Feasibility and reliability of a physical fitness tests battery for adults with intellectual disabilities: The SAMU DIS-FIT battery

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Abstract

Background: People with intellectual disability (ID) have lower performances in physical fitness (PF) tests than people without ID, a situation that exists during all the life stages. However, the assessment of the PF of persons with ID often uses instruments that were designed for non-disabled people.

Aim: To check the reliability and feasibility of 8 PF tests in adults with mild to moderate ID.

Methods: A cross-sectional study was carried out with a test-retest design in a maximum interval of 2 weeks with 240 adults (160 men and 80 women) with mild to moderate ID in order to assess the feasibility and reliability of the following 8 tests: body mass index (BMI), waist circumference (WC), the timed up & go test (TUG), the deep trunk flexion test (DTF), the hand grip test (HG), the timed stand test (TST), the 30-s sit-up (SUP) test, and the 6-min walk test (6MWT). The complete battery was called the SAMU-Disability Fitness Battery (SAMU-DISFIT). The psychometric properties of the battery, feasibility, reliability, the standard error of the measurement (SEM) and the minimal detectable change (MDC) were calculated.

Results: The TUG, DTF, HG, TST, and 6MWT showed an intraclass correlation coefficient (ICC) from fair to high reliability. Only the SUP test in men had an ICC lower than 0.7 and high SEM values.

Conclusion: The psychometric properties provide robust data on the use of the SAMU-DISFIT battery in people with ID and can be considered a useful tool for assessing PF in adults with mild to moderate ID in future research.

Introduction

The American College of Sports Medicine (ACSM) defines physical fitness (PF) as a set of attributes or capacities that a person has or can acquire with a view to soundly doing daily physical activities. The components that make up PF are both those that are related to the functionality of movements (balance, speed, strength, reaction speed, and coordination) and those that are usually related to health parameters (cardiorespiratory fitness, muscular strength, flexibility, and body composition). According to the World Health Organization (WHO), approximately 3% of the world population has intellectual disability (ID). This means 300 million people in the whole world, a figure that is progressively increasing due to the rise in life expectancy and medical and technological advances. In relation to PF, this group has lower performances than people without ID, a situation that exists during all the life stages.

In spite of the known benefits of physical activity for health, sedentary behaviors are noted among people with ID. The personal, social, and environmental barriers this population comes across to doing physical or sports activities can cause a lack of motivation and foster physical inactivity, which prevents this group from being in good PF.

Numerous studies have demonstrated that practicing physical activity increases PF and, hence, the capacity to independently carry out daily life activities in people with ID, while in other groups it has been noted that it can also improve people's cognitive capacity. To know and to increase the level of PF will help to improve the quality of life of people in their close environment.

In the past decades, numerous studies have been conducted with respect to physical activity adapted to people with disabilities and its implications for health. One of the main problems is a lack of standardized tests to specifically assess PF in people with disabilities. In most studies with people with ID, the tests used were tests for non-disabled people without assessing the conditions for their repeatability and viability in people with ID. However, it is necessary to adapt these tests to the characteristics of people with ID in order to be able to measure their physical condition in an adequate manner. One of the main problems in choosing the right tests and applying them correctly is the diversity of people with ID in relation to their capacity to interpret information. Therefore, on the one hand, it is necessary to use simple tasks for adults with ID so that they can properly understand the oral information offered to them. On the other hand, the complexity of the motor response demanded in the tests must not be too high. The complexity of the instructions and executions means that the tests used with people without ID are not always suitable for the cognitive and physical capacities of people with ID. Thus, two relevant challenges can be identified in creating an instrument for assessing the PF of people with ID: (1) the need to adapt the tests to their cognitive and physical capacities and (2) the need to maintain their motivation and attention.

With respect to PF, some physical components are more important when carrying out common tasks than others. Our study was oriented toward 4 fundamental components of PF in people with ID: body composition, motor fitness, cardiorespiratory fitness, and musculoskeletal fitness. Therefore, a combination of tests was created to evaluate the psychometric variables in people with mild to moderate ID to include them in the estimation of the degree of PF in people with ID.

The main aim of this work was to evaluate the feasibility and reliability of a battery of PF tests adapted to adults with mild to moderate ID.

