Measuring physical fitness in persons with severe or profound intellectual and multiple disabilities
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Chapter 4

Feasibility and reliability of two different walking tests in subjects with severe intellectual and sensory disabilities.

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Abstract

Background. The purpose of this study is to describe feasibility and test-retest reliability of the six-minute walking distance test (6MWD) and an adapted shuttle run test (aSRT) in persons with severe intellectual and sensory (multiple) disabilities (SIMD).

Materials and Methods. Forty-seven persons with SIMD, with Gross Motor Function Classification System (GMFCS) grade I and II and wearing a heart rate monitor, performed the 6MWD and the aSRT twice.

Results. 96% of the participants completed both tests successfully. Wilcoxon signed rank test revealed no significant differences between test and retest (p<0.05). Intra Class Correlation coefficients for all variables were ≥.90. Limits Of Agreement for aSRT in GMFCS-II subjects were insufficient.

Conclusion. 6MWD is feasible and reliable for measuring functional exercise capacity in GMFCS-I and II participants with SIMD. aSRT is feasible and reliable for measuring aerobic capacity in GMFCS-I participants. Compared to others, participants with SIMD achieved poor results in 6MWD.
Introduction

People with intellectual disabilities (ID) make up about 1% of the population of Europe [1]. This percentage is based on the WHO population prevalence estimate [1]. Comorbidity in persons with intellectual disabilities is more frequent and patterns of comorbidity differ from the general population [2]. Obesity in women and underweight in both men and women is more common in adults with ID than in the general population after controlling for differences in the age distributions between the two populations [3]. Mc Guire et al. [4] found that 68% of their ID sample was overweight or obese, participation in exercise and adherence to a healthy diet are poor. Other authors described these lifestyle problems in adults with low or moderate ID too: these persons often suffer from overweight and may have poor physical fitness [5, 6, 7]. Adults with ID often are not sufficiently active to achieve health benefits [8, 9].

According to the Toronto model [10], physical fitness and health are related in the sense that good physical fitness decreases health risks and improves wellbeing and quality of life [11, 12, 13]. Health can be defined as a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity (World Health Organization, WHO) [14, 15]. In addition, health is considered a resource for everyday life, not the objective of living. Health is a positive concept emphasizing social and personal resources, as well as physical capacities [16]. Bouchard et al. [17] give the following definition of health related physical fitness: ‘Health related physical fitness is defined as a set of attributes that people have or achieve that relates to the ability to perform physical activity’. According to Caspersen et al. [18] and Pate [19], physical fitness is a set of attributes that are either health-related or skill-related that pertain more to athletic ability. The health-related components of physical fitness are (a) cardiorespiratory endurance, (b) muscular endurance, (c) muscular strength, (d) body composition, and (e) flexibility. These components of physical fitness are more important to public health than are the components related to athletic ability, especially in persons with multiple disabilities, therefore, we limit our discussion to these.

Wuang et al. [20] described that the IQ level substantially predicted overall performance on motor tests. Physical fitness in persons with a visual disability is poorer than in persons without disabilities [21, 22, 23]. Furthermore, a considerable number of persons with both severe intellectual and sensory disabilities are at risk for a variety of health problems [24], among others inactivity, overweight and obesity. The women appear at a higher risk for developing health problems compared to the men [25]. Apart from that, these health burdens often are associated with low levels of physical fitness [8]. Therefore, it is important to get insight in the physical fitness status in these individuals.

Cardiorespiratory endurance, a component of health-related physical fitness [18], can be divided into aerobic power and cardiovascular capacity [17]. This implies that assessment of health-related physical fitness includes measures of aerobic capacity as well as functional exercise capacity [17], both objective measures of fitness level [26]. Aerobic capacity is the ability of the cardiovascular system to deliver oxygen rich blood to body tissues [17], functional exercise capacity is an objective measure of one’s ability to undertake the activities of day-to-day life [27].

