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Article

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The influence of sprint interval training on body composition, physical and metabolic fitness in adolescents and young adults with intellectual disability: a randomized controlled trial

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Abstract

Objective: In this study we evaluated the effect of sprint interval training on metabolic and physical fitness in adolescents and young adults with intellectual disabilities when compared with continuous aerobic training and no training (control).

Methods: Fifty-four persons with intellectual disabilities (age: 17 (3.0), body mass index: 27.7 (3.7), intelligence quotient: 59 (8.6)) were matched based on age, gender and intelligence quotient between sprint interval training (n = 17), continuous aerobic training (n = 15) and control (n = 14). Sprint interval training was composed of three blocks of 10 minutes at ventilatory threshold (blocks 1 and 3: 10 sprint bouts of 15 seconds, followed by 45 seconds relative rest; block 2: continuous training) twice a week for 15 weeks. Continuous aerobic training was composed of three blocks of 10 minutes continuous training. After eight weeks, intensity was increased to 110% of ventilatory threshold. The control group did not participate in supervised exercise training. Before and after the training period, body composition, physical and metabolic fitness were evaluated.

Results: Sprint interval training showed a significant positive evolution for waist circumference, fat%, systolic blood pressure, lipid profile, fasting insulin, homeostasis model assessment of insulin resistance, peak VO_2, peak Watt, ventilatory threshold, 6-minute walk distance and muscle fatigue resistance when compared with no training ($P < 0.01$). The sprint interval training group demonstrated significant improvements for fat%, systolic blood pressure, low-density lipoprotein, fasting insulin, peak VO_2 and peak power and ventilatory threshold ($P < 0.01$) when compared with continuous aerobic training.

Conclusion: In this study we could observe that sprint interval training has stronger beneficial effects on body composition, physical fitness and metabolic fitness compared with control. Compared with continuous aerobic training, sprint interval training seems to result in better outcome.

Keywords

Physical fitness, metabolic fitness, intellectual disability, sprint interval training, continuous aerobic training

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Introduction

It has been well documented that persons with intellectual disability (ID) have suboptimal levels of cardiovascular fitness compared with persons with a typical development.[1,2,3] The decreased muscle strength, aerobic capacity, fat-free mass and increased fat mass are associated with a reduced metabolic condition (unfavourable lipid profile).[4,5]

Regular physical activity has beneficial effects on body composition, physical fitness and cardiovascular risk among individuals in the general population of all ages without ID.[6]

In adolescents and young adults with ID, Varela et al.[7] and Millar et al.[8] reported no effects on body composition, while Ordonez et al.[5] reported a significant decrease in fat mass after endurance training. These studies found no significant improvement in aerobic capacity but showed that work performance and time to exhaustion did significantly improve. Concerning metabolic fitness, only one study was published and found a significant positive and clinical relevant effect.[9]

Concerning strength or resistance training in persons with ID Weber and French[10] and Shields and Taylor[11] reported a significant improvement in muscular strength after weight training, but effects on metabolic fitness were not investigated.

A case study of Lewis and Fragala-Pinkham[12] showed an improvement of aerobic and anaerobic capacity in a 10-year-old child with Down Syndrome after six weeks combined aerobic and strength training, without changes in body composition. Elmahgoub et al.[13,14] reported a significant improvement of aerobic capacity, muscle strength and lipid profile in adolescents with ID.