Methods

Study design

A cross-sectional study with a test-retest design was carried out in a maximum interval of 2 weeks. Participants with ID were recruited from 12 care centers for people with ID.

Participants

A total of 240 subjects (160 men and 80 women) aged between 18 and 65 years old with mild (IQ = 56–70) to moderate (IQ = 40–55) ID were evaluated. Individuals were included if they fulfilled the following inclusion criteria: (i) diagnosed with moderate ID by the official competent administration, (ii) institutionalized, (iii) able to follow simple verbal instructions, and (iv) in possession of medical authorization that reflected their aptitude to carry out physical activity without health risks. The participants who could not walk autonomously and whose ID was related to chromosomal syndromes (e.g., Down syndrome) were excluded from the statistical analyses because of their special anatomical and physiological characteristics; these individuals were analyzed separately.

The legal tutors of the people interested in participating in the study were informed of its aim and methodology. Later, they signed a participation consent form. The study was approved by the Ethical Committee of Biomedical Research of Andalusia (Spain) and followed the Helsinki guidelines for ethical behavior.

Procedures

The participants performed all the tests on 2 non-consecutive days in an interval of 2 weeks. The tests were conducted by the same research team and in the same time slot (10 a.m. - 1 p.m.) in a safe and familiar environment (in their care centers), always in the presence of one or more caregivers of the center itself. Based on the ACSM guidelines, the evaluators gave prior demonstrations to all the subjects about how to perform each of the tests. They also gave simple and clear verbal instructions so as to ease a participant's comprehension. A period of familiarization was not allowed prior to the tests to avoid the learning or conditioning effect on the final results, but the participants had 1 or 2 trials before testing. During the whole measurement process, they were given positive and individualized feedback. In order to guarantee the maximum performance of the participants and to avoid the usual distraction of this group, standardized protocols and instructions were eschewed. If at any moment a subject refused to participate, the measurements were not continued, and the subject was excluded from the study. Any kind of execution error with respect to the correct performance of each test was noted for feasibility test computation.

Measurements

The tests were selected based on their simplicity and having been previously used both in subjects with ID of different ages or cognitive levels and in other populations. However, these tests were also selected in order to assess their psychometric properties, a necessary aspect to unify criteria about the most suitable tests for evaluating people with ID. The low cost of the tests was also a selection factor. Eight field-based fitness tests were proposed to assess the PF of adults with mild to moderate ID.

Firstly, two characteristics with respect to body composition were evaluated: body mass index (BMI) and waist circumference (WC). The following 6 tests were later carried out: the timed up & go test (TUG), the deep trunk flexion test (DTF), the hand grip test (HG), the timed stand test (TST), the 30-s sit-up (SUP) test, and the 6-min walk test (6MWT). The complete battery of tests was called SAMU-DISFIT battery.

Body composition

The BMI was calculated from the weight and the height of the subjects (i.e., kg/m^2). Height was measured with a standard stadiometer, and weight was recorded with a scale. For the WC, the measurement was taken in the medium point between the edge of the 10th rib and the iliac crest. Two measurements were done, and the average of them was established. If the difference between the two measurements was greater than a centimeter, a third trial was performed. The instructions proposed by Suni et al. were followed for the measurement of size and WC.

Motor fitness

The TUG was measured to determine agility, dynamic balance, and capacity of autonomous movement. The result of this test is related to the risk of falls. When signaled, the subject gets up and moves as soon as possible to a line situated 3 m away and returns to the starting position, covering a total distance of 6 m. The fastest result out of two was noted. A modification of this test (comfortable speed) has shown good reliability in people with ID. In this study, the test was done as fast as possible because it seems that people with ID have trouble understanding what "comfortable speed" means.

Musculoskeletal fitness

The DTF was used to evaluate multiarticular flexibility. A measurement bench (10 × 10 × 55 cm, height, width, and length, respectively) was used for the evaluation. Two tries were done, and the best result was chosen, following the indications of Valdivia et al. for children and adolescents. The initial position of the subjects was standing with their legs separated at the width of the waist. The subjects flexed their trunk and knees and put their arms down and behind their legs to slide the cursor of the millimeter bar with the fingertips of both hands. This test was selected because according to our experience, it is easier to perform for people with ID than other flexibility tests (such as the Sit and Reach test) and involved executing a task very similar to tasks of daily life such as taking things off the floor.

