
EFFECTS OF PHYSICAL EXERCISE FOR ADULTS WITH INTELLECTUAL DISABILITIES: A SYSTEMATIC REVIEW

EFEITOS DO EXERCÍCIO FÍSICO PARA ADULTOS COM DEFICIÊNCIA INTELECTUAL: UMA REVISÃO SISTEMÁTICA

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ABSTRACT

The literature presents the benefits of physical activity programs for people with intellectual disabilities (ID), but aspects such as those related to physical exercise prescription, benefits of the type of exercise program, the most recommended exercises, load control, and limitations of the interventions for adults with ID are subjects awaiting scientific research. The aim of this study was to verify, through a systematic review, the effects of physical activity programs for adults with ID. The procedure included an electronic search of the literature published from January 1960 to August 2014, considering terms related to physical activity, ID, and physical activity programs. Eight manuscripts met the eligibility criteria and were included in the study. Based on the systematic review, we found a limited number of studies that investigated, in a structured way, the effect of physical activity programs for adults with ID. In general, the systematized programs of physical exercise promoted consistent and significant benefits for adults with ID. However, there seems to be no consensus on the type of intervention to be used to promote the practice of physical activity in adults with ID. In addition, the methodological quality of the studies appears to be limited. We conclude that intervention studies with physical activity in adults with ID that involve aerobic exercise, sports specialization, and a combination of muscular and aerobic exercise performed two or three times a week for more than 40 minutes seem to be the most highly recommended for adults with ID.

Key-words: Intellectual Disability. Exercise. Quality of life.

RESUMO

Apesar da literatura apresentar os benefícios de programas de atividade física para a pessoa com deficiência intelectual (DI), aspectos como os relacionados à prescrição de exercício físico, benefícios de cada tipo de programa de exercício físico, exercícios mais recomendados, controle de carga, limitações das intervenções para adultos com DI são assuntos em espera de investigação científica. O objetivo deste estudo foi verificar, por meio de uma revisão sistemática, quais os efeitos de programas de atividade física para adultos com DI. O procedimento incluiu uma busca eletrônica da literatura publicada de janeiro de 1960 até agosto de 2014, considerando termos relacionados à atividade física, DI e programa de atividade física. Oito manuscritos preencheram os critérios de elegibilidade e foram incluídos no estudo. Com base na revisão sistemática, foi encontrado um limitado número de estudos que investigou, de forma estruturada, o efeito de programas de atividade física para adultos com DI. De forma geral, os programas sistematizados de exercício físico promoveram benefícios consistentes e significantes para adultos com DI. Entretanto, parece não haver um consenso do tipo de intervenção a ser utilizada para promover a prática de atividade física de adultos com DI. Além disso, a qualidade metodológica dos estudos parece ser limitada. Concluímos que estudos de intervenção com atividade física em adultos com DI que envolvem exercícios aeróbios, especialização esportiva e combinação de exercício de força muscular e aeróbio realizadas duas ou três vezes por semana por mais de 40 minutos parecem ser os mais recomendados para adultos com DI.

Palavras-chave: Deficiência intelectual. Exercício. Qualidade de vida.

Introduction

The prevalence of people with intellectual disability (ID) is 3% in the world¹. Around 22% of the Brazilian population has some disability and 1.4% of the population presents ID². Due to the high prevalence in Brazil and the increase in life expectancy of people with ID in recent years, the health of this group has been established in public health policies³. As a result, there has been an increase in life conditions for people with ID, including a regular

routine of physical activity. However, the number of sedentary people with ID is still elevated, being 10% higher than the general population⁴. One of the reasons for this is the lack of knowledge of physical education professionals about the benefits of physical activity programs and recommended intervention strategies for this population. ID is characterized by significant limitations in intellectual function (e.g., reasoning, learning, and problem solving) and adaptive behavior, which covers a range of everyday social and practical skills⁵⁻⁷. As this deficiency generally originates before the age of 18, problems of personal independence begin early and continue even when these individuals reach more advanced ages. In addition, the process of premature aging causes a greater tendency to a lack of physical conditioning and high morbidity⁸. Poor engagement in physical exercise results in a higher percentage of obesity in ID, which is two or three times higher than in the general population⁹⁻¹². In addition, only a small number of people with ID reach the weekly recommended physical activity targets¹³. The sedentary life of this group of people has led increasingly to the appearance of health problems, such as high cholesterol, hypertension, and cardiovascular problems, as well as negatively affecting quality of life¹⁴⁻¹⁸.