Another exercise training mode with a lot of potential is interval training. Interval training (IT) is defined as vigorous exercise performed at a high intensity for a brief period of time interposed with recovery intervals at low-to-moderate intensity or complete rest. Two distinct types of IT are sprint interval training (SIT) and aerobic interval training (AIT).[15] Investigations examining IT report improvement of sub-maximal and maximal exercise capacity, mitochondrial biogenesis, enzymatic markers associated with glycolysis, aerobic metabolism and beta-oxidation better than continuous aerobic exercise training in the general population.[15–18] Only one study evaluated the effects of IT compared with endurance training in overweight individuals without ID. The endurance group performed 30 to 60 minutes continuous exercise at 80% of the peak heart rate (HR). The IT group performed three to six sets of 60-seconds sprint at 100% of the peak velocity interspersed by a 3-minute active recovery period at 50% of the exercise velocity, twice a week for 12 weeks. In both groups physical and metabolic parameters, focusing on insulin sensitivity, were significantly ameliorated, but with the same magnitude.[19]

There are no published reports concerning this training modality in a population of adolescents and young adults with ID. Therefore the purpose of our study is to evaluate the effect of SIT on anthropometric variables, physical and metabolic fitness in adolescents and young adults with ID compared with the effect of continuous aerobic training (CAT) and a control (CON) group.

Methods

For this study 70 adolescents and young adults with ID, all of which were attending secondary school at two Belgian special education schools (Ravelijn, Brugge and De Varens, Brugge), were eligible.

From these subjects, 54 people were selected so three groups of 18 participants could be matched for age, sex and intelligence quotient (IQ). If three people with the same age, sex and IQ were available, they were randomly allocated to one of the three groups, SIT, CAT or CON (Figure 1).

All participants were living with their families and had no severe physical impairments that could interfere with the training programme or testing protocols. In addition, all participants were able to communicate and understand instructions given by the physiotherapists during training and testing.

All subjects and their parents were informed about the purpose of this study, its risks and procedures. A signed informed consent was provided by all participants and their parents before study admission. The research study was approved by the ethics committee of the Ghent University Hospital.

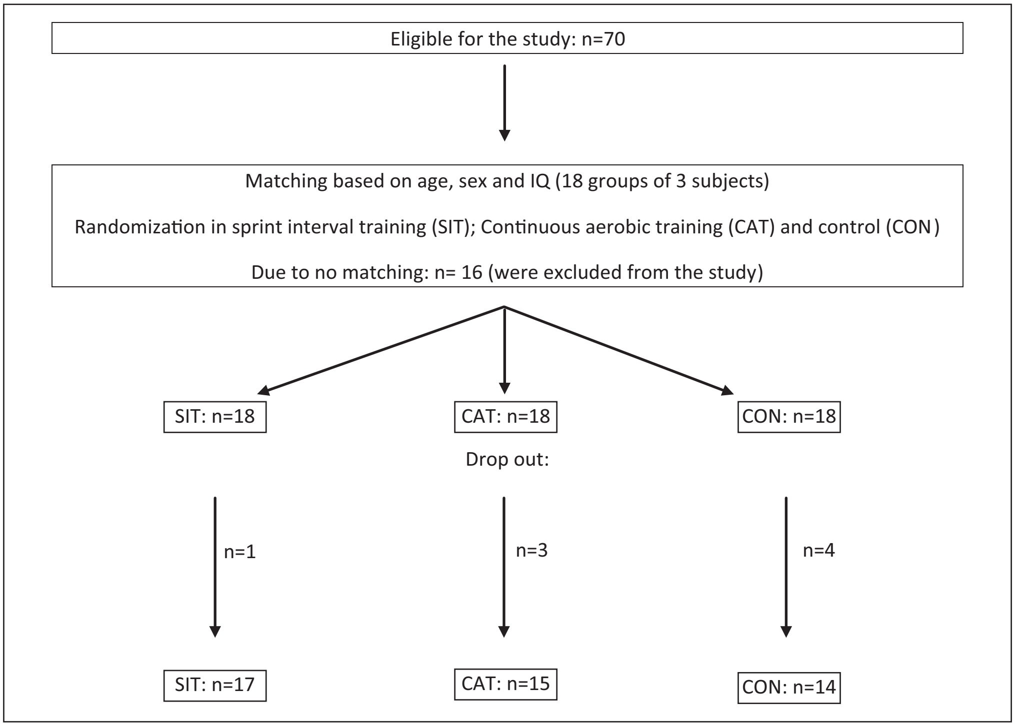

Figure 1. Participants flow diagram depicting the matching and randomization procedure during the trial. Drop-out numbers are also indicated, which were caused by other non-educational commitments.