The HG was used to measure hand strength and the strength of the forearm muscles, especially of the finger flexors. This test was selected because of its good reliability in people with ID. However, there are no data on its feasibility, and it is necessary to provide this psychometric value. The indications of Kato et al. were followed in carrying out the test. The participants were asked to push as hard as possible after the command “and go”. There were two tries with each hand, with 10 s of rest between them. The best attempt of the four was selected for statistical analysis.

The TST is a reproducible measure of lower extremity functionality. It assesses the resistance strength of the muscles of the lower limbs. In the modification of this test, the subjects held their arms crossed at the height of the chest and completed 10 squats as quickly as possible, and the time required to do them was counted. The best of two tries was selected for statistical analysis. A modification of this test has been used before in people with ID and was selected because, as with the previous test, it was observed that the test was easier for participants if a certain number of fixed repetitions were counted before the start of the test. However, there are no data on its feasibility.

The SUP estimates the resistance strength of the muscles of the abdomen and of the hip flexors. The participants lay down on a mat in a supine position with their knees flexed 90°, their feet pressed on the ground, and their hands on their thighs. To complete the tests, the participants had to slide their hands along their thighs to their kneecap and then return to the initial position. The aim was to do the maximum number of repetitions in 30 s.

Cardiorespiratory fitness

The 6MWT assesses cardiorespiratory fitness and is a self-paced test that requires an individual to walk as far as possible in 6 min on a floor without a slope and without running. The distance walked during the test, measured in meters, is used as the outcome measure. Devices with GPS technology were used for the data collection. Only one try was allowed. The researchers strategically positioned themselves along the established route to motivate the participants. This test was selected because of the ease with which it can be carried out by the subjects, since it does not last until exhaustion and because there are no previous results on feasibility.

Statistical analysis

The data of the participants were analyzed to determine the normality of the distribution and the homoscedasticity (Levene test). To find possible differences between groups (men and women) and between conditions (test and retest), a mixed factorial ANOVA was carried out with the test-retest measurements as the intrasubject factor and the gender as the variable between groups.

Feasibility completion rates were calculated as described by Wouters et al., i.e., not feasible <50%, fairly feasible 50–75%, and feasible >75%. The percentages values indicate the percentage of people who were able to perform the test correctly. The test-retest reliability of the battery was determined by the intraclass correlation coefficient (ICC; two-way mixed model, absolute agreement) with 95% confidence intervals. The ICC was interpreted as follows: Values of 0.90–0.99 reflect high reliability, values of 0.80–0.89 good reliability, values of 0.70–0.79 fair reliability and scores equal to or below 0.69 poor reliability. SEM was calculated in order to determine the absolute reliability and the degree to which the repeated measurements varied in the subjects between the test and the retest. The indications of Atkinson et al. were followed for this calculation, and those of Boer et al. for their interpretation. MDC was also calculated. This shows the minimum change necessary between evaluations that is not a consequence of a measurement error.

Results

The results of the sample recruitment are shown in a flow diagram. In the first phase, 12 care centers were contacted and 753 adults with disabilities participated, of whom 513 were excluded for the following reasons: (i) they did not fulfill the inclusion criteria (e.g., severe ID); (ii) they failed to provide a medical report of sporting fitness; (iii) they rejected taking part in the study; or (iv) they presented other reasons, such as limitations in the receiving/comprehension of the information, illnesses, or feeling ill. For our study, 240 people with ID (160 men and 80 women) were selected from this sample. During the follow-up, there were 14 losses (5 men and 9 women), so the drop-out rate

was 5.8% relative to the final participation in each of the tests (3.12% men and 11.11% women). Of the 226 people included for the analysis, 2 people were excluded due to their inability to correctly carry out 2 or more tests. The final sample for the data analysis consisted of 224 people with moderate ID, of whom 153 were men (mean age: 37.85 years; mean height: 167.78 cm; mean weight: 79.1 kg) and 71 were women (mean age: 38.79 years; mean height: 157.53 cm; mean weight: 74.31 kg).