Regular physical activity seems to improve the quality of life and health of people with ID. Previous studies indicate that regular physical exercise improves aerobic endurance, cardiovascular capacity, flexibility, and agility, and decreases the adipose mass of adults with ID.^{17,18} Due to the limitations in areas of adaptive skills presented by people with ID, the benefits of exercise could be distinct compared to people without ID. However, although the literature presents the benefits of physical activity programs for people with ID, aspects such as those related to the prescription of physical exercise, benefits of each type of exercise program, most highly recommended exercises, load control, and limitations of the interventions for adults with ID are subjects awaiting scientific research. Another possible bias in studies with people with ID refers to the methodological quality that may not be based on a randomized controlled clinical trial or a simple randomized controlled trial due to the difficulty of developing interventions for this population.

Thus, the objective of this study was to verify, through a systematic review, the effects of physical activity programs for adults with ID. In addition, the study aimed to identify, critique and summarize the benefits, limitations, and recommendations of physical activity programs for adults with ID.

Methods

This systematic review was based on the criteria established by The PRISMA Statement which was developed to ensure the transparent and complete reporting of systematic reviews and meta-analyses²⁰.

Eligibility criteria

To ensure relevance in this systematic review, the article was required to contain the following keywords: 1) physical activity or physical fitness or physical exercise; 2) intellectual disability or mental handicap or mental retardation; 3) training or intervention.

Initially all these keywords were used together, using the "AND" and "OR" commands to order them. Next, these words were grouped in twos or threes, for example, physical activity and intellectual disability and intervention, and a new search carried out. In addition, the terms of the search strategy were also paired, for example, intellectual disability or intervention. The terms were searched in the titles, abstracts, and key-words of the manuscripts. In addition, a manual search was performed to identify articles that were not

found in the electronic database search, for example, studies cited by other manuscripts. Due to differences in terminology and writing style, a list of synonyms for terms of interest was used for each key term to identify all relevant articles.

Studies involving animals, robots, qualitative methodology, and systematic reviews were excluded from the analysis. The search was limited to articles that studied individuals over the age of 18. In addition, articles that met the eligibility criteria of this study, but for which the full version could not be accessed (not available electronically or on paper or after being requested from authors but not submitted) were also excluded.

Research strategy

The initial search strategy was to identify articles that investigated the effects of exercise programs in adults with ID. An electronic search was conducted in the following databases: PubMed, EBSCOhost, Web of Science, and Scopus, between January 1960 and August 2014. Specific searches in frequently cited journals and authors and article reference lists ensured that all relevant articles were located.

The articles identified for inclusion by the initial search strategy, were evaluated according to the following criteria:

- studies with adults from the age of 18 years, with ID, that included physical activity commitments (defined as systematic planning of actions used at a specific time and place, designed to promote behavioral change among intervention participants²¹);
- involving the following ID of chromosomal origin, Down syndrome, or involving IDs of unknown or environmental etiology that lead to a delay in overall development;
- presented an experimental group, considered as the group where the participants received the most intense intervention, and a control group, who received usual care or some form of attention or individuals who did not have ID, or two experimental groups with different exercise protocols for individuals with ID;
- evaluation before and after the intervention period to demonstrate the efficiency and applicability of the program.

The initial screening was performed by combining all the original articles found in the analyzed electronic databases. Articles not related to the theme of this systematic review were excluded during a secondary screening of titles and abstracts. The abstracts of the remaining articles were independently included/excluded by two reviewers. When the abstract did not contain enough information, the full text was examined to decide on inclusion or exclusion. The results of the two reviewers were cross-checked to verify agreement and discordant results were resolved by consensus. Only articles in English were considered for this analysis.

Methodological quality

The methodological quality was defined as the ability of the study to avoid potential bias and present results with the possibility of generalization²². This was independently assessed by two reviewers who analyzed the studies selected for this systematic review and resolved, by consensus, any disagreements in the analysis. The methodological quality of the studies was reviewed by the PEDro scale²³ based on the Delphi list²⁴. This scale consists of 10 scored questions, each criterion being scored according to its presence (one point) or absence (zero points) in the study in question. Adherence to the PEDro²³ and Delphi²⁴ list items has been the basis of the randomized controlled trial model used in medical research²⁵. The following items were considered to evaluate the methodological quality of the selected studies: generation of randomization sequence; secrecy of allocation; blinding of the evaluated individuals; blinding of professionals and evaluators who applied the

intervention/evaluation; blinding of evaluators to study outcomes; similar groups in the initial evaluation; selection criteria; intention-to-treat analysis; statistical comparison between groups; description of losses and exclusions.