Adolescents were diagnosed as fragile X syndrome, foetal alcohol syndrome, Prader–Willi syndrome, hydrocephalus, pervasive developmental disorder, Sotos syndrome and Steinert syndrome. In several participants, autism, epilepsy or attention deficit hyperactivity disorder was associated with the ID. The medical record of nine intellectually disabled individuals did not contain specific information about the associated impairments or the cause of their ID.

In many participants, lower limb (flat foot, varus and valgus knee misalignment), pelvic deformities (malposition of Spina Iliaca Posterior Superior and Spina Iliaca Anterior Superior) or both were noticed. We observed no severe interference of these deformities with their performance during the training programme or testing protocols. General descriptive statistics are shown in Tables 1 and 2.

The training programme was conducted in the physiotherapy wing at the special education schools. The SIT group followed a 15-week training programme. The adolescents exercised for 40 minutes, twice a week. The training was supervised by three physiotherapists and integrated into the school programme replacing the usual physical education lessons. Each training session included a warm up (stretching of the large muscle groups and cardiovascular exercises at 30% of peak Watt for five minutes), a sprint interval block (10 minutes), continuous aerobic exercise (10 minutes), another sprint interval block (10 minutes) and cooling down (stretching of the large muscle groups and cardiovascular exercises at 30% of peak Watt for 5 minutes). For the first seven weeks, each sprint interval block consisted of 10 sprint bouts (>100 r/min) of 15 seconds at a resistance matching with the ventilatory threshold (VT_R), alternated with 45 seconds relative rest (50 r/min at VT_R). Starting from week 8 until week 15, the intensity of sprinting and relative rest was increased up to 110% of VT_R. All exercises consisted of cycling.

Table 1. Influence of SIT and CAT on indices of anthropometry, blood pressure and lipid profile.

Variables	SIT (n = 17)		CAT (n = 15)		Control (n = 14)	
	Pre	Post	Pre	Post	Pre	Post
General						
Age	18 (3.2)		16.7 (3.6)		17.4 (2.4)	
Gender male/female	11/6		10/5		9/5	
IQ	59.2 (9.1)		57.3 (7.9)		59.1 (9.3)	
Anthropometry						
Weight (kg)	76.8 (18.3)	76.0 (19.1)	77.9 (9.3)	77.6 (8.5)	79.3 (14.7)	80.0 (14.4)
Height (cm)	163.7 (9.5)	164.6 (9.6)	168.3 (7.1)	170.1(7.9)	171.2(12.1)	171.9(11.5)
BMI (kg/m^2)	28.4 (4.7)	27.7 (4.7)	27.5 (2.7)	26.9 (3.1)	26.9 (3.2)	26.9 (2.9)
Waist (cm)	95.8 (13.1)	91.5 (13.1)*	95.9 (9.6)	93.4 (9.6)*	95.0 (8.8)	95.9 (8.2)
Fat (%)	34.2 (6.9)	30.4 (7.0)*$	32.3 (7.0)	31.3 (6.6)*	32.0 (7.1)	32.0 (7.0)
Blood pressure						
SBP (mmHg)	124 (10)	113 (8)*$	121 (11)	119 (9)	118 (10)	119 (10)
DBP (mmHg)	74 (7)	77 (8)	72 (8)	73 (9)	72 (5)	72 (5)
Lipid profile						
Chol. (mg/dL)	169.8 (25.2)	154.8 (22.9)*	162.9 (26.6)	164.0 (31.3)	169.6 (29.7)	171.9 (25.8)
HDL (mg/dL)	54.9 (13.5)	59.4 (11.4)*	48.9 (9.4)	49.7 (10.6)	59.3 (16.9)	55.9 (15.6)
LDL (mg/dL)	105.2(12.4)	95.6 (9.3)*$	96.4 (24.8)	97.4 (28.5)	92.6 (23.5)	96.0 (21.2)
Tri (mg/dL)	79.2 (22.2)	70.8 (16.7)*	91.5 (50.4)	87.5 (50.3)	96.6 (75.6)	95.0 (85.6)
Glucose (mg/dL)	86 (7.6)	85 (7.1)	88 (6.7)	85 (5.1)	86 (6.1)	85 (4.1)
Insulin (IU/mg)	14 (5.9)	11 (4.0)*$	13 (5.3)	12 (4.7)	12 (3.6)	13 (3.7)
HOMA-IR	2.9 (1.3)	2.3 (0.8)*	2.9 (1.3)	2.6 (1.1)*	2.6 (0.8)	2.7 (0.9)