Timed walking tests are accepted methods to assess both above mentioned components of health-related physical fitness and to examine fitness level. Incremental speed walking tests (ISWT) are effective measures of aerobic capacity in healthy individuals and in individuals with chronic health conditions [28, 29]. These tests require participants to walk or run between two markers that delineate a 10-m course. Participants are to walk or run the course at a set
incremental speed determined by a signal, which is played by a standard CD player. Two newly developed shuttle run tests (SRT I, -II) for children with cerebral palsy also yield reliable and valid data for measuring aerobic power [30]. In these SRTs, speed increases every minute at 0.25 km/h steps. The outcome measure is the number of steps successfully completed at the time the test is stopped [30].

The six-minute walking distance test (6MWD) is accepted as a reliable test to measure functional exercise capacity in participants in various disease states [31, 32, 33, 34]. The 6MWD is self-paced and requires an individual to walk as far as possible in six minutes on a course of various lengths, without running. The distance walked during the test, measured in feet or metres, is used as the outcome measure [35].

The target population of this study are persons with severe or profound intellectual and sensory disabilities (SIMD). According to the ICD-10 (World Health Organization, WHO) [36], the IQ of persons with severe intellectual disabilities ranges from approximately 20 to 34, in adults this means an intellectual age from 3 to under 6 years, which is likely to result in continuous need for support. The IQ of persons with profound intellectual disabilities is below 20, in adults this means an intellectual age below 3 years, which results in severe limitation in self-care, continence, communication and mobility.

In particular persons with the combination of severe ID and sensory disabilities are at risk for both decrease of independence and quality of life, due to reinforcement of disabilities and less opportunities for compensation [37]. In these persons the level of health-related physical fitness is difficult to reliably quantify, because they are not accustomed to the above-mentioned assessments, such as performing walking tests. To assess whether a test is feasible for these persons, it is therefore necessary to use specific inclusion criteria to each of the co-morbidities e.g. locomotor disabilities and visual impairments. Furthermore, adjustments to test procedures are necessary, as well as choosing the tests carefully. For example, the SRT-I and II [30] may be most feasible for these persons, because of its increase of speed with 0.25 km/h, instead of the 0.6 km/h increase of speed of the ISWT [28, 29]. Another limiting factor to determine the feasibility and reliability of the measures in these persons are motivational problems. For instance, some do not understand why they have to walk faster than they usually do, or why they have to wear a heart rate monitor.

The feasibility and reliability of timed walking tests, such as the 6MWD and SRT, in participants with SIMD have been unknown. Because good physical fitness decreases health risks and improves wellbeing and quality of life [10, 11, 12], it is important to get comprehensive insight in the health related physical fitness in persons with SIMD. With feasible and reliable tests, a specific training intervention aimed at promoting physical fitness can be evaluated. Therefore, the purpose of this study was to examine the feasibility and the test-retest reliability of the 6MWD and SRT-I and II in persons with SIMD.

**Method**

**Participants**
The participants were recruited from a residential care facility in the Netherlands, in which 200 persons with severe or profound intellectual and sensory disabilities live. Moreover, in 65% they also exhibit associated motor disabilities. We asked the representatives of 92 persons with sufficient motor capacities for permission for the persons to participate in this study.
Eighty representatives gave permission. After informed consent was obtained, we screened these participants based on the examination findings of a physician specialised in intellectual disabilities and of a behaviour scholar and excluded seven participants. Another eight participants were excluded as they did not live at the centre for people with severe intellectual and sensory disabilities where the tests were performed. Eighteen participants were excluded because they presented with exclusion criteria at the time the tests were administered (Figure 1).