Data extraction and analysis

The data were extracted from the articles in their entirety through a structured script, including the following items: sample (disability stage and age of study participants), research design, duration and type of intervention performed in the study, effects found (positive or not), limitations, and recommendations. The data extraction was performed by one reviewer, and the second reviewer verified the extraction of data to ensure that the data collected were accurate and complete. The results of the articles were presented in a descriptive way using means, standard deviations, and minimum and maximum values.

Results

Through the initial search we identified 2808 scientific articles related to the subject of this systematic review (Figure 1). After reviewing the titles and abstracts of the selected articles, we found 177 articles that reported on the effect of physical exercise for adults with ID. After careful reading of the articles in full, 8 studies that met all the inclusion criteria were selected (Table 2) to compose this systematic review.

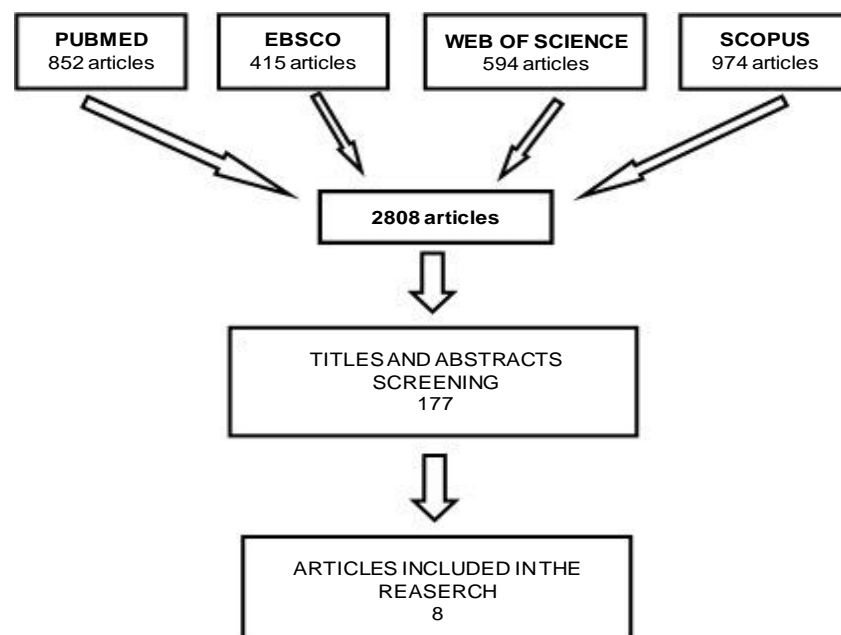


Figure 1. Flowchart of the selection of included manuscripts in the systematic review. The number below the texts indicates the number of original articles (not duplicates) identified in each search stage

Source: The authors

Evaluation of the methodological quality of the studies investigating the effects of exercise programs for adults with ID.

All studies selected for this systematic review presented criteria for selecting the participants and included a statistical comparison between groups (Table 1). However, none

of them presented blinding of the evaluators or the professional who applied the intervention, and only one (12.5%) study²⁷ presented concealment in the participant allocation (the study was based on a simple-blind method, hiding the identity of groups from researchers who collected and analyzed the variables of interest). Furthermore, only three studies (37.5%) presented randomization of participants^{29,31,33}, blinding of the evaluators (researchers who performed the evaluation did not know the distribution of the participants in the groups)^{27,29,31}, and description of the losses and exclusions^{26,28,31}.

Regarding the evaluation of methodological quality through the PEDro scale²³, the studies of Carmeli et al.²⁷ and Shields et al.²⁹ presented the highest score (6) and the Calders et al.³¹ study presented 5 points on this scale. Thus, although the studies in this review demonstrated consistent and positive results on the value of engagement in physical activity, these should be interpreted with caution due to the limitations presented in the methodology of the studies according to the PEDro scale²³.

