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Effects of physical activity on behaviour and emotional problems, mental health, and psychosocial well-being in children and adolescents with intellectual disability: A systematic review.

Ross L. Borland¹, Lauren A. Cameron¹, Bruce J. Tonge¹,², Kylie M. Gray²,¹*

¹ Centre for Developmental Psychiatry and Psychology, Department of Psychiatry, School of Clinical Sciences at Monash Health, Monash University
² Centre for Educational Development, Appraisal and Research, University of Warwick, UK

Corresponding author: Professor Kylie Gray, K.Gray.1@warwick.ac.uk

Mailing address: CEDAR, New Education Building, University of Warwick, Coventry, CV4 7AL, United Kingdom

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Abstract

Background. This systematic review aimed to explore the effects of sport and physical activity on behaviour and emotional problems, mental health, and psychosocial well-being of children and adolescents with intellectual disability.

Method. Five databases were searched systematically (ERIC, MEDLINE, PsycINFO, SportDISCUS, and SCOPUS), up to 28 February 2021. Thirty-two studies met criteria for inclusion.

Results. Studies in this review included case studies (n=15), treatment trials (n=14), cross sectional studies (n=2), and a cohort study (n=1). Evidence was positive, though high risk of bias in treatment trials (7 of 14 rated high) meant generalisability of results was limited.

Conclusions. The available evidence suggests a positive relationship between physical activity and improved behaviour and emotional problems, mental health, and psychosocial well-being; however, more robust randomised controlled trials are required to confirm this.

Keywords: sport, intellectual disability, physical activity, behaviour problems, mental health
1. Introduction

Many health problems present at higher rates in individuals with intellectual disability than in the typically developing population (Allerton et al., 2011; Van Schrojenstein Lantman-de Valk et al., 1997). While some are associated with specific syndromes, for example congenital heart defects in individuals with Down syndrome (Barr & Shields, 2011; Freeman et al., 1998), others occur at higher rates generally for individuals with intellectual disability (e.g. asthma, epilepsy, ADHD, etc.; (Barr & Shields, 2011; Dekker et al., 2002)). Problems with behaviour, mental health, and psychosocial well-being are also seen at increased rates (Cooper et al., 2007; Einfeld et al., 2006; Einfeld & Tonge, 1996a, 1996b). The effect physical activity has on fitness and physical health of children and adolescents with intellectual disability has been well documented (Chanias et al., 1998; Golubović et al., 2012; Pitchford et al., 2018; Stanish & Temple, 2012), however the effect it can have on behaviour and emotional problems, mental health, and psychosocial well-being has been largely overlooked by research (Matson et al., 2012; Pitchford et al., 2018).

Physical activity is associated with health benefits in typically developing children and adolescents (Janssen & Leblanc, 2010; Wiles et al., 2008). In typically developing populations a number of studies have also demonstrated positive effects of physical activity on behaviour and emotional problems (Ash et al., 2017), as well as mental health (Biddle & Asare, 2011; Eime et al., 2013; Fedewa & Ahn, 2011; Parfitt et al., 2009; Penedo & Dahn, 2005). Reductions in anxiety and depression, along with improved memory, self-concept, and academic performance have all been demonstrated through engagement with physical activity (Ahn & Fedewa, 2011; Fedewa & Ahn, 2011).

Minimum recommended levels of physical activity for health benefits are well established (World Health Organisation, 2002, 2003). These guidelines suggest a minimum of 60 minutes of moderate to vigorous physical activity for children every day, however many fail
to reach this benchmark. A cohort study in the UK (Griffiths et al., 2013) estimated that only 51% of children were meeting these minimum guidelines, while lower rates of participation have been reported in Canada (7%: (Colley et al., 2013; Colley et al., 2011) and Australia (20%: (Kremer et al., 2014).

For populations with disabilities, including intellectual disability, participation in physical activity is reported at lower rates when compared to their typically developing peers (Australian Bureau of Statistics, 2010, 2012; Frey et al., 2008; Hinckson & Curtis, 2013). There is also evidence that physical activity declines and sedentary behaviour increases with age in children with syndromes associated with intellectual disability such as autism spectrum disorder (hereafter referred to as autism) (Jones et al., 2017). This trend continues through adolescence into adulthood, with studies showing adults with intellectual disability participate in less physical activity than the general population (Borland et al., 2020; Temple, 2009; Temple & Walkley, 2003). Previous studies point to a number of barriers to participation such as lack of access to facilities, lack of information on appropriate activities, the specific nature of the disability, or lack of community support (Shields et al., 2012), as well as reduced capacity to complete physical activity to the same extent as their typically developing peers (Boonman et al., 2019).

The majority of research on benefits of physical activity for individuals with intellectual disability has focused on the physical health benefit (physical fitness and body composition) with information lacking on the benefits to behaviour and emotional problems, mental health, and psychosocial well-being (Pitchford et al, 2018). Past studies have also concentrated on specific syndromes (e.g. Down syndrome) or conditions that often co-occur with intellectual disability (e.g. autism, ADHD) (Dykens et al., 1998), however these studies often fail to report on degree of intellectual disability, or intellectual disability is not reported in the cohort studied. This is an important factor to consider, as degree of intellectual disability can
impact participation in physical activity (Wouters et al., 2019). Both adults and children with
a severe degree of intellectual disability participate at lower rates, often due to reduced
physical capacity, behavioural problems, or lack of appropriate programs (Barr & Shields,
2011; Borland et al., 2020; Hilgenkamp et al., 2012; McGarty & Melville, 2018; Shields et
al., 2012; Wouters et al., 2019).

The need for systematic reviews to evaluate the quality of evidence about specific outcomes
of physical activity in individuals with intellectual disability has been identified (Pitchford et
al. (2018). Previous systematic reviews have examined a variety of outcomes of physical
activity participation for children, from barriers to participation for children with intellectual
disability (McGarty et al., 2018) to behavioural outcomes for children with autism (Bremer et
al., 2016; Sowa & Meulenbroek, 2012). There has been no focus on the potential benefits of
physical activity on behaviour and emotional problems within populations of children and
adolescents with intellectual disabilities. This review aims to understand whether physical
activity has a positive effect on behaviour and emotional problems, mental health, and
psychosocial well-being in children and adolescents with intellectual disabilities.

2. Method

This study was conducted in accordance with the Preferred Reporting Items for Systematic
Review and Meta-Analysis guidelines (Moher et al., 2009; Rethlefsen et al., 2021).

2.1. Search strategy

A literature search was conducted to identify studies that addressed behaviour and emotional
problems, mental health, and psychosocial well-being outcomes for children and adolescents
with intellectual disability as a result of participation in physical activity. Five databases were
searched (Ovid MEDLINE, PsycINFO, ERIC, SportDISCUS and SCOPUS) from conception
of each database up to February 28th, 2021. A systematic search strategy was developed
based on truncated key terms. The search was limited to English language studies. Reference lists of included studies and relevant identified systematic reviews were also hand searched for relevant studies, however no additional eligible papers were identified.