Data are presented as mean (standard deviation). Between groups analysis of variance with post-hoc Bonferroni was used to evaluate time and interaction effects.
SIT, sprint interval training; CAT, continuous aerobic training; BMI, body mass index; Chol, cholesterol; DBP, diastolic blood pressure; HDL, high-density lipoprotein; IQ, intelligence quotient; LDL, low-density lipoprotein; SBP, systolic blood pressure; Tri, triglyceriden; HOMA-IR, homeostasis model assessment of insulin resistance.
*$p < 0.05$ significant different evolution SIT vs. CON or CAT vs. control; $$p < 0.05$ significant evolution SIT vs. CAT.

The protocol of the CAT group consisted of warming up (stretching of the large muscle groups and cardiovascular exercises at 30% of peak Watt for five minutes), cycling (10 minutes), walking/running (10 minutes), stepping (10 minutes) and cooling down (stretching of the large muscle groups and cardiovascular exercises at 30% of peak Watt for five minutes). During the continuous aerobic protocol (cycling, running, stepping) participants cycled for 10 minutes at a HR similar to the HR at VT (60 r/min), which was increased to 110% of VT from week 8 onwards. The subjects in the control group participated in usual everyday scholar activities without supervised exercise training.

The quantification of all examined variables was performed by blinded assessors (done by the co-authors). All tests and measurements were conducted at the exercise laboratory of the Physiotherapy Department, Ghent University. Prior to all tests and measurements, participants were well informed and familiarized with the equipment and testing protocols. All participants from each of the three groups were tested on the same day pre- and post-intervention.

Anthropometry

Height was measured to the nearest 0.1 cm using a stadiometer (Holtain Ltd, Pembrokeshire, UK). Weight was measured to the nearest 0.1 kg on a

Table 2. Influence of SIT and CAT on indices of physical fitness.

Variables	SIT (n = 17)		CAT (n = 15)		Control (n = 14)	
	Pre	Post	Pre	Post	Pre	Post
Physical Fitness						
Peak VO_2 (L/min)	2.4 (0.7)	2.6 (0.6)*$	2.5 (0.6)	2.4 (0.6)	2.3 (0.6)	2.2 (0.5)
Rel. peak VO_2 (ml/kg/min)	31.5 (5.2)	31.4 (4.8)	31.4 (6.8)	31.2 (6.6)	28.7 (5.7)	27.4 (4.6)
Peak power (W)	155.0 (36.6)	178.8 (41.3)*$	179.0 (42.6)	178.7(42.7)	166.8 (45.7)	158.9 (46.8)
Peak HR (bpm)	178.4 (12.4)	175.5 (13.0)	181.3 (8.5)	174.3 (15.5)	180.3 (15.4)	177.9 (14.3)
VT (W)	99.7 (25.1)	120.6 (32.2)*$	90.3 (24.5)	98.3 (20.3)*	86.1 (27.9)	82.9 (22.7)
VT (VO_2)	1.6 (0.5)	1.8 (0.5)*$	1.4 (0.3)	1.5 (0.3)*	1.2 (0.3)	1.2 (0.3)
6MWD (m)	598.2 (63.6)	665.9 (69.4)*	538.7 (105.0)	619 (72.2)*	567.0 (69.4)	591.8 (82.7)
MFR (s)	13.7 (7.5)	19.9 (6.8)*	19.5 (9.9)	22.5 (10.9)*	21.3 (13.8)	19.2 (11.4)
Sit-to-stand (amount/30 s)	16.8 (4.0)	16.0 (3.4)	20.8 (6.4)	21.7 (6.5)	15.1 (4.4)	16.3 (2.8)