In all, 47 persons participated in this study: 18 were female, mean (SD) age 44 (10) years and 29 were male, mean (SD) age 38 (11) years. Participants were classified according to the adapted Gross Motor Function Classification System (GMFCS) [38]. Twenty-seven participants were classified as GMFCS level I, and 20 participants as GMFCS level II (see below for more information about GMFCS). Eighty-seven percent (41) of the participants had severe intellectual disabilities and 13% (6) had profound intellectual disabilities, according to the classification of the ICD-10 [36]. Most of the participants also had impaired vision. According to WHO guidelines [39], 53% (25) of the participants were severely partially sighted, 40% (19) were partially sighted, and 7% (3) were slightly limited in sight. Most participants had impaired motor abilities: 60% (28) had orthopaedic defects and 8% (4) were diagnosed with spasticity. In addition, 28% (13) of the participants had slight hearing problems, 9% (4) had loss of hearing, and 4% (2) had severe loss of hearing or were completely deaf.

As a group, individuals with severe or profound intellectual disabilities possess several co-morbidities simultaneously, and thus combinations of co-morbidities are also present in our
participants (Table 1). Thirty-six percent (17) of the intellectual disabled participants had both hearing problems and visual disabilities; 60% (28) had both visual and orthopaedic disabilities; 19% (9) had hearing problems and orthopaedic disabilities. 4 Participants were diagnosed with spasticity and they also had visual, and orthopaedic disabilities.

**Table 1. Combinations of co-morbidities of participants with severe intellectual disabilities**

<table>
<thead>
<tr>
<th></th>
<th>Hearing disabilities</th>
<th>Orthopaedic defects</th>
<th>Spasticity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual disabilities</td>
<td>36%</td>
<td>60%</td>
<td>4%</td>
</tr>
<tr>
<td>Hearing disabilities</td>
<td>-</td>
<td>19%</td>
<td>2%</td>
</tr>
<tr>
<td>Orthopaedic defects</td>
<td>-</td>
<td>-</td>
<td>9%</td>
</tr>
</tbody>
</table>

Participants were classified according to an adapted GMFCS [38], a five-level system used to classify the severity of motor abilities in people with physical disabilities. Participants with a “Level I” classification can generally walk without restrictions but tend to have limitations in some more advanced motor skills. Participants with a “Level V” classification generally have very limited mobility, even with the use of assistive technology. These participants always use a wheelchair. The original GMFCS was adapted because most of our participants had impaired vision, and as a result they could not jump and run spontaneously. If persons spontaneously increased their speed during walking, instead of jumping and running, they were classified as GMFCS level I. Participants with a “Level II” classification can walk with slight restrictions and do not spontaneously increase their speed during walking. The adapted version of the GMFCS was presented to the investigator, who translated the original version of the GMFCS into Dutch [40] and he concluded that the adaptations did not influence the reliability of the system.

**Study Design**

Participants were tested twice, with one week between the test and the retest. Test and retest were conducted at the same point in time. The participants performed first the aSRT (Netchild, the Netherlands). In order to let the participants take sufficient rest, at least after 48 hours, the 6MWD [35] was performed.

**Ethical statement**

The study was performed in agreement with the guidelines of the Helsinki Declaration as revised in 1975. Permission to carry out the study was obtained from an institutional ethics committee. All participants were unable to give consent. Therefore, extra care and attention was given to:

1) Asking informed consent: Informed consent was obtained from legal representatives of all participants and also the caregivers of all participants were asked for informed consent;

2) The construction of the study group by formulating exclusion criteria and contraindications: We screened the participants based on the examination findings of a physician specialised in intellectual disabilities and also of a behaviour scholar;
3) The measurement procedure: The measurements were performed in accordance with the behavioural code section entitled ‘Resistance among people with an intellectual disability in the framework of the Act Governing Medical-Scientific Research Involving Humans’ [42]. Consistent distress or unhappiness was interpreted as a sign of lack of assent and further participation in the study was reconsidered.