2.2. Search Terms

Search terms included were based on sport and physical activity, behaviour and emotional problems, mental health, psychosocial well-being, intellectual disability, and children. For intellectual disability, terms relating to autism were included to capture participants with co-occurring intellectual disability. Search terms were combined with ‘and’ between domains, and ‘or’ within domains, with conventions adapted based on each database. The full list of search terms are provided in Table 1.

2.3. Eligibility criteria

To be included in this review, studies had to have: (a) outcomes relating to behaviour and emotional problems, mental health, or psychosocial well-being; (b) include and report separately on, children and/or adolescents (between 2 and 18 years) with intellectual disability; and (c) physical activity was the intervention or moderator of outcomes. Both cross-sectional and experimental studies were included. Studies were excluded if: (a) participants were aged 19 years or older; (b) if there was no diagnosis of intellectual disability; or (c) the intervention was not focused on physical activity.

2.4. Study selection process

Duplicate studies were removed, and all retrieved records were electronically imported into Covidence (www.covidence.org), and online tool for managing systematic reviews. Title and abstract screen were completed by the first author (RLB). Following this, full-text screening was completed by two authors (RLB and LAC). In cases where uncertainty remained, it was
discussed with a third author (KMG). Risk of bias was assessed by three authors (RLB, LAC, KMG), through consensus discussion using pre-developed proformas based on the Cochrane risk of bias tool (Monash Centre for Health Research and Implementation, 2014) and the Newcastle-Ottawa Scale, a widely used tool for assessing the quality of non-randomised studies (Wells et al., 2015). Each study was given a rating of low, moderate, or high risk of bias (see Tables 2, 3 and 4).

After completing the screening process, information on (a) study characteristics (study design, country, year of publication), (b) participant group (age, degree of intellectual disability), (c) type of physical activity (type, frequency, duration), (d) outcome measures (observation method, measurement tool), and (e) results were extracted. Table 2 summarises each case study, Table 3 summaries each cross-sectional and cohort study, and Table 4 summarises each treatment trial.

3. Results

Overall, 3069 references were retrieved. After 844 duplicates were removed, 2225 references remained for title and abstract screening. Two hundred and forty-seven (247) articles were included in the full text review, from which 36 articles met inclusion criteria. Two pairs of articles were based on the same cohort and reported the same outcomes. From the first pair, the thesis (Broadhead, 1969) was included rather than the government report (Rarick & Broadhead, 1968) due to more detail on participants, including detailed information on degree of intellectual disability. Of the second pair the earlier report, Crain et al. (1983), was included rather than Crain et al. (1984) as reporting of participants and outcomes relating to this review were similar.

Two articles were only available as abstracts (Ioannou & Papadopoulou, 2002; Rommel & Anderson, 2013). Online searches were conducted, and contact made with authors in an
attempt to find published literature on these however none was forthcoming, therefore these
were not included in the systematic review.

This left 32 articles for extraction. The full search and selection strategy is presented in
Figure 1.

[Insert Figure 1 about here]

3.1. Risk of Bias

Almost half of studies (46.9%) were assessed as having low risk of bias (15 studies rated low,
7 studies rated moderate, and 10 studies rated high). However, when study design was
considered, the breakdown appeared more skewed. Experimental case design studies were
mostly assessed as having low risk of bias (11 of 15 studies rated low, 78.6%; 3 rated
moderate, 1 rated high). Most other studies were assessed as having high or moderate risk of
bias (9 of 17 studies rated high, 52.9%; 4 studies rated moderate, 4 studies rated low).

Increased risk of bias in studies was due to several factors. Physical activity interventions are
often prone to higher risk of bias due to the difficulty of blinding participants. In some cases,
testing of outcomes was done by the same people running the intervention (nos.20,27), was
unblinded (nos.25,32) or it was unclear who completed measures (nos.22,23). In a number of
studies there was a lack of accurate reporting on who was completing measures
(nos.11,15,19,22,23,29), and many studies did not report the intensity at which physical
activity was being performed
(nos.2,3,4,6,9,10,11,12,13,14,15,16,17,19,20,22,23,24,25,26,27,28,29,30,31,32). Many
studies did not report on degree of intellectual disability (nos.1,11,19,24,25,28,29,31), or any
comorbidities or co-occurring disabilities participants may have
(nos.1,11,12,13,15,16,18,19,22,26,27,28,29,30,31,32) which could have affected
participation or outcomes. Controlled trials were not always randomised
(nos.22,23,24,25,26), and when they were, this process was not always detailed. Two studies only provided descriptive data, and did not undertake any statistical analyses (nos.2,19). Two studies did not clearly report numbers of participants, with contradictory data in text and tables (nos.21,22).

### 3.2. Study and participant characteristics

Studies were published between 1968 and 2019. Twenty-seven studies were published in peer-reviewed journals, while the remaining five were unpublished theses (nos. 7,8,24,27,28). Sixteen studies (50%) were conducted in the United States of America, with the remainder undertaken in China (n=3), Turkey (n=3), Canada (n=2), India (n=2), Italy (n=2), Israel, Czech Republic, Japan, and Kuwait (all n=1) (see Tables 2, 3 & 4).

#### 3.2.1. Physical activities

The included studies reported on a wide variety of sports and physical activities undertaken in different settings as interventions and moderators of outcomes (see Tables 2, 3 and 4). Four studies used in-school physical education classes, eight studied the effects of jogging, and another ten examined different forms of generic aerobic exercise (exercise bike, calisthenics, play activities etc.). Other activities included soccer, basketball, track & field, yoga, judo, swimming, and dancing. One study measured general levels of daily activity using accelerometers. Types of physical activity examined in each study could be broadly categorised into six distinct groups: aerobic exercise (18 studies; e.g. jogging, cycling, yoga, calisthenics), play activities (3 studies; e.g. ball playing), team sports (3 studies; e.g. basketball, soccer), individual sports (4 studies; e.g. swimming, judo, dancing, track and field), varied sport/activities (5 studies; e.g. physical education classes, Special Olympics where not otherwise specified), and daily activity (1 study; overall daily activity measured via accelerometer).
Duration and scope of physical activity varied, with bouts of physical activity as short as 10 minutes in some studies (nos.3,7,8,10,11,14). Other studies included 2-hour sessions of exercise (no.16), or a weekend-long sporting carnival (no.30). The regularity of activity also varied, including lifetime participation (nos.16,17), multiple bouts per week over an extended period (nos.2,15,19,20,21,23,24,26,27,28,29,31,32), or exercise immediately before the observation period (nos.1,3,4,5,6,7,8,9,10,11,12,13,14,25). One study did not report on duration of activity (no.22).