Data are presented as mean (standard deviation). Between groups analysis of variance with post-hoc Bonferroni was used to evaluate time and interaction effects.
6MWD, 6-minute walk distance; MFR, muscle fatigue resistance; CAT, continuous aerobic training; SIT, sprint interval training; peakVO_2, peak oxygen consumption; peak HR, peak heart rate; Rel peak VO_2, relative peak VO_2;VT, ventilatory threshold; *$p < 0.05$ significant different evolution SIT vs. Control or CAT vs. control.
$\$p < 0.05$ significant evolution SIT vs. CAT.

digital balance scale (Seca, Germany) with the subject wearing lightweight clothing and no shoes. The body mass index (BMI) was calculated from weight and height. Waist circumference was measured by a tape meter at the level of the umbilicus with the subject in a standing position after normal expiration. Fat mass and fat-free mass were assessed by bioelectrical impedance analysis (Bodystat 1500 MDD, Douglas, Isle of Man, UK). Subjects were in the supine position for at least five minutes. Surface electrodes were attached to the dorsal side of the right foot and the dorsal side of the right wrist. Fat mass and fat-free mass were calculated using the formula of Wabitsch.[20]

Physical fitness

Maximal cardiopulmonary exercise test. Participants were tested on a computer-driven cyclo-ergometer (Marquette Case, Marquette Electronics, Milwaukee, WI, USA) using a ramped protocol (15 W/min) starting at 30 W. Twelve-lead electrocardiogram and HR were recorded continuously during the test, whereas blood pressure was measured with a manual sphygmomanometer every two minutes. Subjects were familiarized with the test procedure before baseline testing. Subjects were asked and encouraged to perform exercise testing until physical exhaustion or until the physician stopped the test because of severe adverse events, such as increasing chest pain, dizziness, potentially life threatening arrhythmias, clinically important ST-segment deviations, marked systolic hypotension or hypertension. Tests were classified as maximal as Respiratory exchange ratio (RER)>1.1. Respiratory gas measurements were obtained by using a Metalyzer 3B (Cortex, Leipzig, Germany). Oxygen consumption (VO_2), carbon dioxide production (VCO_2), minute ventilation (VE), tidal volume, respiratory rate and mixed expiratory carbon dioxide concentration were measured continuously with mixed chamber analysis. Peak VO_2 was expressed as the highest attained VO_2 during the final 30 seconds of exercise according to the American Thoracic Society guidelines.

The VT was determined based on the metabolic equivalents of O_2 and CO_2 (VE/VO_2 and VE/VCO_2). The point at which the VE/VO_2 increased without an increase in VE/VCO_2 was identified as the VT.[21]

6-minute walk test. All subjects performed a standardized, self-paced 6-minute walk test (6MWD) in a 20-m long corridor. They were asked to cover as much distance as possible within six minutes without running. Subjects were allowed to stop at any time but were encouraged to restart as soon as possible. During the test, subjects were instructed and encouraged continuously.[22] The distance covered after six minutes was measured to the nearest meter.

