2020) / China	Survey	To examine the associations between MVPA, psychological problems, and self-harm behaviours. 13,349 students aged 11-18 years (Stratified cluster sampling)	Sociodemographic information, including age, gender, grade, BMI, and SES, were collected. The YRBS scale evaluated students' frequency of MVPA (days/week) psychological symptoms and self-harm behaviours. Depressive symptoms were examined by CES-D scale. Anxiety symptoms were measured using the MASC scale. GEBS problems, ADHD symptoms, ODD, and conduct problems were assessed with YSR.	- A high frequency of MVPA was associated with a lower risk of depression and anxiety for boys. The moderate frequency of MVPA was associated with a lower risk of ADHD. - For girls, both MVPA (high frequency and moderate) groups were associated with a lower risk of depression. High MVPA was associated with a lower risk of ADHD. Only a moderate frequency of MVPA was associated with a lower risk of ODD.	High
Michael, Lowry, Merlo et al. (2019) / USA	Survey / Cross-sectional study	To study associations between PA, sedentary, and healthy dietary behaviours and indicators of mental	Sex-stratified logistic regression was used to separately model each mental health-related outcome on the health-related behaviours.	- Significant associations were found between insufficient PA, sedentary and less healthy dietary behaviours, and mental health-related outcomes.	High

		health, suicidal thoughts, and suicidal attempts. Representative sample of 14,765 students aged 15-18 years (YRBS)	Measures of PA included daily PA, muscle-strengthening activity, physical education, and sports team participation. Dietary behaviours included breakfast intake, fruit intake, vegetable intake, intake of soda, sports drinks, and water consumption.	<ul style="list-style-type: none"> - Concerning insufficient PA, feeling sad and hopeless was associated with not meeting the aerobic PA guideline (male only) and not playing on at least one sports team. - Suicidal thoughts were associated with not meeting the aerobic PA guideline. 	
Brailovskaia, Teismann, & Margraf (2020) / Germany	Survey / Longitudinal study	To investigate PA and PMH as potential factors for reducing the risk of suicide ideation and suicidal behaviour. 223 students ($M_{age} = 22.85$ years)	<p>“How frequently do you engage in physical exercise (e.g., swimming, cycling, jogging?” assessed the frequency of PA.</p> <p>The PMH scale measured subjective and psychological aspects of well-being.</p> <p>The item “Have you ever thought about or attempted to kill yourself?” of the SBQ-R assessed lifetime suicide-related outcomes.</p>	<ul style="list-style-type: none"> - Suicide-related outcomes were significantly negatively correlated with PA and with PMH. - PA (at baseline) was significantly positively correlated with PMH. 	High
Pfledderer, Bruns, & Bruseau (2019) / USA	Survey / multi-stage cluster sampling	To examine the associations among PA, sleep, and factors relating to the school environment with adolescents’ self-reported rates of suicidal ideation.	YRBS questionnaires were self-administered to assess weapons carried to school, absence from school due to feeling unsafe, bullying, and being offered illegal drugs at school, PA, and sleep.	<ul style="list-style-type: none"> - Meeting PA guidelines every day of the week, hours of sleep, and factors relating to the school environment, including bringing weapons to school, perceived school safety, and being bullied and buying illegal drugs, all significantly independently predicted suicidal ideation. 	High

10,125 students aged 12-18 years (2017 YRBS survey)

LaRocca, James, Rosenberg et al. (2022) / USA	Survey / two-stage stratified clustered sampling design	To examine the relationship between team sports participation, depression, and suicidal ideation among a representative sample of adolescents aged 15-18 years (n = 46,537) in the Healthy Kids Colorado Survey.	Students were asked about team sports participation, depression, suicidal ideation, sexual orientation, and gender identity with items from the YRBS.	- Team sports participation was associated with a reduced likelihood of depression in all groups and reduced likelihood of suicidal ideation in all groups except for LGBQ youth.	High
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Table 2: Characteristics and quality assessment of eligible studies

Note: PA = Physical Activity; LMICs = Low- and Middle-Income Countries; GSHS = Global School-based Health Survey; SB = Sedentary Behaviour; BMI = Body Mass Index; GAD-2 = Generalized Anxiety Disorder Scale; PHQ-2 = Patient Health Questionnaire; PSQI = Pittsburgh Sleep Quality Index; MVPA = Moderate-to-Vigorous Physical Activity; SES = Socioeconomic Status; YRBS = Youth Risk Behavior Survey; CES-D = Center for Epidemiologic Studies-Depression Scale; CES-DC = Center for Epidemiological Studies-Depression Scale for Children; MASC = Multidimensional Anxiety Scale for Children; ADHD = Attention Deficit Hyperactivity Disorder; GEBS = General Emotion, Behavior, and Social; ODD = Oppositional Defiant Disorder; YSR = Youth Self-Report; CMHS = Complete Mental Health Status; DFS = Diener's Flourishing Scale; CESD-R-10 = Center for Epidemiologic Studies Depression Scale Revised; SMI = Severe Mental Illness; MHC-SF = Mental Health Continuum-Short Form; PMH = Positive Mental Health; SBQ-R = Suicidal Behaviors Questionnaire-Revised