Intensity of physical activity was examined in six studies (18.8%). Accelerometers were used in just two of the 32 (6.3%) studies included in this review (nos.8,18). One (no.18) had participants wear the devices for seven days to track daily activity, while the other (no.8) had participants only wear the devices during the intervention activities. Three studies (nos.5,7,21) measured intensity of activity using heart rate (HR) monitors. One study (no.7) had participants wear a chest-belt and watch receiver to track HR during exercise. Another study (no.5) used the inbuilt HR monitor (hand grips) on the exercise bike participants rode; however, readings were taken only on the first use of the exercise bike. The third study (no.21) ensured activities were completed between 50-75% of maximum HR, assessed using wrist worn sensors; however, the observers wore the monitors rather than the participants. The sixth study measured HR by periodically taking the pulse rate at the child’s radial artery during activity (no.1).

3.2.2. Outcomes

Nineteen different measures were used to assess outcomes across fourteen studies (43.8% of included studies). The only measure used by multiple studies to assess outcomes was the Vineland Social Maturity Scale (VSMS: (Doll, 1947); nos.24,32), while other measures were used in single studies (see Tables 2, 3 and 4 for full list of measures). Observation schedules were used to assess outcomes in the experimental case studies (fifteen studies), as well as in
three treatment trials (nos.19,23,29) (18 of 32 studies overall, 56.3%). These reported on behaviour during activity and/or in a classroom or separate non-activity setting after the activity had been completed. They were completed either by a member of the research team (all studies) or a teacher (nos.19,23). Format of the observation schedule, number of observers, and frequency of observations differed across all studies. Parent report of behaviour at home was used in one study (no.29).

3.2.3. Sample sizes

In total, 995 individuals with intellectual disability were included in the review. Individual studies ranged from one participant to 275 participants. Six studies also included children without intellectual disability (nos.5,6,8,10,14,27). In these cases, only results from the groups or individuals with intellectual disability were examined in this review. Two studies reported different sample sizes in text compared to what was reported in tables and figures (nos.21,22; see Table 4, Note).

3.2.4. Age

The age range across studies was three to 18 years. All controlled trials included reported that there were no significant age differences between the intervention group/s and control group at baseline.

3.2.5. Degree of intellectual disability

Degree of intellectual disability ranged from mild to severe across studies where reported. Fourteen (43.8%) studies reported scores based on IQ or another standardised measure of intellectual functioning (nos.3,5,6,7,8,13,14,15,16,17,22,25,27,30), while nine (28.1%) provided a general report on degree of intellectual disability, identifying the presence of mild, moderate or severe intellectual disability (nos.4,9,10,12,18,20,23,26,32). Two further studies reported on ‘mental age’ or ‘developmental age’, which could be used to provide an estimate
of degree of intellectual disability (nos.2,21). Seven studies (21.9%) did not report degree of intellectual disability. Six of these noted the presence of “mental retardation” or “intellectual disability” in the study sample based on their attendance at a special school for children with intellectual disabilities (nos.1,19,24,28,29) or participation in Special Olympics (no.31). The seventh was an experimental case study where the source of intellectual disability diagnosis was not provided (no.11).

3.2.6. Comorbidities and co-occurring disabilities

Ten studies (31.3%) were interventions for children with autism (nos.2,3,4,5,7,8,10,14,21,25), and one for children with Down syndrome (no.17). One study focused on children with intellectual disability who also had visual impairments (no.20, five blind, two visually impaired). Two additional studies included participants with autism (no.23, 60% with autism; no.9, 1 of 4 participants with autism), and one additional study included a participant with Down syndrome (no.6, 1 of 3 participants). Other co-occurring disabilities included cerebral palsy (no.20, two participants), Fragile X syndrome (no.6, one participant), foetal alcohol syndrome (no.9, one participant), quadriplegia (no.9, one participant), ataxia (no.20, one participant), and microcephaly (no.9, one participant).

Seventeen studies (53.1%) did not report on comorbidities or co-occurring disabilities. Three studies excluded participants with physical disabilities or health problems that would impact their participation in or ability to perform sport and physical activities (nos.21,28,31). Other studies excluded participants who had a co-morbid psychiatric disorder (no.25), complex neurological disorder (nos.21,25,32), or visual and auditory deficits (nos.25,32).

3.3. Study design

3.3.1. Experimental case studies

Nearly half (n=15, 46.9%) of the studies were case studies (see Table 2). All of these were experimental studies that examined the effects of aerobic activities. Sample size ranged from
one to seven participants. Activities were primarily jogging (nos.1,3,4,6,7,13,14,15), but also
included swimming (no.2), cycling (no.5), roller skating (no.11), calisthenics (nos.9,12),
trampoline jumping (no.10), or aerobic activity completed during recess at school (no.8). The
studies relied on observations by researchers or teachers, and examined outcomes including
stereotypic and self-stimulatory behaviours, or on- and off-task behaviours in class. All
studies included multiple baselines (prior to intervention) or repeated baselines (re-set each
day, or before each event).

Duration of activities varied, with some looking at single sessions of activity ranging from six
to twenty minutes, and others examining a program of multiple sessions per week for up to
twelve weeks. Despite this variation, positive outcomes were reported in all studies. One
study noted that the participants with low baseline of inappropriate behaviours saw no change
after intervention while the participants with high baseline did (no.1). Three studies observing
outcomes immediately after exercise noted that improvements were not maintained when
participants were re-observed later in the day (nos.7,9,12).

Eight studies examined children with co-occurring autism and outcomes of behaviour and
emotional problems related to autism symptomatology and stereotypy (nos.2,3,4,5,7,8,10,14).
While these studies all reported an immediate decrease in stereotypy or improved social
interactions after physical activity, one study reported improvements were not maintained
when participants were re-observed later in the day (no.7).

[Insert Table 2 about here]

3.3.2. Cohort & cross-sectional studies

Two cross-sectional studies (nos.17,18) and one cohort study (no.16) met inclusion criteria
(see Table 3). These studies examined daily physical activity (no.18), individual sport (no.17,
swimming as part of Special Olympics), and mixed activities (no.16, participants in Special
Olympics broadly). One study included data on 35 participants with intellectual disability who had not been involved in Special Olympics as a comparison group (no.17). One study examined the effect of total daily physical activity (measured via accelerometer across the course of seven days) on behaviour regulation (shifting emotions, inhibition, and emotional control) and executive functioning (working memory, planning) as assessed using the BRIEF (Gioia et al., 2000) in 104 participants with intellectual disability, aged 7-18 years (no.18). This was one of only two studies to use accelerometers to measure activity, and was therefore able to distinguish between mild, moderate, and vigorous activity. While minimum wear-time requirements were established by the authors, they did not report how many participants met this criteria. The study reported a positive relationship between moderate and vigorous physical activity and higher working memory and planning skills, but no significant relationship with behavioural regulation.