Strength

Sit-to-stand test. The sit-to-stand test measures the maximum number of repetitions within 30 seconds that an individual can rise to a full stand from a seated position, without pushing off with the arms and return to a fully seated position. The participant's score is defined as the number of completed stands. This test was developed in a population of older adults and is highly correlated with strength of the lower limbs.[23] In a population with ID, there was also a good correlation of the sit-to-stand with the 1RM of lower limb strength ($r = 0.69$).[13]

Muscle fatigue resistance (MFR). The participant had to squeeze the hand dynamometer with as much force as possible and for as long as possible. The test terminated when grip strength dropped to 50% of its maximum value during sustained contraction. The reliability of this test was evaluated in healthy young subjects and in a geriatric population without ID. The Intra class correlation (ICC) ranged from 0.77 to 0.94 in both groups.[13]

Metabolic fitness

Blood pressure. Resting systolic and diastolic blood pressure was taken seated on a chair at the beginning of the testing after 10 minutes rest. Blood pressure was measured with a manual sphygmomanometer.

Lipid profile. Blood samples were obtained after an overnight fast. The following variables were evaluated using diagnostic kits (Roche Diagnostics) for high-density lipoprotein (HDL)-C (polyethylene glycol (PEG) + cholesterol-oxidase), triglycerides (glycerol phosphate-peroxidase anti-peroxidase (PAP)) and total cholesterol (cholesterol-oxidase-PAP). LDL-C was calculated from total cholesterol and HDL-C.

Homeostasis model assessment of insulin resistance (HOMA-IR)

Fasting plasma glucose and insulin concentrations were measured in the morning (before 10 am). HOMA-IR index was calculated as [fasting serum insulin (mU/L) × fasting plasma glucose (mmol/L)/22.5], with higher values indicating a higher degree of insulin resistance.[24] Glucose (hexokinase method) and insulin concentrations were determined on a Modular P and E, respectively, using Roche Diagnostics consumables (Roche Diagnostics, Mannheim, Germany).

Statistical analyses

All data were analysed with a commercially available statistical software program (Statistical Package for the Social Sciences, SPSS 20.0, SPSS Chicago, IL, USA). Data are expressed as mean and standard deviation (SD). To evaluate pre–post differences between groups, a repeated measure analysis of variance (ANOVA) with post-hoc Bonferroni test was performed.

Results

Groups were matched for age, sex and ID

There were eight drop-outs, one in the interval group, three in the continuous group and four in the control group, owing to other educational commitments. Participants in the intervention groups performed a minimum of 27 sessions (40 minutes each) and a maximum of 30 sessions over 15 weeks. Interruption of training sessions was owing to illness or other commitments. No adverse or side-effects were reported.

After 15 weeks of training, waist circumference and body fat percentage was decreased significantly more in the SIT compared with no training. Only percentage of body fat was decreased more in the SIT group compared with CAT (Table 1).

Systolic blood pressure decreased significantly in the SIT group when compared with the control group and CAT group ($P < 0.01$). Fasting insulin levels decreased significantly after SIT compared with the control group and to CAT. The decrease in insulin sensitivity (HOMA-IR) was more pronounced in the SIT group compared with the control group, but the change was not significantly different from CAT ($P < 0.01$). Lipid profile (triglyceride, total cholesterol, HDL and LDL levels) ameliorated significantly in the SIT group compared with the control group, but only LDL was more decreased compared with the CAT group ($P < 0.01$).

Regarding variables associated with physical fitness (Table 2), SIT demonstrated a significant different evolution on peak VO_2, peak power, ventilatory threshold (W and L/min), 6-minute walk distance and MFR compared with no training ($P < 0.01$). Compared with CAT, there was a more pronounced increase of peak VO_2, peak power and ventilatory threshold (W and L/min) after SIT ($P < 0.01$).