The ANOVA results showed significant differences ($p < 0.05$) between men and women for several variables of PF, so it was opted to do the analysis of men and women separately. The test-retest reliability and feasibility results in female and male adults with ID are expressed in Table 1 and Table 2. It is also necessary to observe the information provided for the SEM and the MDC in order to be able to properly interpret the changes caused after a physical activity program.

All the tests were feasible (>90%), except the SUP for women (fairly feasible). Fair to high test-retest reliability was found for all the tests in our sample, with values above 0.7 ICC, except for the SUP in men (ICC = 0.56). Apart from the body composition tests, the HG ICC ranged from 0.86 to 0.94 in women and from 0.85 to 0.92 in men (95% IC). The TST (0.77–0.91 and 0.79–0.89, respectively) showed the highest ICC values in the tests, whereas the SUP showed the lowest ICC values in both genders. The TUG had a very good reliability (ICC > 0.8) and the lowest measurement error (SEM = 0.50, 0.49; MDC = 1.38, 1.36; in women and men, respectively). In contrast, the 6MWT showed a relatively high SEM (>38) and MDC (>105), but it was reliable (ICC is 0.73 in women and 0.82 in men). All the SEM values achieved the criterion (SEM < SD1/2) for an admissible measurement precision, except the 6MWT in women (SEM = 38.21, SD1/2 = 36.84) and the SUP for both genders (SEM = 3.12, SD1/2 = 2.96; SEM = 4.46, SD1/2 = 3.36; in women and men, respectively).

Discussion

The psychometric properties (reliability and feasibility) of the PF tests proposed in this study show that the SAMU-DISFIT is an appropriate battery for adults with mild to moderate ID.

The majority of the proposed tests have previously been tested only for reliability in people with ID, and the sample sizes were small. For the TUG and the HG, only 37 subjects were measured by Salb et al. (2015), while for the 6MWT only 46 participants were evaluated. Furthermore, only 62 people were measured with the TST by Cuesta-Vargas et al. (2011), and only 43 individuals were tested with the SUP (Down syndrome). In the present study, a large sample of 224 people with ID and with a wide age range was measured, and it is the first study to show results for men and women separately. Reliability and feasibility levels have been included, as well as MDC and SEM values, providing statistical strength for the study.

The field tests were used because ID adults need to understand and perform all of them easily. In order to create a useful battery for assessing PF in all the care centers, none of the tests required any practice or familiarization, thus making them suitable for a broad ID population.

The BMI and WC presented good values of reliability and feasibility. These are the only tests in which the subjects do not have to make any movement, so the experience of the evaluator is paramount in obtaining a high reliability and feasibility. This may be the reason why it is the test that has obtained the best ICC results in both sexes.

As previous studies pointed out, it is important to indicate the possible consequences of a high BMI and WC, such as cardiovascular problems, osteoporosis, loss of independence, or an increase in morbidity and mortality. Therefore, in order to decrease the body fat percentage in this group, it is indispensable to carry out physical exercise and sports programs, along with education on nutritional habits.

With respect to the TUG, our ICC results are excellent but lower than the results of Salb et al., although our SEM data are better (0.5 s). The small differences could be due to various factors. Their sample was made up of both adults and elderly adults, and a different protocol was used for the TUG. In our study, we did the TUG with the subject moving as quickly as possible, as we consider this to be the most appropriate way to measure agility and dynamic balance, and it has a greater similarity to possible daily actions. In our experience, people with ID have less difficulty understanding and doing tests with specific information (the quickest possible) than understanding and doing tests with subjective information (comfortable speed).

According to recent research, it was also necessary to find suitable and valid field tests that measured agility, cardiorespiratory capacity, and flexibility. Based on the suitability and relevance for the health and daily functioning of people with mild to moderate ID, the 6MWT and the DTF were the tests chosen to evaluate these capacities. The tests obtained a good feasibility and a high reliability both in men (DTF = 0.83; 6MWT = 0.82) and in women (DTF = 0.77; 6MWT = 0.73).

Regarding the DTF, according to the literature reviewed, this is the first study in which the DTF is tested in the ID population. Good ICC values have been found in this and prior studies. Due to the conditions presented and the results obtained, this test is advisable for evaluating flexibility in people with ID.