The other two studies examined years enrolled in Special Olympics programs. One (no.17) reported that improved social skills, and improved behaviour problems as measured by the SDQ (Goodman et al., 1998; Muris et al., 2003), were positively associated with participation in Special Olympics swimming in children with Down syndrome (average of 5 hours per week for 8 years), when compared with a group of adolescents with Down syndrome who did not participate in Special Olympics activities (both groups aged 11-17 years). No difference in emotional symptoms such as anxiety were reported between the two groups. The other study (no.16) measured functional ability using the WHODAS 2.0 (World Health Organization, 2000), and reported a positive association between years involved in Special Olympics and higher concentration and learning, better interactions with unknown people, and better maintenance of friendships for 31 adolescents aged 12 to 18. Data was available when they began school (baseline), when they began their sport participation (repeat baseline), and at time of data collection, however it was not clear whether the data from
earlier time points were collected retrospectively or not. The study also did not provide
information on years involved with Special Olympics for the group, how many sessions had
been attended during that period, or which sports participants were involved in. It was not
clear how the data were analysed. The methods indicated that regression analyses were
conducted to determine the effects of active participation and number of years in school on
each outcome variable; however, only t-test results were reported. These were reported for
each outcome variable, but the groups being compared in the analyses were unclear.

[Insert Table 3 about here]

### 3.3.3. Treatment trials

#### 3.3.3.1 Uncontrolled treatment trials

Three uncontrolled treatment trials (nos.19,20,21) examined small groups of individuals
(between seven and 24 participants) receiving an intervention multiple times a week (see
Table 4). One study (no.19) provided dancing instruction to thirteen adolescents aged 13-15
years, three times a week for 30 minutes, over 10 weeks. Social behaviours (e.g. cooperation,
initiating interactions) were assessed during eleven of the thirty dancing sessions though an
observation schedule completed by researchers. Disruptive behaviours (e.g. biting, hitting)
were assessed using a similar observation schedule, though only in the first and last week of
the program. Overall, improvements in social skills and reductions in disruptive behaviours
were reported. Evidence was anecdotal and no statistical analysis was applied. Four groups
were described; those who improved social behaviours (n=5), those who improved
(decreased) disruptive behaviours (n=2), those who improved in both (n=4), and those with
no improvement post treatment (n=2).

The second uncontrolled trial (no.20) examined the effects of a judo training program (two
90-minute sessions per week, for six months) on psychosocial functioning and self-help skills
in seven children aged 6-12 years. One author was an advisor at the school from which children were recruited and delivered the judo training program, a potential source of bias. Psychosocial functioning was measured using a scale designed by staff working with the children and not tested for reliability or validity. Participants had moderate to severe intellectual disability and were blind or visually impaired, with other co-occurring conditions including cerebral palsy and epilepsy. The variety and types of co-occurring disabilities in this group were cited as the reason for no control group. The authors reported significant improvements in psychosocial functioning during the training programme; however, functioning reverted to baseline after the training programme ended. No change was reported in self-help skills.

The third uncontrolled study (no.21) included three different activities for eight weeks; walking (60 minutes, three times per week), jogging/jumping (30 minutes, three times per week), and paper plane building and throwing (30 minutes, two times per week). Twenty-four participants with co-occurring autism were included in the study (age range 11-14 year), with results relating to autism specific outcomes (Autism Treatment Evaluation Checklist; ATEC, (Geier et al., 2013). Rather than assessing the impact of each activity separately, participants were involved in all three activities. Baseline data was only provided for six participants, a non-physical activity intervention (paper plane building) was included, and the intensity of exercise was monitored by taking the HR of the researchers accompanying the participants during the activity rather than the participants themselves, resulting in a high risk of bias rating. Outcomes in terms of speech/communication skills, sociability, cognitive awareness, and stereotypic behaviours were measured before and after walking activities and jogging activities. The study reported significant improvements in communication skills, cognitive awareness, and sociability, but no significant change in stereotypic behaviours.
3.3.3.2 Controlled treatment trials

Eleven studies reported on the results of controlled trials (see Table 4). Six of the eleven studies were randomised controlled trials (54.5%; nos.27,28,29,30,31,32). Only two of these detailed the randomisation process (nos.27,31). One study used a cross-over design, with participants acting as their own controls (no.25). Ten of the eleven studies (90.1%) included a non-physical activity control group. Five of these included a control group with no alternate activity (nos.22,23,26,30,31), and five included a control group participating in a non-physical activity (nos.25,32) or regular classroom activities (nos.24,27,28). The control group in the other study allowed children to play with balls for the same period as the intervention, though no instruction or interaction was provided (no.29). Three studies also included comparison groups of an alternate sport activity (nos.22,24,27), as well as the non-physical activity control group.

Three studies looked at team sport activities (nos.22,29,31). One of these studies examined the impact of participation in basketball on behaviour problems at home and in the classroom, (no.29). Results of the preassessment showed that the treatment group had lower rates of problem behaviours at baseline at home compared to the control group. The treatment group had significantly decreased problem behaviours at home immediately after the program finished, and at the 45-day follow-up, while no change was seen across this time in the control group. Problem behaviours in school at baseline were comparable between the two groups. Results showed that immediately after the program and at the 45-day follow-up the treatment group had significantly improved behaviours compared to the control group. The other two studies examined participation in soccer (Special Olympics) (nos.22,31). One study reported positive outcomes in terms of problem behaviours and social competence following participation in integrated activities (with typically developing students) (no.22). This study included a segregated sport group, which also showed improvements in problem
behaviours and social competence compared to the control group. The segregated sport group reported lower happiness than the integrated group after the intervention. The authors did not specify the duration or frequency of the program, and provided inconsistent numbers of participants, and country of origin when reporting results. The other study compared outcomes following participation in an intervention three times a week for eight weeks to a control group who attended an education session at the same time (no.31). Problem behaviours were reduced in the treatment group at post-test; however, there was no difference compared to the control group.

One study examined participation in individual sport (track and field) as part of the Special Olympics (no.30). A group of participants who attended a single weekend event (24 randomly selected from a pool of 376 registered participants) were compared with a group who usually attended but did not on this occasion (24 participants, randomly selected from a list of 66 non-participating children). All participants in both groups were regular attendees at past events. The randomisation process for each group was not detailed. Demographic variables of the participation and control groups were compared to ensure the groups did not differ statistically. The two groups were reported to be ‘similar’, however the statistics used to establish this were not detailed nor were results provided. Compared to the control group of regular attendees, the children who attended the track and field event on this occasion reported improvements in social acceptance and self-confidence after the event.