Table 1. Analysis of the methodological quality of the articles selected for this systematic review

	Carmeli et al.²⁶	Carmeli et al.²⁷	Shields et al.²⁹	Carmeli et al.²⁸	Guidetti et al.³⁰	Mendonça et al.³²	Calders et al.³¹	Carraro & Gobbi³³
Randomized sequence generation	No	No	Yes	No	No	Uninformed	Yes	Yes
Allocation concealment	No	Yes	Uninformed	Uninformed	No	Uninformed	No	Uninformed
Blinding of participants	Uninformed	Uninformed	Uninformed	Uninformed	Uninformed	Uninformed	Uninformed	Uninformed
Blinding of the professionals who applied the intervention	Uninformed	Uninformed	Uninformed	Uninformed	Uninformed	Uninformed	Uninformed	Uninformed
Blinding of outcome assessors	Uninformed	Yes	Yes	Uninformed	Uninformed	Uninformed	Yes	Uninformed
Similar groups in the initial evaluation	Yes	Yes	Yes	No	Uninformed	No	Yes	Uninformed
Participant selection criteria	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Intention-to-treat analysis	Uninformed	Yes	Uninformed	Uninformed	Uninformed	Uninformed	Uninformed	Uninformed
Statistical comparison between groups	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Description of losses and exclusions	Yes	Uninformed	Yes	Yes	Uninformed	Uninformed	Uninformed	Uninformed
PEDro Scale Score ²³ (pts)	4	6	6	3	2	2	5	3

Source: The authors

Characteristics of the study samples

The articles included participants of both sexes, aged between 18 and 67 years, with a mean and standard deviation age of 45.05 ± 11.29 years (Table 2). Only one of the studies did not inform the mean age of the participants³⁰. Three studies^{26,27,28} analyzed the effects of a physical exercise program in adults with ID over 60 years of age. None of the studies verified the effect of physical exercise throughout the aging process or compared the effects of interventions between adults and the elderly. The number of participants with ID in the studies presented a range of from 13 to 45 participants (27.6 ± 10.6 participants).

The studies analyzed adults with ID with different levels of disability. All studies included adults with mild to moderate ID. One study evaluated people with ID at all levels of disability - mild, moderate, severe, and profound³⁰. Another study evaluated adults with ID at severe levels of disability²⁹. Although the studies presented clear criteria regarding the intellectual disability level, only two studies used the type of intellectual disability of the participants as an inclusion/exclusion criterion^{27,31}.

Regarding the presence of a control group and comparison of different interventions, six studies^{29,26,28,31,33} presented a group of adults with ID that did not perform physical exercise or performed their usual daily and leisure activities during the study period (control group). In addition, two studies^{26,32} presented a control group of adults without ID and three studies compared different types of training programs^{27,28,31}.

Physical exercise program duration

The intervention period of the studies was from 2.5 to 9 months, with a weekly frequency of from one to three times per week (Table 2). Four studies^{26,27,28,30} demonstrated the effects of a long-term exercise program (minimum 6-month intervention period), with a frequency of three times a week and sessions of at least 30 minutes. The duration of the sessions varied between 20 minutes and 120 minutes of exercise. Only one study²⁹ did not report the duration of the exercise session, since the time taken to perform the muscle exercises indicated for the session determined the duration of the session.

Table 2. Description of the selected articles for this review. CG - Control Group