Discussion

Seven studies were identified through the screening and selection process focusing on the relationships between PA and suicidal ideation or behaviours (Baiden, Tadeo, Tonui, et al., 2020; Brailovskaia, Teismann & Margraf, 2022; Liu, Zhang, Kamper-DeMarco et al., 2020; Michael, Lowry, Merlo et al., 2020; Pfladderer, Burns & Brusseau, 2019; Uddin, Burton, Maple et al., 2020). One study examines sports participation and suicidal ideation among sexual minority youth (LaRocca, James, Rosenberg et al., 2023). All data were drawn from quantitative sources (see Table 1). The countries of first authors were as follows: United States (x5), Australia, and Germany. Sample sizes ranged from 223 to 206,357.

Two themes run through the findings of this review: the value of PA and the danger of sedentary behaviours. It is important to recognize that PA and sedentary behaviours are not opposites (Thivel, Tremblay, Genin et al., 2018). The former label typically refers to any waking behaviour with an energy expenditure of 1.5 metabolic equivalent task (MET) or less. Examples of sedentary behaviour are sitting or lying down (Park, Moon, Kim et al., 2020). Physical inactivity indicates the failure to achieve a formal target of PA. For example, the World Health Organisation (2020) guidance calls for an average of 60 minutes of moderate-to-vigorous-physical-activity (MVPA) per day for children and adolescents (defined as any activity with a MET value between 3 and 5.9; vigorous-intensity PA is defined as ≥ 6 METs; Farooq, Martin, Jansset et al., 2020). Individuals are considered active when they reach PA recommendations for their age. Yet, it can also be the case that adolescents who achieve PA targets can still be vulnerable to the risks associated with sedentary behaviours.

Only two studies reported PA and sedentary behaviour (Michael, Lowry, Merlo et al., 2020; Uddin, Burton, Maple et al., 2020). A large-scale study focused on sedentary behaviour among adolescents from 52 low and middle-income countries (Uddin, Burton, Maple et al., 2020). Spending more than three hours per day in leisure time, sedentary behaviours were associated with a 45% likelihood of reporting suicidal ideation and 29% greater in planning and attempting suicide compared to adolescents who reported spending less than three hours per day of sedentary behaviour during the past 12 months. The authors suggested that young men deal with suicidal behaviours differently from young women: the former are more impulsive in times of crisis and are triggered by difficulties in coping with temporal stress with unprecedented

suicidal behaviours; the latter generally contemplate the different stages of suicidal behaviour. This may explain why the present study found no association between suicidal planning and attempts with sedentary behaviour in males.

Table 2. Reporting impact summary

Authors (year)	Physical Activity (instrument)	Sedentary behaviour	Impact on suicide ideation/behaviours
Uddin, Burton, Maple et al. (2019)	Global School-based Student Health Survey.	Yes	<p>High leisure-time SB significantly increases the risk of suicidal thoughts and behaviours among adolescents in LMICs.</p> <p>Inadequate PA has a stronger impact on suicide planning and attempts in males.</p> <p>The combined effect of low PA and high SB amplifies the risk of suicidal ideation, planning, and attempts.</p> <p>Active lifestyle promotion should be a key component of suicide prevention efforts in resource-poor settings.</p>
Baiden, Tadeo, Tonui et al. (2019)	PA was assessed asking respondents how many days they were physically active for at least 60 minutes in the past week.	Yes	<p>Insufficient sleep was associated with an increased risk of suicidal ideation, while PA was associated with a reduced risk of suicidal ideation among adolescents in the study.</p>
Liu, Zhang, Kamper-DeMarco et al. (2020)	Moderate-to-vigorous physical activity (MVPA).	No	<p>No significant association was identified between MVPA and self-harm or psychological issues in either gender.</p>
Michael, Lowry, Merlo et al. (2019)	Four measures of PA: daily PA, muscle-strengthening activity, physical education, and sports team participation.	No	<p>SB like skipping breakfast, drinking sugary drinks, and watching too much TV were linked to adolescents' suicidal thoughts and attempts. Suicidal thoughts were associated with inadequate aerobic activity.</p>

Brailovskaia, Teismann, & Margraf (2020)	5-Likert scale, with higher scores indicating more frequent PA.	No	The greater positive mental health mediated the suicide-prevention benefits of PA.
Pfledderer, Bruns, & Brusseau (2019)	Q79 on the Youth Risk Behaviour Survey Procedures (YRBS) questionnaires.	No	PA and the school environment reduce adolescent suicidal ideation, but sleep duration increases it (though more research is needed).
LaRocca, James, Rosenberg et al. (2022)	Team sports participation from YRBS questionnaires.	No	The study indicated that team sports engagement reduced depression and suicidal ideation in all groups except LGBTQ adolescents.

