VALIDITY AND RELIABILITY OF THE INCREMENTAL SHUTTLE WALK TEST AND SIX-MINUTE WALK TEST IN CHRONIC HEART FAILURE

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Valid - measures what it’s supposed to measure
Reliable - gives consistent results repeatedly

PeakVO₂ (peak oxygen uptake) from cardiopulmonary exercise test (CPET) = most accurate measure of exercise capacity (gold standard)

CPET: incremental cycling / treadmill protocol to symptom-limited peak BUT time-consuming, costly, and often poorly tolerated (clinically inaccessible)

Incremental Shuttle Walk Test (ISWT) and self-paced 6-minute Walk Test (6MWT) = popular clinical substitutes; simplistic, inexpensive, familiar
**6MWT** (Butland et al, 1982)
self-paced over known distance for
6 minutes (with rests as required)

many trials in CHF* inconsistently confirming validity and reliability
* = chronic heart failure

**ISWT** (Singh et al, 1992)
externally-paced, progressive walking speed (around cones) governed by audio signal

less evidence to support use - very few trials in CHF

**Trials comparing tests in CHF:**
ISWT more valid
Reliability confirmed though lack of consensus regards pre-test familiarisation / practice walk?

(Green et al, 2001; Morales et al, 1999; Pulz et al, 2008)
To examine:

- Validity of the ISWT and 6MWT (in relation to symptom-limited treadmill CPET)

- Test-retest reliability of each walking test

- Whether familiarisation has any effect on walking test reliability
**INCLUSION CRITERIA**
- Left ventricular dysfunction
- Clinically stable for at least one month (ACPICR, 2006)
- Optimised cardiac medication doses

**EXCLUSION CRITERIA**
- Contraindications to exercise testing (ACSM, 2006)
- Local NHS Ayrshire & Arran treadmill testing protocol (exclusions) adhered to

- Power calculation: n=22 (80% power) (Green et al, 2001)
- Recruited from CHF nurses, and cardiology clinics
n=22 familiarised with either ISWT or 6MWT (randomly assigned)

1 x treadmill CPET, STEEP protocol (Northridge et al, 1990)

3 x ISWT and 3 x 6MWT (familiarised test first)

Data from 1st walking test compared to data from CPET

VALIDITY OF EACH WALKING TEST

Data over 3 attempts of each walking test examined

RELIABILITY OF EACH WALKING TEST

Reliability data of those familiarised compared to those not

EFFECT OF FAMILIARISATION ON RELIABILITY

OUTCOMES:
peakVO₂ (ml.kg⁻¹.min⁻¹)
walking test distance (m)

Methodology

Cosmed K4b²
Results

27 participants recruited initially
n=22 completed study with no adverse events

<table>
<thead>
<tr>
<th>CHARACTERISTICS</th>
<th>VALUES</th>
</tr>
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<tbody>
<tr>
<td>n</td>
<td>n=22</td>
</tr>
<tr>
<td>Mean age (years)</td>
<td>64</td>
</tr>
<tr>
<td>range (years)</td>
<td>51-76</td>
</tr>
<tr>
<td>(males / females)</td>
<td>19 / 3</td>
</tr>
<tr>
<td>NYHA class:</td>
<td>13 / 9</td>
</tr>
<tr>
<td>II / III</td>
<td></td>
</tr>
<tr>
<td>Aetiology of heart failure:</td>
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</tr>
<tr>
<td>- idiopathic</td>
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</tr>
<tr>
<td>- ischaemic</td>
<td>14</td>
</tr>
<tr>
<td>- other</td>
<td>8</td>
</tr>
<tr>
<td>Baseline ECG:</td>
<td></td>
</tr>
<tr>
<td>sinus rhythm / atrial fibrillation</td>
<td>17 / 5</td>
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Neither walking test stressed participants to the level of CPET.

**Mean peakVO$_2^*$:**
- CPET: 16.99
- ISWT: 13.43
- 6MWT: 14.39

(* = ml.kg$^{-1}$.min$^{-1}$)
6MWT distance has stronger relationship with CPET peakVO\textsubscript{2} - though both relationships significant (p<0.05)

**regression correlation, †closer to 1.0 = stronger relationship**
### Reliability & Familiarisation

**PeakVO₂ Data Over 3 Attempts of Each Walking Test**

<table>
<thead>
<tr>
<th>WALKING TEST</th>
<th>ICC† (p VALUE)</th>
<th>ICC† (p VALUE)</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>ALL PARTICIPANTS</td>
<td>THOSE FAMILIARISED</td>
</tr>
<tr>
<td>6MWT</td>
<td>0.74 (p=0.97)</td>
<td>0.58 (p=0.45)</td>
</tr>
<tr>
<td>ISWT</td>
<td>0.84 (p=0.15)</td>
<td>0.86 (p=0.29)</td>
</tr>
</tbody>
</table>

*Two-way ANOVA

†intra-class correlation co-efficient (closer to 1.0 = stronger relationship)

- **ISWT showed better reliability - enhanced by familiarisation**
- **Reliability of 6MWT reduced with familiarisation**
- **All reliability analyses non-significant** (p>0.05)
Conclusions

- Neither walking test stressed participants to the level of CPET.

- 6MWT distance is a more valid representation of exercise capacity than ISWT distance.

- ISWT demonstrated greater reliability - and reliability improved with familiarisation.

- Familiarisation increased variation in 6MWT data, reducing its reliability.

- As reliability is a pre-condition of validity, the ISWT may be the more valid test for clinical practice in CHF.
References