Authors	Aim	Sample	Intervention duration and types	Benefits for adults with ID
Carmeli et al. ²⁶	To determine the effects of therapeutic balance exercise in adults with ID.	29 people with ID (initial stage) 12 CG without ID 50 to 67 years of age	3x week: 6 months (30 min - session) G1: dynamic exercise with ball and walking G2: people with ID without intervention CG: without intervention	No benefit to static or dynamic balance after the intervention.
Carmeli et al. ²⁷	To investigate the effect of physical exercise on balance, muscle strength, and overall well-being in adults with ID.	22 people with ID 54 to 66 years of age (initial stage)	3x week: 6 months (40-45 min - session) G1: muscular strength and balance exercise G2: general exercise	- Both exercises improve overall well-being - Muscle strength and balance exercise improve balance and muscle strength compared to general exercise. - Muscle endurance exercise improves lower limb muscle resistance compared to the CG - Neither group improved lower limb strength.
Shields et al. ²⁹	To determine the effect of aerobic progressive exercise on muscle strength and endurance in adults with ID.	20 people with ID 20 to 49 years of age (initial, moderate, and severe stages)	2x week: 2.5 months G1: progressive exercise of muscular endurance CG: daily life activity	- Neither group improved lower limb strength.
Carmeli et al. ²⁸	To determine the effects of physical exercise on anxiety and quality of life in adults with ID.	24 people with ID 45 to 50 years of age (initial stage)	3x week: 6 months (20-40 min - session) G1: aerobic exercise G2: leisure activity G3: without exercise	Aerobic exercise and leisure activity improve anxiety after intervention, while CG did not improve.
Guidetti et al. ³⁰	To compare the effect of athlete training with people who engage in recreational or leisure activities in adults with ID.	41 athletes with ID 23 non-athletes with ID 18 to 45 years of age (initial, moderate, severe, and profound stages)	3x week: 9 months (60 min - session) G1: exercise for physical ability and sports modality G2: leisure and recreational activity	Sport activity promotes improved balance, muscular strength, coordination, and agility in comparison to leisure and recreational activity.
Mendonça et al. ³²	To verify the effect of a combined exercise program on the physical capacity of adults with ID.	13 people with ID (initial and moderate stages) 12 CG without ID 27 to 50 years of age	3x weeks: 3 months (30min - session) ID and CG: muscular and aerobic endurance exercise	Combined exercise induces improvement in physical fitness components similarly between groups.
Calders et al. ³¹	To compare the effect of combined aerobic capacity and muscle strength exercise on exercise aerobic capacity in adults with ID.	45 people with ID 18 to 60 years of age (initial and moderate stages)	2x week: 5 months (70 min - session) G1: muscular and aerobic exercise G2: aerobic exercise G3: daily life activity	- Both types of exercise provided improvements compared to the activities of daily living - Combined exercise brought greater benefits of muscle and aerobic strength than aerobic exercise.
Carraro; Gobbi ³³	To investigate the effect of exercise on anxiety in adults with ID.	27 people with ID 31 to 49 years of age (initial and moderate stages)	1x weeks: 3 months (120 min - session) G1: generalized exercise G2: without exercise	Generalized short-term exercise program promotes improvement in anxiety.

Source: The authors

Types of physical activity programs

The types of intervention were diverse among the articles in this review (Table 2), including leisure and recreational activities (three studies)^{28,30,33}, combined strength and endurance exercises (two studies)²⁹⁻³², aerobic walking activities, with races and on stationary bicycles (three studies)^{26,28,31}, widespread activities (two studies)^{28,31}, and sports specialization in athletics and basketball (one study)³⁰. The following is a general description of the activities proposed in each type of exercise.

1) Therapeutic, leisure, and recreational activities: comprised of recreational games, relaxation, activities with bobath balls, activities with a rope, adapted games, breathing exercises, jokes, and manual art such as painting.

2) Combined strength and muscular endurance exercises: involved maximal strength exercises with one repetition only (1RM) and muscle endurance, with the number of repetitions being 50% of the weight of 1RM or sets of 10 to 15 repetitions of each apparatus or movement, with two replicates in each series. The main devices and exercises reported were: a) lower limbs: leg press, weight and weightless squats, abduction and adduction of legs, knee flexion and extension, and weight and weightless calf exercises; b) upper limbs and trunk: vertical traction, biceps and triceps elbow flexion and extension, shoulder abduction and adduction, peck deck, and various abdominal movements.

3) Aerobic activities: walking activities ranged from 15 to 35 minutes, based on the individual participant's speed. The running duration and intensity were not specified by the authors, as they were included as running intervals among other exercises, not characterized as continuous running of long duration (only 5 to 10 minutes). On the exercise bicycle, the activities lasted between 15 and 35 minutes, but also without description of speed or intensity.

4) Generalized activities: participants in the studies performed general body movements such as sitting and lifting, trunk flexion, pelvic rotation, arm movements, walking, body stabilization postures, flexibility exercises without use of weights in the ventral and dorsal decubitus positions, and rotation of the body. Basically, participants performed a combination of strength and muscular endurance exercises with aerobic activities.

5) Sports specialization: here the intervention proposals included activities related to the components of physical capacity, such as strength, aerobic resistance, speed, flexibility and coordination, and the training of a sporting modality, for example athletics or basketball in the case of the studies in this review.

Effects of physical exercise programs

In general, the physical exercise presented benefits in several aspects for adults with ID, especially physical capacity²⁹⁻³, health³¹, and anxiety^{31,33} (Table 2). The authors did not detect any effects of the physical activity program in only one study²⁶. The main benefits of physical activity programs were related to physical fitness components, such as muscle strength, aerobic capacity, balance, coordination and agility, psychological well-being such as anxiety, health, body fat, blood pressure and cholesterol, and quality of life of adults with ID.