Discussion

The current study registered significant improvements in body composition (waist and fat percentage) after SIT compared with the control group and in fat percentage compared with CAT. Body composition management is an important concept in a population with ID, as Salaun and Berthouze-Arande[25] recently demonstrated that the prevalence of obesity is high among adolescents with ID (average level of 37%). Any attempt to improve the body composition in an overweight population is welcomed, as negative chronic health consequences are well recognised.[26] Unfortunately many studies incorporating aerobic training[6,8,27,28] or combined aerobic and resistance training[27,29] have had no significant effects on body composition indices in a population with intellectual disabilities. Only one study reported small but significant weight loss with combined aerobic and resistance training.[30] The results of our study also did not reveal significant weight loss in either intervention groups. The variability of these results is difficult to explain as none of the studies controlled for dietary intake. One explanation is that after exercise training, satiety associated hormones are higher in overweight individuals.[31] If adolescents with ID have free access to food after training, a negative impact on the overall outcome of body weight is a possibility. On the other hand, a decrease in waist circumference and percentage of body fat were observed in both intervention groups, but fat percentage was more pronounced in the SIT group. The effect of CAT is in line with a recent review by Alberga et al.,[32] reporting strong evidence that aerobic training decreases waist circumference and percentage of body fat in obese adolescents. Only one study evaluated the effect of SIT in obese adolescents without ID. In this publication a positive effect on body composition was reported, but there was no difference between SIT and endurance training.[19]

After SIT we observed significant improvement in resting systolic blood pressure, lipid profile (HDL, LDL, total cholesterol and triglycerides) and insulin sensitivity as measured by HOMA-IR compared with no training, but when compared with CAT only systolic blood pressure (SBP) and LDL were more influenced by SIT ($P < 0.01$).

The effect of aerobic exercise training on systolic and diastolic blood pressure is well established. In a review by Cardoso et al.,[33] overall positive effects on systolic blood pressure, with the largest effect in those with hypertension, was observed. No effect on diastolic blood pressure was reported. Positive effects of IT in adolescents without ID have also been reported in those with normotensive subjects.[34] Our results are in accordance with these results.

Concerning lipid profile, previously two other studies have demonstrated similar favourable results, but this was after combined aerobic and resistance training in overweight individuals with ID.[13,14] Studies in the general population have also revealed that SIT or a combination of aerobic and strength training is more beneficial on the lipid profile compared with aerobic training alone.[15,35] The effects of SIT on insulin sensitivity were recently demonstrated in a review to have moderate to strong favourable influences in a general population[36] and one study demonstrated it in adolescents with obesity without ID.[19] The variability of the results

(+19% to +58%) in these studies could be explained by differences in SIT protocol, length of the intervention programme and means of insulin sensitivity measurement (fasting insulin, HOMA-IR or glucose tolerance test).

Dipietro et al.[37] concluded in their study (comparing the effects of different training intensities on insulin sensitivity) that the effects of low to moderate intensity training were lower than those of high intensity exercise. Another study that specifically compared the effects of IT and CAT in a population of young women demonstrated a 31% decrease in fasting insulin levels ($P < 0.01$) compared with the 9% of CAT (which was not significant).[38] The results of our study revealed a significant decrease of 21% in fasting insulin levels (SIT) compared with 8% (CAT).

The SIT group demonstrated significant improvements in peak VO_2 and peak power compared with control and CAT. Also the ventilatory threshold (expressed as watts and L/min) was increased more in the SIT group compared with the control and CAT group ($P < 0.01$).

This is similar to studies in the general population[18,39–41] who also compared the effects of interval with continuous training.