**Protocols**

Before the tests took place, the testing leaders and personal guides of the participants completed a checklist that included all contraindications. Participants were excluded from the study if they exhibited any of the following exclusion criteria at the time of the measurements: psychoses, depression, or other severe psychological problems; or somatic diseases, which were defined as chronic diseases and/or diseases that do not resolve in the short term (e.g., osteoarthritis, osteoporosis, pneumonia, etc). Participants were also excluded for the following reasons: general illness or fever; taking antibiotics; worsening of asthma, epilepsy (recent insult or epileptic fits), fresh wound(s)/bruise(s), or other factors causing pain during movement; or stress due to the subject’s behaviour just before the measurement date. To reduce learning effects, the participants practised twice before formal testing began.

**Six-minute walking distance test**

Participants performed the 6MWD test on a 36-m course (Figure 2), which was located in a gymnasium. The participants walked six minutes at a self-chosen pace and tried to cover as much distance as possible without running. Instructors accompanied all participants to help them find their way. This was necessary because of the participant’s visual disabilities. The participants were encouraged in a standardized way. The total distance covered represented a participants level of functional exercise capacity.

![Figure 2 6MWD course](image-url)
SRT-I, II and adapted Shuttle Run Test (aSRT)
Due to the severe multiple disabilities and the co-morbidities, practice sessions were performed in order to examine whether the protocols of the SRT-I and II had to be adjusted. The SRT-I has a starting speed of 5 km/h, whereas the SRT-II has a starting speed of 2 km/h. During the abovementioned familiarisation period, we found that 5 km/h was too fast for our participants, but 2 km/h was too slow. Thus, we adjusted the starting speed to 3 km/h. In this adapted SRT (aSRT), speed was increased every minute at 0.25 km/h steps, conform the original procedure by Verschuren [30]. Every increase in speed is called a step. The number of steps successfully completed at the time the test is stopped, represents a participant’s level of aerobic capacity.

The aSRT course was located in a gymnasium and was composed of an oval curve with two markers (Figure 3). The subjects walked between two markers that delineated the 10-m course at a set incremental speed determined by an audio signal played from a standard CD player. Instructors accompanied all participants to help them pace themselves according to the audio signal. The course adaptations and the use of instructors were necessary because of the participants visual disabilities.

At the end of each step, the participants were told to walk a little faster. The test was finished when, on two consecutive paced signals, the participants were more than 1.5 m away from the end marker.

![Figure 3 Shuttle test parcourge](image)

**Figure 3** Shuttle test parcourge
R=1 Metre
Distance between Start and Finish = 6.86 m + ½ (2πR)= 6.86 + 3.14= 10 m

**Motivation**
To determine whether the participants pushed themselves to their limits and whether motivation influenced the tests, we used two strategies.

First, we compared the registered heart rate at the end of the test or when the test was stopped with the estimated peak heart rate. All participants wore a heart rate monitor (Polar Accurex plus™, Kempele, Finland), so that we could measure their heart rate every minute during performance and immediately after performance. During the tests, peak heart rate in beats per minute (bpm) was registered on a heart-rate-monitor storage device; these data could later be read from a wrist monitor and recorded on a datasheet. Each participant’s peak heart rate was estimated using the formula of Fernhall [42] for participants with intellectual disabilities: 210 - 0.56 (age) - 15.5 (DS). DS is 1, however if a participant has Down’s Syndrome, DS factor equals 2.

The second strategy to examine whether the participants pushed themselves to their limits
and whether motivation influenced the test results, was the use of the Visual Analogue Scale [43, 44]. The Visual Analogue Scale (VAS) is an instrument on which an instructor could score the degree of motivation on a 100-mm line with a stripe right-angled on the line. On one end of the line the maximum score was marked as 'good motivation' and on the other end was the minimum score, 'bad motivation'. The number of millimetres between the stripe scored by the instructor and the minimum score, is the score on the VAS instrument. Two instructors scored the degree of motivation.

Data analysis
Data were analysed using SPSS 14.0. Feasibility, test-retest reliability and motivation were examined as follows:

Feasibility
To assess feasibility, we compared the number of unsuccessful measurements with the total number of measurements. The feasibility was considered to be sufficient when 95% of the measurements were successful, which is strict, but only then it makes sense to use the test.