Specifically, therapeutic, leisure and recreational activities promoted a reduction in body mass³⁰ and anxiety²⁹. Combined strength and muscular endurance exercises lowered blood pressure and cholesterol and improved mobility, lower abdomen muscle strength, lower limb resistance and resistance to fatigue³¹, aerobic capacity, lower limb and upper limb strength³¹⁻³², and economy of movement during walking³². In addition, the results of the studies showed that combined strength and endurance exercises are more effective than aerobic exercises for blood pressure, lower limb and upper limb muscle strength, mobility, and resistance to fatigue³¹. On the other hand, aerobic activities were effective in lowering

blood pressure and improving mobility, muscle resistance to fatigue³¹ and anxiety²⁹, but without a positive effect on balance²⁷. Furthermore, generalized activities improved well-being²⁷ and anxiety and mental health³³. In addition, sports specialization promoted a reduction in body mass and improvement in balance, lower limb muscle power, lower and upper limb strength and muscle strength, and coordination³⁰. In particular, athletics was able to improve the balance and aerobic capacity of people with ID³⁰. Finally, while muscular endurance exercises improved upper limb strength and muscle strength, but without a positive effect on endurance and lower limb strength²⁹, muscle strength exercises improved well-being, mobility, lower limb strength, and flexibility²⁷.

Physical exercise program limitations and recommendations for adults with intellectual disability

Table 3 presents the main recommendations and limitations of exercise programs for adults with ID. The main recommendations pointed out by the authors of the included studies were that physical exercises should be incorporated into the daily routine of this population²⁷ and that control of the intensity, frequency, and duration of the physical exercise program is essential for benefits to be observed in this population²⁹.

The main limitations indicated by the studies were related to the accomplishment of a physical exercise program without follow-up of the benefits^{27,28,33}, a low number of participants in the studies²⁶⁻²⁹, and lack of motivation and commitment of the adults with ID in the activities developed^{28,32}.

Table 3. Main recommendations and limitations presented by the studies in this review on exercise programs for adults with ID

Authors	Recommendation	Limitation
Carmeli et al. ²⁶	<ul style="list-style-type: none"> - Exercise program with bobath ball and walking are not recommended to improve static and dynamic balance. - Beware of intensity (maximize intensity) of exercise to benefit adults with ID. 	<ul style="list-style-type: none"> - Need for a test that is easy to apply and execute to assess balance. - Low number of participants.
Carmeli et al. ²⁷	<ul style="list-style-type: none"> - Physical exercise is recommended to improve psychological aspects. - Exercise program of balance and muscle strength is more recommended than general physical activities. - Regular physical activity preserves physical ability. 	<ul style="list-style-type: none"> - Lack of follow-up to check the benefits. - Low number of participants.
Shields et al. ²⁹	<ul style="list-style-type: none"> - Progressive muscular endurance exercise provides improvements in lower limb muscle performance. - High commitment of adults with ID is recommended to ensure benefits from the intervention. - A long duration of exercise program is required to improve muscle strength. 	<ul style="list-style-type: none"> - Lack of control in the intensity, frequency, and duration of the exercise program. - Low number of participants.
Carmeli et al. ²⁸	<ul style="list-style-type: none"> - Prescribe aerobic exercises and leisure activities to reduce anxiety. - Physical exercise raises self-esteem, competence, confidence, and motivation. - Exercise programs increase the care and attention of this population. 	<ul style="list-style-type: none"> - Adherence, commitment, and low motivation. - Lack of measures of well-being, quality of life, and interest in the exercises. - Lack of follow-up to check the benefits. - Low number of participants.
Guidetti et al. ³⁰	<ul style="list-style-type: none"> - Sports specialization is recommended to maintain physical ability. - Inclusion of sports programs in leisure and recreational activities. 	<ul style="list-style-type: none"> - Difficulty in including sports activities.
Mendonça et al. ³²	<ul style="list-style-type: none"> - Physical exercise provides the same physical benefit for adults with ID as for adults without ID. 	<ul style="list-style-type: none"> - Lack of control group that did not perform physical exercise. - Lack of interest, effort, and commitment during the exercises of adults with ID.
Calders et al. ³¹	<ul style="list-style-type: none"> - Physical exercise improves health parameters such as blood pressure and cholesterol. - Combination exercise programs improve cholesterol, muscle strength, and cardiovascular capacity more than programs with specific exercises. 	<ul style="list-style-type: none"> - Lack of dietary control may interfere with the effects of physical exercise and body composition. - Randomization of the sample.
Carraro; Gobbi ³³	<ul style="list-style-type: none"> - Physical exercise is recommended to reduce anxiety. - Physical exercise is an interesting strategy for maintaining mental health. 	<ul style="list-style-type: none"> - Lack of knowledge of the mechanism or aspect of physical exercise that reduces anxiety (e.g., physical involvement, social relationship, etc.). - Lack of follow-up to check the benefits.