Four studies examined varied sports and activities in school-based physical education classes (nos.24,26,27,28). Each intervention ran every weekday, with the intervention duration ranging from ten to 24 weeks. One study (no.27) included two physical education classes (group activities, and individual activities) along with an art activity class and a non-participating control group. Participants were randomly assigned to one of the three activity groups, or the non-participating control group. A second study (no.24) also included two
physical education classes as interventions (traditional physical education, and body
movement training) as well as a non-participating control group, although no randomisation
process was used. The other two studies (nos.26,28) had a single physical education group
and a non-participating control group. One (no.28) randomised participants into intervention
and control groups, while the other (no.26) divided participants into equal groups based on
number, sex and age without randomisation. One randomised controlled trial showed no
change in participant self-concept, self-perception, anxiety, or social competency after
participation in physical education classes compared to non-participating controls (no.28).
Another showed improvement in social behaviours after participation in two different
physical education classes (individual and group focused) compared to non-participating
controls, although there were no differences in outcomes comparing the physical activity
groups to an art activity program (no.27). This study also reported statistically significant
improvements in emotional problems in the individualised physical activity program
compared to the group physical activity program and non-participating control group;
however, this improvement was less than the improvement reported in the art program. The
two non-randomised controlled trials examining physical education classes found
consistently positive results in outcomes including interpersonal skills, social maturity, and
self-regulation, compared to controls after the intervention (nos.24,26). One study (no.26)
also measured outcomes 16 weeks after completion of the program to determine whether
improvements were maintained after physical activity stopped. While their findings reported
improvements in the intervention group being retained at the 16-week follow-up, no
statistical comparison was made between the intervention and control groups.
Two further controlled trials used play activities as an intervention to target self-stimulating
behaviours of hand flapping and body rocking in individuals with autism (no.25) or
electoral self-control and social interactions (no.23). Both included thirty participants. One
study (no.23) included three 45-minute sessions per week for eight weeks, of play activities including running, jumping, and ball play. Outcomes were recorded through systematic observations by teachers of emotional and social behaviours in the classroom. Statistically significant improvements were reported for self-control post-intervention in the physical activity group compared to the control group. No improvement in social interaction with other children was reported. The other study (no.25) had participants engage in 15 minutes of ball play and tapping activities designed to mimic hand flapping movements followed by five minutes of seated stretching, twice a week for twelve weeks. Outcomes were recorded using the repetitive behaviour scale from the Gilliam Autism Rating Scale – 3rd edition (GARS-3; Gilliam, 2014). Participants acted as their own controls, with a placebo condition included where they were read a story for the corresponding time periods. A one-month washout period was used between the experimental and placebo conditions. When compared to the placebo condition, the treatment condition was associated with significantly decreased frequency of hand flapping. There was no change in body rocking behaviours.

The final randomised controlled trial reported on a one-hour yoga program that ran each weekday for 12 months (no.32). Participants were aged 6-15 years and had mild to severe intellectual disabilities. There were 90 participants in total, with n=45 randomised to the intervention group and n=45 to the non-participating control group. Pre- and post-intervention measurements of cognitive ability, visual perception, and social maturity and competence were recorded. Improvements were seen for all outcomes in the physical activity group compared to the control group, with the greatest improvements noted in those with moderate intellectual disability.

[Insert Table 4 about here]
4. **Discussion**

The aim of this review was to understand whether physical activity has a positive effect on behaviour and emotional problems, mental health, and psychosocial well-being in children and adolescents with intellectual disabilities. Thirty-two studies reporting on effects of participation in sport and physical activity by children and adolescents with intellectual disability on behaviour and emotional problems, mental health, and psychosocial well-being were included. While the type, duration, and setting of activity varied greatly, outcomes were generally positive, with improvements reported in 93.8% of studies.

The experimental case studies (n=15) reported benefits to stereotypical behaviours, social behaviours, and on-/off-task behaviours in the classroom, through following participation in a variety of different aerobic activities, and were generally rated as having a low risk of bias (11 of 15; 73%). These studies demonstrate the short-term effects physical activity can have, although there was no evidence for maintenance of effects. The larger cohort and cross-sectional studies (n=3, including 31 to 104 participants) provided a broader view of the potential impact physical activity participation can have, though methodological limitations make conclusions difficult to draw. The cross-sectional study design used in two studies (nos.17,18) meant it was impossible to determine the direction of effect; whether improvements in behaviour and social skills were an outcome of participation in sport and physical activity, or whether low rates of behaviour problems and higher levels of social skills were a facilitator for participation. Behaviour problems and poor social skills have been highlighted as barriers to participation in sport and physical activity (Bossink et al., 2017; Trost et al., 2002).

The treatment trials included in this review had a range of methodological problems, limiting the conclusions that could be drawn. Two studies included potential conflicts of interest (nos.19,20). Randomisation of treatment and control groups was done in only six studies.
Further complicating interpretation, blinding of investigators was not achieved in some studies (nos.20,22,23,25,27,32). Many of the studies were poorly reported, including inconsistencies in information as fundamental as participant numbers (nos.21,22). Control groups varied; some studies had non-participating controls, and some had alternate activity participation (e.g. classroom activities, art activity). The effect of exclusion and lack of social interaction from those non-participating groups creates potential confounders, as the social aspect of sport and the attention an intervention provides may impact outcomes. Of the three controlled trials with a low risk of bias, two were published in 1970 (nos.24,28) and the other was published in 1989 (no.32), highlighting the lack of recent quality research in this field.

Three controlled trials made additional comparisons, examining the difference between individual and group designed activities (no.27), and comparing unified/integrated sport (participating with non-disabled athletes) and segregated sport (athletes with intellectual disability only) (no.22). While there were positive outcomes reported across all activity groups, improved emotional behaviour was observed only in the individually tailored activity group and increased happiness was reported only for the integrated athletes. Further exploration of these differences is warranted, as they reflect findings from studies on groups without intellectual disability which have demonstrated different outcomes of physical activity programs based on variations in type, duration, frequency and intensity of activity (Pluhar et al., 2019; Sowa & Meulenbroek, 2012; Steptoe & Bolton, 1988).

Stereotypical behaviour and autism symptomatology were examined in ten of the included studies (31.3%). Eight of these studies (80%) were experimental case studies which showed improvements in behaviours immediately after exercise. Of the other two studies, one was an uncontrolled trial with high risk of bias (no.21) and the other was a controlled trial that looked at very specific stereotypical self-stimulatory behaviours (hand-flapping and body rocking; no.25) making it difficult to draw generalisable conclusions. The study that followed
While results of these studies suggest that physical activity can decrease stereotypical and self-stimulatory behaviours in children and adolescents with intellectual disability and co-occurring autism, they do not consider the broader impacts physical activity could have on other behaviour and emotional problems, mental health, or psychosocial well-being. In cases where activities are designed to mimic behavioural outcomes, findings may be specific to the behaviour and the disability (no.25).