Poole and Gaesser[42] demonstrated similar findings regarding the VT in which group 1 and 2 performed continuous training at 50% and 70% of VO_2 maximum, respectively, and group 3 performed SIT, three days a week for eight weeks. All three groups demonstrated significant improvements in the VT but the increase of SIT group was superior to the other groups. Enhancement of the VT is important as it improves submaximal exercise performance,[42] functional performance[43]and quality of life.[43]

Tjonna et al.[41] and Ciolac et al.[39] attributed this finding to improved central and peripheral physiological benefits, such as cardiac function and mitochondrial capacity. Likewise, Daussin et al.[44] established that both mitochondrial oxidative capacity and capillary density increased only with SIT and not CAT. Trapp et al.[38] also showed that the SIT group improved mitochondrial capacity by 31% after 15 weeks of training. Unfortunately these variables were not measured in the current study. Considering adolescents and young adults with ID, significant improvements in VO_2 peak were reported, but of small magnitude when combined aerobic and resistance was used.[27,30] On the other hand, studies incorporating CAT only found small improvements in VO_2 peak but with no significance.[7,8]

Peak power also improved significantly by 24 W in the SIT programme with no associated increase after the CAT protocol. This was also the case in both studies by Elmahgoub et al.[13,14] and the study by Calders et al.[27] who reported significant increases in peak power with combined aerobic and resistance training, but not after aerobic training, only in a population of intellectually disabled individuals.

Concerning the functional tests, 6-minute walk test and MFR ameliorated significantly more in the SIT group compared with control, but not to CAT.

A study by Calders et al.[27] previously revealed that a combined aerobic and resistance training programme elicited greater benefits, not only in the 6-minute walk test, but also in the muscle fatigue test compared with aerobic training alone in a population of intellectually disabled individuals. They explained that the combined exercise programme afforded improved quadriceps muscle strength and cardiovascular fitness. The 6-minute walk test is easy and safe to perform, inexpensive, field based and it reflects one's ability to take part in everyday living activities and functional capacity.[22] The benefits of CAT and SIT shown in the current study are especially important in an overweight population with intellectual disabilities who have poor functional ability.[3,29]

Finally, the functional sit-to-stand test revealed no significant improvements in the intervention groups. This can be expected as the sit-to-stand test is highly correlated with the strength of the lower legs.[23] Resistance training was not performed in either of the intervention groups.

Strengths, limitations and future studies

This is the first randomized controlled trial to investigate the effects of SIT in adolescents and young adults with ID. The participants were trained by knowledgeable, experienced and enthusiastic physiotherapists who carefully directed the training sessions. As a result we obtained very accurate and favourable results with no adverse events and excellent programme compliance. A possible limitation of the current study was that a strict randomized controlled trial was not possible. As strong heterogeneity exists in this population, the matching for different criteria was necessary. As such, not all of the participants had an equal chance to be allocated to one of the three groups and could have biased the experimental groups. Furthermore, the participants in the study excluded those with severe musculoskeletal, neurological and cardiovascular problems, and care should be taken to generalize the results of this study. Also, most of the tests applied in this study have previously been applied in other scientific studies within this population, but the validity and reliability of, for example, the MFR test have not been proven for participants with ID. However, performances had increased after the training modalities and therefore we can conclude that training elicited beneficial effects.

Finally the number of participants in each group is small (n = 14 to n = 17) and this may affect the statistical power of the various analyses. As a priori we did not nominate one primary outcome. The purpose was to focus on different aspects of body composition, physical and metabolic fitness.

The outcome of a future study exploring the effects of SIT combined with progressive resistance training and its relationship to function, health, performance and cardiovascular endurance will provide valuable insight and possible additional training recommendations for this population group. Also a study exploring the effects of an aerobic interval vs. SIT may provide differences in practical findings. The same study explored in more homogenous subpopulations with ID, e.g. Down syndrome or fragile X-syndrome (whom is known to have poorer cardiovascular fitness or mitochondrial dysfunction compared with individuals with ID without Down Syndrome or fragile X-syndrome) may also provide valuable feedback.

Clinical messages

- In children and adolescents with intellectual disability, sprint interval training and continuous aerobic exercise improves indices of physical and metabolic fitness.
- Sprint interval training seems to be more effective compared with continuous aerobic exercise training.
- Sprint interval training is feasible and well tolerated in this population.

Conflict of interest

The author declares that there is no conflict of interest.

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