Test-retest reliability
First, to determine whether significant differences existed between the test and retest of the 6MWD, aSRT, and peak heart rate, we compared the test and retest data using Wilcoxon signed rank tests. The level of statistical significance was set at 0.05. Limits of agreement (LOA) between the test and retest of the same variables were calculated according to the procedure described by Bland and Altman (1986). The LOA is considered to be an indicator of test – retest reliability. LOAs are expressed in units and as a percentage of the mean of the 1st test. Tests were considered to be reliable when the LOA was 30% of the mean of the 1st test, or less, which is based on clinical experience of the professionals working with the target group and the measurements as suggested by Bland and Altman [45]. Finally, intraclass correlation coefficients (ICC, 2-way random, absolute agreement) of the test and retest of the same three variables were computed. Reliability was considered acceptable when the ICC value was greater than .80 and the 95% confidence intervals (CI) were 0.30 or less.

Motivation
To get insight into the influence of motivation on the test results, we first compared the registered heart rate at the end of both tests with the estimated peak heart rate using Wilcoxon signed rank tests. We also compared the registered heart rate at the end of the 6MWD with the registered heart rate at the end of the aSRT using Wilcoxon signed rank test. The level of statistical significance was set at 0.05.

Second, we calculated Spearman correlation coefficients for the number of aSRT steps achieved and motivation VAS score and for the 6MWD distance achieved and motivation VAS score. The level of statistical significance was set at 0.05. To calculate the influence of motivation on the test results we estimated the quadrate of the correlation coefficients and multiplied it with 100%. This is the variation which can be clarified with motivation [46]. The interrater reliability on the VAS for the aSRT and for the 6MWD were estimated with Spearman correlation coefficients, the level of statistical significance was set at 0.05.
Results

Feasibility
All 47 (100%) participants completed the tests successfully, and 45 (96%) of them also wore a heart rate monitor which produced valid data.

Test-retest reliability for all measurements
Table 2. summarizes the results of the Wilcoxon signed rank test, the LOA, the LOA as a percentage of the mean, and ICC analyses. There were no significant differences between the test and retest results in the 6MWD and aSRT. The LOAs and the LOAs expressed as a percentage of the means were less than or equal to 30% for all measurements, except for the aSRT of GMFCS-II participants. The ICCs were .80 or above. The LOA of the 6MWD was 115 m and that of the aSRT for GMFCS-I participants was 2.8 steps.

Table 2. Results of Wilcoxon ranking test, LOA, percentage LOA of mean, and ICC*

<table>
<thead>
<tr>
<th></th>
<th>Mean 1(SD)</th>
<th>Mean 2 (SD)</th>
<th>P value</th>
<th>LOA *</th>
<th>LOA of mean (%)</th>
<th>ICC* 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>SRT steps</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GMFCS I</td>
<td>12 (3.5)</td>
<td>12 (3.5)</td>
<td>0.422</td>
<td>2*</td>
<td>1.4023</td>
<td>0.96</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>23%</td>
<td>0.92-0.98</td>
</tr>
<tr>
<td>SRT steps</td>
<td>6 (3)</td>
<td>7 (3)</td>
<td>0.363</td>
<td>2*</td>
<td>2.4438</td>
<td>0.82</td>
</tr>
<tr>
<td>GMFCS II</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>74%</td>
<td>0.54-0.93</td>
</tr>
<tr>
<td>6MWD distance</td>
<td>389 (104)</td>
<td>389 (109)</td>
<td>0.990</td>
<td>2*</td>
<td>57.7221</td>
<td>0.92</td>
</tr>
<tr>
<td>GMFCS I and II</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>30%</td>
<td>0.86-0.96</td>
</tr>
<tr>
<td>Peak heart rate</td>
<td>125 (20)</td>
<td>125 (19)</td>
<td>0.587</td>
<td>2*</td>
<td>14.348</td>
<td>0.84</td>
</tr>
<tr>
<td>SRT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>22%</td>
<td>0.60-0.91</td>
</tr>
<tr>
<td>Peak heart rate</td>
<td>117 (26)</td>
<td>119 (17)</td>
<td>0.907</td>
<td>2*</td>
<td>21.066</td>
<td>0.84</td>
</tr>
<tr>
<td>6MWD</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>35%</td>
<td>0.71-0.91</td>
</tr>
</tbody>
</table>