A limitation of the included studies was inconsistency in how physical activity participation was recorded. More widespread use of objective measurement devices such as accelerometers (two studies) and HR monitors (three studies) would have allowed for more consistent reporting of activity between studies regardless of type of activity. ActiGraph accelerometers have been tested for validity for use with individuals with intellectual disability (McGarty et al., 2016; Zhu et al., 2020). These require diary or questionnaire usage to fill in gaps where these devices can’t be used such as during aquatic activities or contact sports, or to collect data about activity type. This was not done in the studies included in this review. Only one study used chest-belt HR monitors (no.7), which are currently the best option to provide an accurate indication of HR outside of controlled laboratory conditions and are a suitable tool for assessing exercise intensity during activity (Gillinov et al., 2017). Proper use of these tools in physical activity research is important, as they record duration of activity and intensity of activity, which can have an effect on outcomes (Parfitt et al., 2009).

Another limitation of studies was missing information on both usual levels of physical activity participation and intellectual disability. Measurement of physical activity outside of the intervention was missing in all treatment studies. External physical activity outside the scope of the intervention may have affected willingness and ability to participate in the interventions, as well as outcomes. Seven studies (22%) did not report on participants’ degree...
of intellectual disability. This makes it impossible to draw conclusions for sub-groups within the population of individuals with intellectual disabilities. There are significant differences in the characteristics and capabilities of individuals with a more severe intellectual disability, and individuals with a mild/moderate intellectual disability. These can include decreased working memory function (Schuchardt et al., 2010), decreased social abilities (Nota et al., 2007), and higher rates of physical disabilities and mobility issues (Borland et al., 2020; Kobe et al., 1994) which could effect an individual’s ability to engage with and participate in physical and sport activities. Thorough reporting of participants is important to support a better understanding of how particular types of physical activity interventions might be appropriate for different children and adolescents with intellectual disability.

A limitation of this systematic review is that older studies may have been missed, due to differences in terminology used to define intellectual disability in the past. The hand-searching of reference lists that was conducted would likely have identified any papers missed.

4.1. Conclusions

The generally positive results reported throughout the studies included in this review provide some indication that physical activity may have benefits for behaviour and emotional problems, mental health, and psychosocial well-being for children and adolescents with intellectual disability. However, this review highlights the lack of quality research in this area. These outcomes are under-represented in the existing literature, with the focus of past studies being primarily physical health outcomes (Pitchford et al., 2018), or stereotypical or repetitive behaviours corresponding with a syndrome diagnosis (most commonly autism) (Sowa & Meulenbroek, 2012).
Case study designs have demonstrated the effects of exercise on improving the short-term behaviour and emotional problems and mental health outcomes of individuals with intellectual disability, however their generalisability is limited. Larger studies conducted to date have numerous methodological limitations. To ensure effects are related to physical activity participation and the intervention being studied, and to differentiate between short-term, long-term, and sustained effects, several recommendations can be made. Control groups should be participating in an alternate social or interactive activity. Participation in physical activity undertaken outside of the intervention needs to be recorded, and varying levels of physical activity participation need to be accounted for. Measurement of physical activity needs be as consistent and non-biased as possible, including frequency, duration, intensity, and type. Long-term follow-up should be conducted to determine whether short-term benefits are sustained. Accurate recording of degree of intellectual disability is essential to understand who interventions might be best for. The different impact of individual activities, group activities, and team activities, as well as the different impact of segregated and integrated activities also deserve further exploration than what has been covered in this review.

Rigorous, well-designed randomised controlled trials, examining the effects of sport and physical activity on behaviour and emotional problems, mental health, and psychosocial well-being of children and adolescents with intellectual disabilities should be a focus of future research.

5. Registration and Protocol

This review was registered with PROSPERO, registration number CRD42018112934. The protocol can be accessed at https://www.crd.york.ac.uk/prospero/display_record.php?ID=CRD42018112934.
6. References

*studies included in the systematic review


Crain, C., Eisenhart, M., & McLaughlin, J. (1984). The application of a multiple measurement approach to investigate the effects of a dance program on educable


### Table 1: Search Terms

<table>
<thead>
<tr>
<th>Sport and physical activity</th>
<th>Outcomes</th>
<th>Population (diagnosis)</th>
<th>Population (age range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>sport*, “physical activ***”,</td>
<td>depress*, stress*, anxi*,</td>
<td>“intell* disab***”, “mental”</td>
<td>child*, adolesc*, youth*,</td>
</tr>
<tr>
<td>“physical educat***”,</td>
<td>mood*, “social funct***”,</td>
<td>retard***, “development***”</td>
<td>teenage*, kid*, pediatric*</td>
</tr>
<tr>
<td>exercis*</td>
<td>“mental health”, behav*,</td>
<td>disab***, “developmental”</td>
<td></td>
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<tr>
<td></td>
<td>psychosoci*, emotion*</td>
<td>delay”, “learning disab***”,</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>autis*, asperg*, PDD*,</td>
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<tr>
<td></td>
<td></td>
<td>“pervasive developmental”</td>
<td>disorder”</td>
</tr>
<tr>
<td>#</td>
<td>Author (year), Country</td>
<td>Type of physical activity</td>
<td>Description of intervention and baseline / control condition</td>
</tr>
<tr>
<td>----</td>
<td>-------------------------</td>
<td>---------------------------</td>
<td>-------------------------------------------------------------</td>
</tr>
<tr>
<td>1</td>
<td>Bachman &amp; Fuqua (1983), USA</td>
<td>Jogging</td>
<td>All jogging completed in the morning before classes, intensity measured by taking radial pulse rate of participants. Exercise started as 1-mile of moderate jogging every second day, progressing to 1.5 miles of vigorous jogging every day. One participant with lower baseline saw no improvement, so progressed to 2-miles of vigorous jogging. Intervention lasted for approximately 30-40 days. Baseline observations recorded prior to intervention over 10-15 days.</td>
</tr>
<tr>
<td>2</td>
<td>Battaglia et al (2019), Italy</td>
<td>Swimming / Aquatic Therapy</td>
<td>45–50-minute Aquatic Therapy program. 2x per week for 12 weeks. Baseline observations recorded across 6x 1-hour sessions.</td>
</tr>
<tr>
<td>3</td>
<td>Kern et al (1982), USA</td>
<td>Jogging</td>
<td>15 minutes prior to observation period every second day for 45 days. Baseline observations recorded on alternating days.</td>
</tr>
<tr>
<td>4</td>
<td>Kern et al (1984), USA</td>
<td>Jogging &amp; Ball playing</td>
<td>15 minutes of jogging prior to observation period on alternate days (total 3 days) 15 minutes of ball play prior to observation on alternate days (total 3 days) Baseline observations recorded on a non-exercise day prior to intervention, and again after the first 3 days of intervention.</td>
</tr>
<tr>
<td>5</td>
<td>Losinski et al (2017), USA</td>
<td>Exercise bike</td>
<td>Intensity of physical activity measured with HR monitors.</td>
</tr>
</tbody>
</table>
6 Luke et al (2014), USA
Aerobic exercise – e.g. running, jumping as play activities
20 minutes prior to observed period for 9 days. Baseline observations recorded for 6 days prior to intervention, and again for 5 days halfway through the intervention.

