**SHORT REPORT**

**Muscle performance, work ability and physical functioning in middle-aged men**

Juhani Smolander¹, Lars Sörensen², Mika Pekkonen³ and Markku Alén⁴

**Background**
Limited data exist on the associations between muscle performance and work ability measures in working age adults.

**Aims**
To evaluate how the results of simple muscle performance tests correlate with self-reported work ability and physical functioning in middle-aged men.

**Methods**
Muscle performance was measured with handgrip, sit-up, arch-up, squatting and lifting tests. The Physical Functioning scale and the Role Limitations due to Physical Health Problems scale of the RAND-36 health questionnaire were used to assess functioning and the Work Ability Index (WAI) questionnaire to assess perceived work ability in a subgroup of 51 subjects.

**Results**
A total of 104 men aged 45–55 years employed in physically active work participated. Muscle performance was weakly associated with WAI and functioning measures, accounting for 10% of the variance at most. Dynamic lifting test results for both arms correlated with WAI scores (right: \( r = 0.31 \), left: \( r = 0.34 \)). Scores of the dynamic lifting test for both arms correlated with the Physical Functioning scores (right: \( r = 0.23 \), left: \( r = 0.28 \)) and with the Role Limitations due to Physical Health Problems scores (right: \( r = 0.25 \), left: \( r = 0.28 \)). Results of the squatting test were associated with the Physical Functioning scores (\( r = 0.24 \)).

**Conclusions**
The study failed to provide support for the use of muscle performance tests in work-related fitness evaluations in middle-aged men employed in physical jobs.

**Key words**
Muscle performance tests; physical functioning; work ability index.

**Introduction**

In Finland, physical fitness assessments are widely carried out in occupational health practice, often as an integrated part of health and well-being promotion activities. Typically, they involve tests of aerobic and muscular fitness. However, relatively few and somewhat controversial data are available on their validity in relation to more global well-being indicators such as work ability [1–3].

The aim of this study was to evaluate how the results of simple muscle performance tests (commonly used in fitness for work evaluations in Finland) correlate with work ability and physical functioning in middle-aged men.

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analysis. The subgroup did not differ from other subjects in terms of weight, height, waist circumference or age. Full data for physical functioning and WAI were obtained for 76 and 43 subjects, respectively. Due to a human error, we did not receive the WAI questionnaire from all subjects and the number of subjects for whom full data were available was smaller than anticipated because not all subjects were able to undergo the physical tests in full.

The muscle performance test battery consisted of a bent-knee sit-up test, a repetitive arch-up test for back endurance, a squatting test, a dynamic lifting test with both arms with a 10 kg weight (all measuring the maximum number of repetitions achieved) and handgrip strength measurement in both hands using a dynamometer (Newtest Ltd, Oulu, Finland). According to our recent survey [6], these tests (so called ORTON tests) are the most commonly used muscular performance tests in Finland, and they have acceptable reliability [7].

The associations between variables were analysed by calculating the Pearson product-moment correlation coefficients. Multiple regression analysis was also considered but not used because there was too much multicollinearity between predictor variables. The results were considered significant when \( P < 0.05 \).

**Results**

Based on WAI, the work ability was poor in 8%, moderate in 25%, good in 51% and excellent in 16% of the subjects. There was a weak but statistically significant correlation between the dynamic lifting test results of both arms and WAI \( (P < 0.05 \) for both) (Table 1).

Similarly, results of the dynamic lifting test of both arms correlated with the Physical Functioning scores \( (P < 0.05 \) for both) and with the Role Limitations due to Physical Health Problems scores \( (P < 0.05 \) for both). Results of the squatting test were significantly associated with the Physical Functioning scores \( (P < 0.05) \) (Table 1).

**Discussion**

Our main finding was that the results of muscle performance tests correlated weakly with self-reported work ability and physical functioning, accounting for \( \sim 10\% \) of the variance at most. A statistically significant correlation was, however, found between dynamic lifting test scores and WAI as well as with self-reported physical functioning. Squatting test results had also a significant correlation with the Physical Functioning dimension of RAND-36.

We had no specific data available on the individual job demands of the subjects, but in general, the jobs were physically demanding ones in the construction and manufacturing industries. They contained a fair amount of manual materials handling (lifting, lowering, pushing or pulling), tool handling or machinery operation. Thus, in these types of jobs, capacity for work with the arms may be a factor influencing perceived work ability and physical functioning. Statistically, our data support this hypothesis, but the association was weak. Similarly, squatting ability may be an important element of some physical jobs, but our study did not give much support for the use of the squatting test in work-related fitness evaluations.

Self-reported work ability and functioning reflect, to a large extent, a person’s subjective view of their abilities (self-efficacy), but this is affected by the psychosocial as well as the physical work environment [8]. In our study, no measures of psychosocial risk factors were included and this is clearly a methodological limitation.

Pohjonen [1] showed that in 5 year follow-up poor results in the sit-up, balance, dynamic lifting and squatting

<table>
<thead>
<tr>
<th>Muscle performance test</th>
<th>Work Ability Index ((N = 43))</th>
<th>Physical Functioning ((N = 76))</th>
<th>Role Limitations due to Physical Health Problems ((N = 76))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Handgrip, right (N)</td>
<td>0.00</td>
<td>0.06</td>
<td>-0.05</td>
</tr>
<tr>
<td>Handgrip, left (N)</td>
<td>-0.14</td>
<td>0.04</td>
<td>-0.03</td>
</tr>
<tr>
<td>Dynamic lifting, right arm (10 kg, maximum no. of repetitions)</td>
<td>0.31*</td>
<td>0.23*</td>
<td>0.25*</td>
</tr>
<tr>
<td>Dynamic lifting, left arm (10 kg, maximum no. of repetitions)</td>
<td>0.34*</td>
<td>0.28*</td>
<td>0.28*</td>
</tr>
<tr>
<td>Back endurance (maximum no. of repetitions)</td>
<td>0.19</td>
<td>0.19</td>
<td>0.12</td>
</tr>
<tr>
<td>Sit-ups (maximum no. of repetitions)</td>
<td>0.17</td>
<td>0.12</td>
<td>0.12</td>
</tr>
<tr>
<td>Squatting (maximum no. of repetitions)</td>
<td>0.12</td>
<td>0.24*</td>
<td>0.18</td>
</tr>
</tbody>
</table>

Numerical values quoted are Pearson correlation coefficients.

\*\( P < 0.05 \).
tests and poor knee extension strength predicted a high risk for reduced WAI in 132 female home care workers (age 23–59 years). Nygård et al. [2] found that the level of WAI correlated significantly with the handgrip strength, trunk flexion strength, trunk extension strength and with the results of the sit-up test in a cross-sectional sample of Finnish municipal workers (72 men and 65 women, mean age 55 years). The somewhat differing results between studies may be due to different characteristics of the study populations (e.g. age, gender and homogeneity of study groups).

In conclusion, our study failed to provide support for the use of muscle performance tests in work-related fitness evaluations in middle-aged men employed in physical jobs. Probably, a much larger battery of measures, rather than simple muscle tests alone, are needed to predict work ability in middle-aged men employed in physical jobs.

Key points
- Testing muscular fitness is popular in Finland in health promotion programmes and work ability evaluations. However, limited data exist on the association between muscle performance and work ability and functioning measures in working age adults.
- The present study failed to provide support for the use of muscle performance tests in work-related fitness evaluations in middle-aged men employed in physical jobs.

Conflicts of interest
None declared.

References