Source: The authors

Discussion

The main objective of this study was to verify, through a systematic review, the effects of physical activity programs for adults with ID. In general, the physical exercise programs had a positive effect on the physical capacity and anxiety of adults with ID. Three types of physical activity programs for adults with ID were the most commonly indicated in the search for improvement in the quality of life of this population: combined exercises of strength and

muscular endurance, aerobic activities, and sports specialization, although the combined exercises of strength and muscular resistance are more effective than aerobic activities for some aspects (blood pressure, muscular strength of the abdomen, lower limb and upper limb, mobility, and muscular resistance to fatigue). In addition, effects of generalized, therapeutic, recreational, and leisure activities were also analyzed by the studies for the population in question. However, the latter had limited and doubtful efficacy for adults with ID, as they performed short-term interventions only once or twice a week, as well as including few structured activities and mostly with little movement. Although conventionally indicated for adults with ID, interventions involving aerobic activities seem to have less effect than programs that combine muscle strength and aerobic endurance. Aerobic exercise programs have a positive effect on the aerobic capacity, anxiety, and quality of life of adults with ID^{28,31,32} due to the increased functionality of specific mitochondrial enzymes of the muscular system, promoting benefits for this population^{28,31,32}. In addition, aerobic exercise stimulates brain function by influencing neurotransmitters of the central nervous system, such as dopamine and serotonin, among others. These neurotransmitters are responsible for regulating mood, and consequently, behavioral aspects^{34,35}. However, this type of intervention has shown few benefits in other aspects of physical capacity, such as muscular strength. Exercise programs that combine muscular strength with aerobic resistance are indicated for adults with ID to provide benefits, besides those already indicated for aerobic exercise, to the peripheral nervous system, helping to reduce heart rate and blood pressure^{31,36}. In addition, muscle strength exercises promote benefits in balance, postural stability, agility, flexibility, bone mineral density, muscle mass, well-being, and quality of life^{27,29,31,32}. However, interestingly, a specific program with muscle strength exercises was not recommended in any of the studies as the only intervention for adults with ID, as this type of exercise was always combined with another type of exercise. Possibly the small effect on cognitive ability presented by adults with ID after interventions including exclusively muscle strength is an explanation for the fact that no study used this type of intervention.

An interesting alternative in physical exercise programs for adults with ID is sports specialization. This type of program promoted benefits in motor skills and aspects of social integration^{30,37}. The studies indicated that collective sports are an attractive activity for adults with ID, partly to develop the physical and motor aspects but mainly for incorporating social relationships through interpersonal relationships^{30,34}. Furthermore, individual sports, such as running, improve balance and cardiovascular aspects that are impaired in adults with ID²⁷.

Our second objective was to discuss the benefits, limitations, and recommendations of physical activity programs for adults with ID investigated in the literature. Overall, this review has shown that, with one exception²⁶, systematic exercise programs promote consistent and significant benefits for adults with ID. However, there seems to be no consensus on the type of intervention to be used to promote the practice of physical activity in adults with ID. Despite this, from this systematic review we can identify that the benefits of the physical activity programs found were dependent on the intensity, duration, frequency, and type of proposed activity. Additionally, the physical activity programs seem not to be specific to the population in question, being adaptations of programs developed for adults without disabilities.

The intensity, duration, and type of exercise appear to be essential parameters to provide benefits in adults with ID. Low-intensity physical exercise, such as recreational and leisure activities, seem to benefit aspects related to well-being, anxiety, self-confidence, and mood in adults with ID^{28,30,33}. However, aspects of physical capacity, and especially those related to health, only improved after interventions that presented moderate or high intensity.

For example, physical exercise only provided benefits for hypertension when the activity intensity was around 70% of maximum oxygen consumption, at least three times a week and lasting more than 30 minutes^{36,38}. Furthermore, duration and frequency of activities appear to be important for the development of exercise programs for adults with ID. Activities performed once a week seem to be sufficient to improve the individual's well-being, whereas for improvements in physical fitness components, such as strength and muscular endurance, a weekly program (two or three times) is necessary. In addition, session time should be controlled. The studies that presented short sessions (20-40 minutes) observed benefits in psychological aspects²⁸, whereas studies that performed longer session times, around 70 minutes, also obtained improvement in physical capacity and health aspects³¹. One possible explanation for this is that physical activity programs that do not meet ACSM³⁹ recommendations, 3 to 5 times weekly physical activity with a minimum duration of 40 minutes, are not capable of promoting metabolic, neural, or morphological alterations.