Although in the majority of studies the Sit and Reach test is used to assess the flexibility of the lower body, in the present work, the DTF was used because the technique involved seems to be simpler, as the participants do not have to keep their knees totally stretched during the test. In addition, as the test is done standing, the movement is more natural than the movement in the Sit and Reach test, since it is more frequent in a person’s daily activity (e.g., picking things up from the floor). In any case, this test could be individualized according to the subjects’ anthropometric characteristics. To do so, it is proposed to relate them, for example, to the length of the arms and legs. This procedure has already been proposed for people without ID.

Conclusion

The battery proposed represents an advance in the assessment of PF of adults with mild or moderate ID. The main strength of the present study lies in the fact that it provides information on the psychometric properties (reliability, feasibility, MDC, and SEM) in people with ID in tests that can measure some of the fundamental components of PF.

Thus, the SAMU-DISFIT battery can be considered a useful tool for assessing PF in adults with mild to moderate ID in future research.

Of all the tests performed, the TUG, DTF, HG, TST, and 6MWT show an ICC from fair to high reliability. However, only the SUP in men had a correlation below 0.7, so this test should be used with caution.

Since the population with ID is increasing, we think that further detailed studies are necessary to explore whether the SAMU-DISFIT battery could achieve greater reliability and feasibility in both young and old people with ID.

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Declaration of Competing Interest

No conflicts of interest have been declared.

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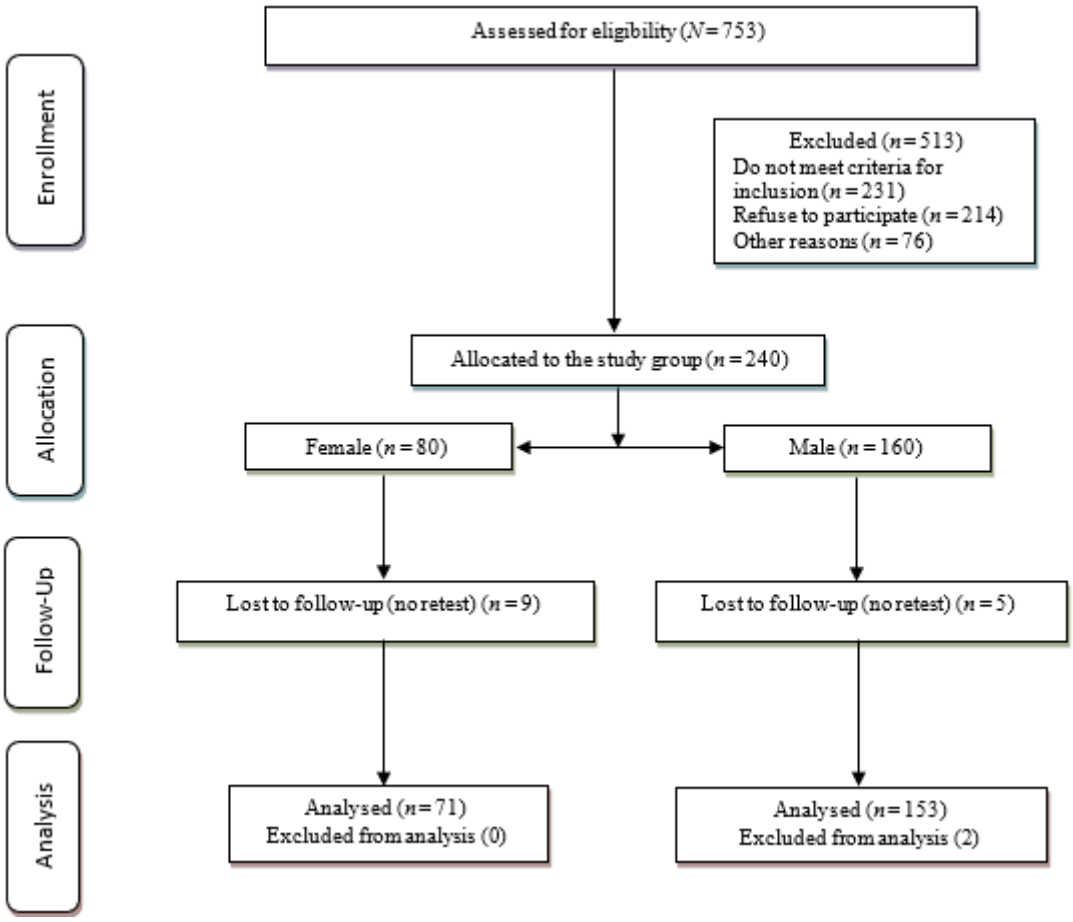
Enrollment
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Follow-Up
Analysis
Assessed for eligibility (N = 753)
Excluded (n = 513)
Do not meet criteria for inclusion (n = 231)
Refuse to participate (n = 214)
Other reasons (n = 76)
Allocated to the study group (n = 240)
Female (n = 80)
Male (n = 160)
Lost to follow-up (no retest) (n = 9)
Lost to follow-up (no retest) (n = 5)
Analysed (n = 71)
Excluded from analysis (0)
Analysed (n = 153)
Excluded from analysis (2)