*LOA, Limits of Agreement, ICC, Intraclass correlation coefficient, CI, Confidence Intervals

Motivation
Table 3. compares the mean peak heart rate achieved during both tests. The Wilcoxon signed rank test revealed a significant difference at p<0.001 between the registered heart rate at the end of both tests and the mean (SD) estimated peak heart rate (172 bpm ± 6). The Wilcoxon signed ranks test also identified a significant difference (p<0.001) between the estimated peak heart rate and peak heart rate achieved during the SRT (126 ± 20 bpm) and 6MWD (119 ± 16 bpm). The participants achieved a higher peak heart rate during the SRT than during the 6MWD.
Table 3. Mean peak heart rate achieved with aSRT and 6MWD*

<table>
<thead>
<tr>
<th></th>
<th>Mean peak heart rate (SD)</th>
<th>Mean estimated peak heart rate (SD)</th>
<th>p Wilcoxon test</th>
</tr>
</thead>
<tbody>
<tr>
<td>aSRT</td>
<td>126 bpm (20)</td>
<td>172 bpm (6)</td>
<td>P&lt;0.001</td>
</tr>
<tr>
<td>6MWD</td>
<td>119 bpm (16)</td>
<td>172 bpm (6)</td>
<td>P&lt;0.001</td>
</tr>
<tr>
<td>p Wilcoxon test</td>
<td>p=0.01</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

*aSRT, adapted shuttle run test; 6MWD, six-minute walking distance test.

The Spearman correlation coefficient of SRT steps and motivation was 0.538 (p<0.01), and this correlation coefficient of 6MWD distance and motivation was 0.556 (p<0.01). The influence of motivation on the test results was calculated by quadrating the correlation coefficients and multiplying it with 100%. Thus, 29% of the variation we observed in the SRT step and 31% of the variation we observed in the 6MWD outcomes can be explained by motivation. The interrater reliability on the VAS for the aSRT was 0.87 (Spearman's rho; p<0.01) and for the 6MWD 0.92 (Spearman's rho; p<0.01).

Discussion

As far as we know, this is the first study in which the feasibility and test retest reliability in participants with severe intellectual and multiple disabilities is examined. The results of our study show that both the 6MWD and the aSRT, combined with heart rate monitoring, are feasible in participants with severe intellectual and sensory disabilities. Both tests can be reliably performed by GMFCS-I participants; GMFCS-II participants can only reliably perform the 6MWD.

The results are in line with the original procedures of the aSRT [30] and the 6MWD [33]: the aSRT appeared to be suitable for assessing aerobic capacity, because a higher peak heart rate was achieved with the aSRT, and the 6MWD is suitable for assessing functional exercise capacity.

Motivation is a term to express that someone tries to achieve a certain goal. We asked ourselves if persons with SIMD are motivated to exert themselves fully and if we get a realistic representation of what they really are able to. To determine whether the participants pushed themselves to their limits and whether motivation influenced the tests, we used the described two strategies: first, comparing the registered heart rate with the estimated peak heart rate and second, evaluating with the instructor the motivation of the participants on a VAS. We found that a participant’s motivational level substantially can influence test outcomes. Twenty-nine percent of the variation in the SRT steps could be explained by motivation, whereas thirty-one percent of the variation in the 6MWD could be explained by motivation. Comparison of the estimated peak heart rate with the achieved peak heart rate shows that the participants did not fully exert themselves as they were performing the tests. We tried to motivate the participants by creating as optimal circumstances as possible: testing at the regular gymnastic time, in the regular gymnastic environment, accompanied by the familiar gymnastic instructors, who are used to motivate the participants. Our hypothesis is that the participants are not yet used to experience
the effects of considerable physical effort, due to their intellectual disabilities and reinforced by their visual disabilities. In order to get an adequate interpretation of the test results, we recommend to include both the comparison of estimated peak heart rate with the achieved peak heart rate and the score on motivation into the protocols of the aSRT and 6MWD.