Physical exercise programs for adults with ID are not specifically formulated for this population, being adaptations of programs for adults without disabilities. None of the studies in this review indicated a physical exercise program that was specifically formulated for the population in question. This seems to be an important limitation of exercise programs for adults with ID. Specific characteristics of this population, such as limitations in the understanding of activities, lack of motivation, interest, and effort, a tendency to obesity, and limitations in the area of adaptive skills, among others, should be considered for the ideal planning of the physical exercise program. Moreover, consideration of the specific characteristics of each type and/or stage of ID, for example, adults with Down syndrome present cardiopathy and hyperflexibility (hypotonia), among others¹⁹, is important for the exercise program to promote the expected benefits. In this way, training effects and recommendations should be differentiated for people with Down syndrome or with other intellectual disabilities. Thus, we recommend that future studies and physical exercise programs for people with ID are formulated considering these specificities.

Biases of the studies methodological quality

Our systematic review showed a limited number of studies that investigated, in a structured way, the effect of physical activity programs for adults with ID. One of the challenges of scientific studies on intervention effects that includes human contact between participants and professionals is to address the recommendations and risks of bias in the construction of the research itself. The first challenge is the "blinding" of participants and evaluators. When a participant acts and behaves as instructed by the instructor it is inconceivable to think that the instructor does not perceive that the volunteer is responding to a scheduled intervention. For the evaluator or instructor administering the intervention protocol, remaining "naive" is only possible in relation to the study objectives and results of evaluations (carried out by other professionals), but not to the positive effects of physical activity on participants. Moreover, there is no "placebo" context in physical activity programs. Finally, other elements such as secrecy in participant allocation also reflect the same blinding problem. Randomization of participants may be achieved at the start of the research, but ethically it is required that the opportunity to experience the context of the experimental intervention, especially if positive effects are confirmed, be offered to all groups. Thus, the main items to be considered in future studies, in this order of importance are: randomization of participants between intervention and control groups; blinding of the evaluated individuals, the evaluators, and the professionals regarding the results of evaluations; secrecy in the allocation of participants; and description of losses and exclusions.

Study limitations

Despite consistent findings, our study has some limitations. First, the studies reviewed were limited to manuscripts in English, which potentially led to the exclusion of literature published in other languages. Second, despite the quality of the articles included in this systematic review, many doubts arise regarding the way the activities were developed and programmed. The quality assessment highlighted a few methodological shortcomings in the reviewed studies that need to be considered. However, it is important to recognize the difficulty in reaching this group of participants, as well as their adherence to physical activity programs, and the influence of environmental and personal factors. Third, it is still unclear what the format of an adult physical activity program with ID should be. Therefore, it is recommended that future studies clarify the strategies of development of activities and planning of the physical exercise programs for this population and not only based on the benefits that the physical exercise can provide. Fourth, small samples weaken the findings of studies, and studies with a larger number of participants are recommended. However, the heterogeneous characteristic and rarity of the available sample (for example, severe ID) often prevent this recommendation being followed. In addition, there is no normalization regarding the inclusion of a sedentary control group of adults with ID, and thus, care is necessary so that the results are not masked. Fifth, some studies included adults and older adults with ID in the same research group. Therefore, these studies ignored the effects of aging on the analyzed variables, and it is recommended that in future studies this analysis be performed separately, studying adults and elderly with ID in different groups. Based on the above, generalization of the conclusions of this review should be considered with caution.

Conclusion

Based on the present systematic review, we can conclude that the benefits of exercise programs seem to be in accordance with the goal to be achieved from the intervention, although the combined exercise program of muscle strength and aerobic exercise achieved multiple benefits for quality of life, health, and physical capacity in adults with ID. In addition, it seems that interventions involving aerobic exercise, sports specialization, and a combination of muscle strength and aerobic exercise performed 2 or 3 times a week for more than 40 minutes are recommended for adults with ID. However, intervention studies with physical activity for adults with ID present biases in methodological quality. Thus, it is recommended that future studies compare different types of interventions for adults with ID to advance the knowledge about which intervention is more appropriate and effective for this population, considering the indications of this systematic review.

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Received on Nov, 24, 2016.
Reviewed on May, 06, 2017.
Accepted on Jun, 25, 2017.

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