7 Mays (2015), USA
Jogging
Intensity of physical activity measured with HR monitors. Jogging for 10 minutes, HR 60-80% of maximum HR on 5-separate days. Baseline observations recorded prior to intervention. Baseline and intervention were repeated three times.

8 McLaughlin (2011), USA
Play activities during recess (aerobic activities)
Intensity and duration of activity measured with accelerometer. 5 continuous minutes vigorous activity in the last 15 minutes of recess, immediately prior to observation period (5 or 6 sessions) 5 1-minute intervals of vigorous activity in the last 10 minutes of recess, immediately prior to observation (4 or 6 sessions) Baseline observations recorded prior to intervention, and re-established between continuous activity, and interval activity conditions.

9 Morrissey et al (1992), USA
Light calisthenics
15 minutes of calisthenics (intensity estimated as light) prior to observation periods for 21 days. Two alternate conditions were included: 15 minutes of free time or 15 minutes of relaxation session. During intervention, all three conditions were tested each day, separated by at least 1 hour. Baseline observations recorded prior to intervention across 5 days.

10 Neely et al (2015), USA
Trampoline jumping
Trampoline jumping until bored, average 6min 18sec, prior to instructional session. Brief trampoline jumping (20% of previous time, 1min 38sec) prior to instructional session. Instructional sessions were conducted 2-3 times per week for 10-12 weeks. Baseline observations recorded prior to intervention and re-recorded periodically across the intervention period.

10 minutes at pace that had brought HR above 100 beats per minute for 5 minutes in first session (HR not measured after this), prior to observation period, 5x across 5 days. Baseline observations recorded across 5 consecutive days before starting intervention.

with extremely low communication immediately after intervention.

3-5 years 2-3SD below the mean on Mullen Scales of Early Learning (scores of 62, 55 & 70) Observations of on- and off-task behaviours immediately after intervention.

2 10 & 11 years IQ=38 & 45 Observation of stereotypical behaviours immediately after intervention, and later in the day (time not specified).

2 3-5 years 1.5-3SD below mean on Battelle Developmental Inventory: Cognitive Observation of stereotypical behaviours immediately after intervention.

4 8-13 years “Untestable IQ” estimated moderate-severe intellectual disability Observation of self-stimulatory behaviour and on-task / attending-to-task behaviour immediately after intervention, and in regular living conditions later in the afternoon.

1 7 years Severe intellectual disability Observation of stereotypy and academic engagement immediately after intervention.

Greater on-task behaviour was observed after physical activity sessions compared to baseline periods.

Stereotypic behaviours decreased 10-12% compared to baseline in classes immediately following physical activity. This effect was not maintained in sessions later in the same day.

Decreased stereotypical behaviours following both physical activity conditions when compared to baseline for both students.

Decreased self-stimulatory behaviour and attention-to-task was observed after calisthenics sessions compared to baseline and free-time conditions. Effects were matched in the relaxation condition. Effects were not maintained later in the day.