Table 1.

Test-retest reliability in female adults with intellectual disabilities

		n	TEST Mean (*SD*)	RE-TEST Mean (*SD*)	ICC (95% CI)	SEM	MDC	FEASIBILITY %
Body composition	Waist circumference (cm)	71	96.21 (15.93)	95.99 (15.81)	0.96 (.934 - .974)	3.25	9.02	99.30
	Body Mass Index (kg/m^2)	71	30.09 (6.64)	30.04 (6.73)	0.99 (.992 - .997)	0.67	1.85	97.20
Motor fitness	Timed up & go test (s)	71	4.80 (1.20)	4.80 (1.05)	0.81 (.704 - .874)	0.50	1.38	100
Musculoeskeletal fitness	Deep trunk flexibility test (cm)	71	34.53 (7.49)	34.28 (7.16)	0.77 (.648 - .851)	3.53	9.78	91.55
	Hand grip (kg)	71	20.45 (6.68)	21.31 (6.14)	0.91 (.861 - .944)	1.91	5.30	99.30
	10 Timed-Stand Test (s)	71	20.65 (5.79)	20.50 (6.92)	0.85 (.771 - .906)	2.44	6.78	97.20
	30 second Sit-up (number)	71	15.88 (5.91)	17.57 (5.94)	0.72 (.562 - .831)	3.12	8.65	73.95
Cardiorespiratory fitness	6 min walk test (m)	71	482.73 (78.30)	472.82 (69.06)	0.73 (.599 - .824)	38.21	105.93	99.30

Notes: SD= standard deviation; ICC = intraclass correlation coefficient; CI = interval confidence; SEM = standard error of measurement; MDC = minimal detectable change

Table 2.

Test-retest reliability in male adults with intellectual disabilities

		n	TEST Mean (*SD*)	RE-TEST Mean (*SD*)	ICC (95% CI)	SEM	MDC	FEASIBILITY %
Body composition	Waist circumference (cm)	153	97.45 (13.90)	97.54 (13.66)	0.96 (.948 - .972)	2.69	7.44	100
	Body Mass Index (kg/m^2)	153	28.09 (5.47)	28.13 (5.41)	0.99 (.995 - .996)	0.54	1.51	99.65
Motor fitness	Timed up & go test (s)	153	4.38 (1.18)	4.26 (1.22)	0.83 (.778 - .876)	0.49	1.36	99.65
Musculoeskeletal fitness	Deep trunk flexibility test (cm)	153	35.39 (8.45)	36.16 (8.04)	0.83 (.773 - .875)	3.39	9.39	95.75
	Hand grip (kg)	153	28.98 (9.59)	29.79 (8.91)	0.89 (.854 - .920)	3.05	8.46	99.00
	10 Timed-Stand Test (s)	153	18.84 (6.10)	18.13 (5.71)	0.85 (.794 - .886)	2.32	6.43	97.35
	30 second Sit-up (number)	153	17.64 (6.03)	19.60 (7.41)	0.56 (.429 - .666)	4.46	12.37	85.60
Cardiorespiratory fitness	6 min walk test (m)	153	538.61 (93.99)	527.88 (100.02)	0.82 (.762 - .867)	41.04	113.76	99.65

Notes: SD= standard deviation; ICC = intraclass correlation coefficient; CI = interval confidence; SEM = standard error of measurement; MDC = minimal detectable change