Another complex question in these participants is informed consent: they are unable to give consent themselves. Therefore, extra care and attention was given to asking informed consent, the measurement procedure and the construction of the study group by formulating exclusion criteria and contraindications. All persons involved in the study were fully aware of the vulnerable position of the participants. If a participant did not like the testing, further participation was stopped.

In our study, the reliability of the 6MWD showed to be in line to that of similar measurements in other studies, and so was the aSRT. Several studies have used the 6MWD in participants having a variety of diseases. For participants with fibromyalgia, the ICC of 6MWD test-retest measurements was 0.73 [47]. For participants with heart failure, the ICC was 0.91 [48] and 0.82 [49]; and for participants with pulmonary disease, the ICC was 0.99 [50]. In our study, the ICC was 0.92, which is notable, because the comorbidities of the participants under study could potentially affect reliability. The reliability of the SRT-I and II was described by Verschuren et al.[30], who obtained an ICC of 0.97 for GMFCS-I participants. In our study, the ICC for comparable participants was 0.96. For GMFCS-II participants, Verschuren et al. [30] obtained an ICC of 0.99. In our study, the ICC was 0.82; however, the 95% CI were too wide and the LOA of the aSRT was unacceptable for GMFCS-II participants. This suggests, that aerobic capacity cannot be reliably assessed in GMFCS-II participants. A hypothesis might be that their locomotor skills do not allow them to increase their speed consequently.

The participants in our study first practiced twice before we measured their performance on the 6WMD and aSRT. Stevens et al. [51] described several studies that showed that practise sessions are necessary to promote optimal performance in participants. These investigators indicated that two practise sessions are required in order to allow participants to learn and to establish optimal performance when conducting repeated measures at relatively short intervals. This was also necessary for the participants of our study.

We compared the achieved mean distance in the 6MWD of our participants with that of others. The mean distance (SD) of our participants was 389 m (107). In healthy elderly persons, the mean distance was 631 m (93) [33]; in people with heart failure, the mean distance was 419 m (120) [31]; and in people with COPD, the mean distance was 369 m (18) [32]. This comparison indicates that persons with severe multiple disabilities performed poorer on the 6MWD than other persons with specific (chronic) health conditions.

In conclusion, the 6MWD is feasible and reliable for measuring functional exercise capacity in GMFCS-I and II participants with severe intellectual and multiple disabilities. The aSRT is feasible and reliable for measuring aerobic capacity in GMFCS-I participants. The participant’s motivational level can influence test outcomes, so we recommend to insert both heart rate monitoring and motivational score into the protocols of the aSRT and 6MWD. The poor 6MWD results we observed indicate that the poor functional exercise capacity of persons with severe multiple disabilities is a serious health problem, which may burden their independence in day-to-day activities. Based on this result, further research should be aimed at developing, implementing and evaluation of an appropriate intervention to reduce problems in functional exercise and aerobic capacity in these participants.
Acknowledgements

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The authors kindly acknowledge and thank the participants for their participation in this study, their representatives for giving permission to this and the gymnastic instructors of The Brink, for accompanying the participants during the walking tests.

Heart rate was registered by a heart rate monitor of Polar Accurex plus™, Kempele, Finland. The protocol of the Shuttle Run Test was provided by Netchild, the Netherlands. For the 6 MWD the protocol of Butland et al (1982) was used.
References