Reduction in stereotypy and improved academic engagement after both exercise activities. Greater improvements seen after exercise until bored.
<table>
<thead>
<tr>
<th>Study</th>
<th>Intervention</th>
<th>Duration</th>
<th>Age Range</th>
<th>intellectual disability</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Powers et al (1992), USA</td>
<td>Roller skating</td>
<td>10 minutes</td>
<td>8 years</td>
<td>Intellectual disability with autistic-like behaviours</td>
<td>Observation of self-stimulatory behaviour and on-task performance immediately after intervention. Decrease in self-stimulatory behaviour and increase in on-task behaviour was observed after exercise when compared to baseline.</td>
</tr>
<tr>
<td>Reid et al (1988), Canada</td>
<td>Calisthenics</td>
<td>20 minutes</td>
<td>12-17 years</td>
<td>IQ in severe intellectual disability range</td>
<td>Observation of on- and off-task behaviour, prosocial behaviour, and inappropriate vocalisations immediately after intervention. Improvement in on- and off-task behaviour was observed post exercise compared to baseline. Behaviours returned to baseline during follow-up. No changes to prosocial behaviour and inappropriate vocalisations.</td>
</tr>
<tr>
<td>Rosenthal-Malek &amp; Mitchell (1997), USA</td>
<td>Jogging</td>
<td>Mildly strenuous (flushing and increased breathing, but not discomforted/out of breath)</td>
<td>14-15 years</td>
<td>Mean IQ=42.2 (SD=4.9)</td>
<td>Observation of self-stimulatory behaviour and academic responding immediately after intervention. Self-stimulatory behaviour decreased following physical activity compared to academic condition. Number of correct responses and completed tasks increased after physical activity compared to academic condition.</td>
</tr>
<tr>
<td>Watters &amp; Watters (1980), Canada</td>
<td>Jogging</td>
<td>8-10 minutes</td>
<td>9-11 years</td>
<td>IQ=34-48</td>
<td>Observation of self-stimulatory behaviour and academic responding immediately after intervention. Observed self-stimulation decreased following physical activity compared to alternate conditions. No change in academic responding was observed after physical activity.</td>
</tr>
<tr>
<td>Yamanaka et al (1994), Japan</td>
<td>Jogging</td>
<td>20 minutes</td>
<td>4-5 years</td>
<td>IQ=40-56</td>
<td>Observation of behaviour and social interaction in school and play activities across the entire school day that the intervention took place, for the last 4 weeks of the intervention 2 of 4 participants with intellectual disability showed improvements in observed social interaction and behaviours in the last 4 weeks of intervention compared to baseline.</td>
</tr>
<tr>
<td>#</td>
<td>Author (year), Country</td>
<td>Type of physical activity</td>
<td>Description of physical activity</td>
<td>Participant characteristics</td>
<td>Outcomes</td>
</tr>
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<tr>
<td>16</td>
<td>Ghosh &amp; Datta (2012), India</td>
<td>Special Olympics - general</td>
<td>Number of years enrolled in Special Olympics was recorded but not reported</td>
<td>31</td>
<td>12-18 years</td>
</tr>
<tr>
<td>17</td>
<td>Fiorilli et al (2016), Italy</td>
<td>Special Olympics - Swimming</td>
<td>Participants in Special Olympics (average 5hrs per week for 8 years) Comparison group of adolescents who had never done Special Olympics.</td>
<td>93 (58 in Special Olympics, 35 in comparison group)</td>
<td>11-17 years</td>
</tr>
<tr>
<td>18</td>
<td>Protic &amp; Valkova (2018), Czech Republic</td>
<td>Daily activity measured by accelerometer</td>
<td>All daily activity (accelerometer), for 7 consecutive days</td>
<td>104</td>
<td>7-18 years</td>
</tr>
<tr>
<td>#</td>
<td>Author (year), Country</td>
<td>Type of physical activity</td>
<td>Description of physical activity and control groups</td>
<td>Participant characteristics</td>
<td>Outcomes</td>
</tr>
<tr>
<td>----</td>
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</tr>
<tr>
<td>19</td>
<td>Crain et al (1983), USA</td>
<td>Dancing</td>
<td>30 minutes, 3x per week for 10 weeks</td>
<td>13, 13-15 years</td>
<td>Physical and social behaviours during exercise (observations) and changes outside this interview</td>
</tr>
<tr>
<td>20</td>
<td>Gleser et al (1992), Israel</td>
<td>Judo</td>
<td>90 minutes, 2x per week for 6 months</td>
<td>7, 6-12 years</td>
<td>Brigance Diagnostic Inventory of Early Development, staff-designed scale measuring overall psychosocial functioning</td>
</tr>
<tr>
<td>21*</td>
<td>Ye et al (2019), China</td>
<td>Outdoor walking, jogging &amp; jumping, and paper plane building &amp; throwing</td>
<td>Intensity of physical activity measured with HR monitors worn by observers. Walking 3x per week (60 mins @ 50-75% maximum HR). Jogging/jumping 3x per week (30mins, 4 sets of 2-3min intervals). Building/throwing paper planes 2x per week (30mins @ 50-75% maximum HR) for 8 weeks.</td>
<td>24, 11-14 years</td>
<td>Developmental age considerably lower than chronological age (estimated IQ range 33-68)</td>
</tr>
<tr>
<td>22*</td>
<td>Alruwah (2015), Kuwait</td>
<td>Special Olympics - Soccer</td>
<td>Participation in unified/integrated sport and participation in segregated sport, based on Special Olympics. Duration and intensity unknown. Control group did not participate in any activity.</td>
<td>40 (12 unified, 10 segregated, 18 control), 11-18 years</td>
<td>Mean IQ: Unified=58.29, Segregated=57.09, Control=58.11 Piers-Harris Self-Concept Scale (self-concept, behavioural adjustment, anxiety, popularity, happiness &amp; satisfaction)</td>
</tr>
<tr>
<td>23</td>
<td>Choi et al (2016), China</td>
<td>Play activities – e.g. jumping, ball play</td>
<td>45 minutes, 3x per week for 8 weeks. Control group did not participate in any activity.</td>
<td>30 (18 intervention, 12 control), 7-8 years</td>
<td>Mild intellectual disability</td>
</tr>
<tr>
<td>No.</td>
<td>Study</td>
<td>Region</td>
<td>Activity Type</td>
<td>Duration</td>
<td>Age</td>
</tr>
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<td>-----</td>
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</tr>
<tr>
<td>24</td>
<td>Goodwin (1970), USA</td>
<td>Physical education class &amp; body movement training</td>
<td>30 minutes, 5x per week for 10 weeks for both physical activity groups. Control group attended regular classroom activities during these periods.</td>
<td>10-15 years</td>
<td>“Trainable mentally retarded”</td>
</tr>
<tr>
<td>25</td>
<td>Tse et al (2018), China</td>
<td>Ball tapping &amp; throwing</td>
<td>15 minutes of tapping/throwing followed by 5 minutes of seated stretching, 2x per week for 12 weeks. Control condition was 20 minutes of story time, 2x per week for 12 weeks.</td>
<td>9-12 years</td>
<td>Intellectual disability, non-verbal IQ over 40</td>
</tr>
<tr>
<td>26</td>
<td>Yilmaz &amp; Soyer (2018), Turkey</td>
<td>Physical Education class</td>
<td>2 hours, 5x per week for 24 weeks. Control group did not participate in any activity.</td>
<td>7-9 years</td>
<td>Mild intellectual disability’</td>
</tr>
<tr>
<td>27</td>
<td>Broadhead (1968), USA</td>
<td>Physical Education class</td>
<td>35 minutes, 5x per week for 20 weeks for both physical activity groups, and the art activity group. Control group attended regular classroom activities during these periods.</td>
<td>Mean IQ=65.3</td>
<td>Bender Motor Gestalt Test, Cattell Personality Questionnaires (intellectual, social &amp; emotional behaviour)</td>
</tr>
<tr>
<td>28</td>
<td>Funk (1970), USA</td>
<td>Physical Education class</td>
<td>30 minutes, 5x per week for 12 weeks. Control group attended regular classroom activities during these periods.</td>
<td>8-18 years</td>
<td>“Trainable mentally retarded”</td>
</tr>
<tr>
<td>29</td>
<td>Gencoz (1997), Turkey</td>
<td>Basketball</td>
<td>40 minutes, 3x per week for 7 weeks. Control group could play with balls in any manner during this time but received no instruction.</td>
<td>10-14 years</td>
<td>“Trainable mental retardation”</td>
</tr>
<tr>
<td>30</td>
<td>Gibbons &amp; Bushakra (1989), USA</td>
<td>Special Olympics – Track &amp; Field</td>
<td>1.5-day Special Olympics meet (Friday evening, all day Saturday). Min 4 events participated, max 6.</td>
<td>IQ=48-70 (mean 58.5)</td>
<td>Pictorial Scale of Perceived Competence and Social Acceptance for Young Children</td>
</tr>
</tbody>
</table>
Control group of children who normally participate but did not on this occasion.

<table>
<thead>
<tr>
<th>Study</th>
<th>Authors</th>
<th>Country</th>
<th>Duration</th>
<th>Sample Size</th>
<th>Age</th>
<th>Disability</th>
<th>Measures</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>31</td>
<td>Ozer et al (2012), Turkey</td>
<td>Special Olympics - Soccer</td>
<td>1.5-hour session 3x per week for 8 weeks. Control group did not participate in any activity.</td>
<td>38 (23 intervention, 15 control)</td>
<td>12-15 years</td>
<td>Intellectual Disability</td>
<td>Child Behaviour Checklist (Parent &amp; Teacher report), Friendship Activity Scale, Adjective Checklist</td>
<td>Significant increase in social competence and attitude to social activity compared to control group. Reduction in problem behaviour was matched by control group.</td>
</tr>
<tr>
<td>32</td>
<td>Uma et al (1989), India</td>
<td>Yoga</td>
<td>1 hour, 5x per week for a school year. Control group attended regular school activities during these periods.</td>
<td>90 (45 intervention, 45 control)</td>
<td>6-15 years</td>
<td>Mild to Severe Intellectual Disability</td>
<td>Seguin Form Board, Vineland Social Maturity Scale</td>
<td>Significant improvement in both measures after yoga when compared to the control group. Individuals with moderate intellectual disability saw greatest improvements.</td>
</tr>
</tbody>
</table>

Note. a Study 22 specified 40 participants in the results tables, however in-text it was stated that 30 participants were included in the study. Study 21 only provided demographic data on six participants, however in-text it was stated analyses were completed using 24 participants. In discussing these two studies, the sample sizes referred to in analyses were reported.
Figure 1. PRISMA flow diagram