The finding that low levels of PA were associated with an increased risk of suicidal behaviour among male adolescents is consistent with the other studies in this review as well as earlier research (Pascoe, Bailey, Craike et al. 2020; Rodriguez-Ayllon, Cadenas-Sánchez, Estévez-López et al., 2019). However, in the study by LaRocca, James, Rosenberg, and colleagues (2023), PA was not strongly associated with suicidal ideation and behaviours for girls. The authors argue - persuasively, we think - that this reflects previous studies (see Vancampfort, Hallgren, Firth et al., 2018) that highlight the relative importance of the type of PA participation, rather than PA, per se, in terms of mental health vulnerability. The social connectivity of sports participation has become a recurring theme in recent mental health literature (e.g., Bang, Won, & Park, 2020; Bohr, Boardman, & McQueen, 2019; Kleppang et al., 2018). This highlights a weakness in a German study (Brailovskaia, Teismann & Margraf, 2022), which reported a significant positive relationship between higher PA and higher positive general mental health and a significant negative association between higher PA and lower suicide-related outcomes. Unfortunately, the research team did not include a detailed PA assessment, so it is impossible to learn whether sports or other types of PA were linked to a differential association with suicide-related outcomes. Another article in this review (Michael, Lowry, Merlo et al., 2020) did not find a significant association between sports participation and suicidal behaviours. However, a significant association showed that not playing in a sports team increased the risk of feeling sad and hopeless, and this applied to both young men and women. So, these two studies corroborate the hypothesis that the social character of team sports offers a protective buffer against mental illness, in general, and suicidal ideation and behaviour, in particular.

Also relevant is an article focused on the relationship between PA and mental health and suicidal ideation among lesbian, gay, bisexual, transgender, and questioning (LGBTQ) youth (LaRocca, James, Rosenberg et al., 2023). This heterogeneous group deserves special attention as its members experience significantly higher levels of depression and suicidal thoughts than heterosexual youth (Hatchel, Polanin & Espelage, 2021; Marshall, 2016). Data from the United States indicate most LGBTQ adolescents felt persistently sad or hopeless during the past year compared with 32% of heterosexual youth. These students are more than 300% more likely to have made suicide plans than heterosexual peers (Centers for Disease Control and Prevention, 2019). Transgender youth report considerably higher numbers of suicide attempts compared to adolescents as a population (Toomey, Syvertsen, & Shramko, 2018). Researchers examined

depression and suicidal ideation among a large, state-representative sample (nearly 50,000) of adolescents in a US survey. Using logical regression modelling, they found a statistically significant association between team sports participation and reduced likelihood of depression and suicidal ideation among all groups. For LGBTQ students, team sports participation at any level was associated with a reduced chance of depression but did not affect the likelihood of suicidal ideation. For transgender students, in contrast, participation in three or more team sports was associated with reduced likelihood of depression, and participation in two or three or more team sports was associated with reduced likelihood of suicidal ideation. It is unclear why LGBTQ did not benefit from sports participation to the same extent. Perhaps it is linked to the increased risk of bullying for homosexual young people in some sports settings (Baiocco, Pistella, Salvati et al., 2018). Nevertheless, since LGBTQ express disproportionate levels of depression and suicidal ideation, the findings from this large-scale survey reinforce the potential mental health benefits of offering appropriately planned and delivered team sports opportunities to sexual minority students.

Limitations

There are several limitations to this review which should be acknowledged. First, a relatively small sample of studies examined the relationship between PA and suicidal ideation and behaviours. It is unclear why this should be the case and what we could have done differently. However, it should be acknowledged that the paucity of evidence should indicate a degree of caution in practical implications drawn from the findings. Second, the findings were based mainly on cross-sectional studies. Cause and effect could not be determined, and there remains a need for more longitudinal and interventional research.

Conclusion

Cognisant of the limitations recorded above, the evidence gathered in this review unambiguously demonstrates that participation in PA is associated with reduced incidents of suicidal ideation and behaviour. The evidence base related explicitly to sports is not strong, but the potential potency of participation in socially orientated sports seems plausible. Since it

carries almost no harmful side effects and is affordable to every young person, these findings suggest that PA provision deserves its place in preventing and managing suicidal thoughts and actions.

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