Chapter 6

Physical functioning before and after total hip arthroplasty - perception and performance

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Abstract
Background and Purpose: Most research into the relationship between self-report and performance-based measures of physical functioning after total hip arthroplasty is limited to measurement at one moment in time. Additionally, research into the possible explanations for the found discrepancy is scarce. Aim is to determine the relationship at multiple moments as well as determine whether the influence of pain on self-report measures is an explanation for the expected discrepancy.
Subjects: Seventy-five subjects admitted for total hip arthroplasty
Methods: Western Ontario and McMaster University osteoarthritis index (WOMAC) and Short Form health survey (SF-36) score and walking speed were obtained preoperatively and 6 and 26 weeks postoperatively.
Results: Pearson’s correlation coefficients between walking speed and the WOMAC and SF-36 physical functioning subscales were poor preoperatively, while moderate short-term and long-term postoperatively. Correlations between the physical functioning scales and the pain scales of the WOMAC and SF-36 were high. Preoperatively, all self-report measures load on factor one except for walking speed. Long-term postoperatively, the self-report physical functioning scales load on both factors.
Discussion and conclusion: Pain and the diminishing pain after surgery appear as explanatory factors in the discrepancy between self-report and performance-based outcome measures. When assessing physical functioning with a self-report measure, other factors, such as pain, are measured as well.
**Introduction**

Outcome after total hip arthroplasty (THA) can be measured by means of self-report questionnaires; the Western Ontario and McMaster University (WOMAC) Osteoarthritis Index and the Short Form health survey (SF-36) are the most used and recommended questionnaires. These questionnaires are filled in by the patients; the score provides an indication of their perceived level of physical functioning, among other things. Besides the self-report measures, performance-based measures are available in which patients actually have to perform one or more activities of daily living (ADL). Advances and disadvantages are reported for both kinds of measures. Advantages of self-report measures are that they are easy to administer and inexpensive, and can evaluate multiple aspects of function in one test. Mentioned disadvantages are that self-report measures are influenced by expectations and beliefs of the patients and impaired cognition and errors in memory; performance-based instruments do not have these disadvantages. However, disadvantages of performance-based instruments are that activities often have to be assessed in an artificial environment and are time-consuming and expensive.

From research into the relationship between self-report and performance-based measures, there appears to be a poor-to-moderate relationship between the two kinds of measures. Self-report and performance-based measures seem to assess a different aspect of recovery. It is recommended to use a self-report as well as a performance-based measure to obtain full insight into the outcome after THA, as they are considered complementary. Most research determining the relationship between these measures is however limited to measurement at one moment in time (eg, preoperatively or 12 months postoperatively). Additionally, research into the possible explanations for the discrepancy is scarce. Recently, Terwee et al. investigated the influence of pain on the relationship between self-report and performance-based outcome measures before and after total knee arthroplasty. They discovered that self-report measures of physical functioning are more influenced by pain than performance-based measures, which could be the explanation for the low correlations between them. They also found that the correlations changed over time after surgery — correlations were somewhat better 3 months postoperatively compared to preoperatively — which can also be explained by influence of (disappearing) pain.

This explanation could also be valid for total hip arthroplasty patients. To that end, research needs to be conducted into the relationship between self-report and performance-based measures determined in total hip arthroplasty patients before as well as across the spectrum of recovery after surgery. First aim of this study is therefore to determine the relationship between the WOMAC and SF-36 physical functioning scales as self-report outcome measures and walking speed as performance-based outcome measure in total hip arthroplasty patients preoperatively as well as short-term and long-term postoperatively, and secondly, to determine if the influence of pain on self-report measures explains the discrepancy between self-report and performance-based measures. Hypothesis is that the correlations between...
self-report and performance-based measures will be much higher as soon as 6 weeks postoperatively compared with preoperative correlations because after THA most pain disappears abruptly after surgery, and even higher 6 months postoperatively, when no pain should be experienced at all. Further, it is hypothesized that in factor analysis preoperatively self-report physical functioning and pain load on the same factor, while the performance-based outcome measure loads on a different factor. Postoperatively, when pain has disappeared, it is hypothesized that self-report as well as performance-based physical functioning will load on one factor and pain on the other factor, as would be expected given the existing dimensional structure of the questionnaires.

**Method**

**Subjects & Measurements**

Patients admitted to the Orthopedic Department of University Medical Center Groningen (UMCG) for unilateral total hip arthroplasty and participating in the short-stay program between September 2002 and August 2004 were included in the study. The criteria for the short-stay program were: estimated surgery time less than 120 minutes, weight lower than 110 kg, estimated hospital stay less than 6 days, no signs of severe mobility disablement or psychological dysfunction, and no severe deformity of the spine. After surgery, patients were allowed to start walking with aids on the first postoperative day and were discharged on the fifth postoperative day unless there were complications.

Measurements were performed at the time of the patients’ admission and 6 and 26 weeks after the surgery, when they visited the outpatient clinic. The patients were asked to complete the WOMAC and SF-36 and to perform gait analysis. In total, 87 total hip arthroplasty patients were admitted during the study period. Twelve patients were excluded from further analyses, as they did not complete the questionnaires or the gait analysis at all three measurement times for various reasons: one had severe surgical complications, one moved out of the country, one died and two had health problems due to causes unrelated to the orthopedic surgery, two refused further participation due to personal circumstances, four did not show up at the outpatient clinic and one had a THA at the contralateral side. The remaining 75 patients were predominantly women (N=53, 70.7%), with a mean age of 62.7 (±11.7) years and mean Body Mass Index (BMI) of 26.6 (±3.4) kg∙m⁻². Mean length of hospital stay was 7.0 (±3.3) days.

**Measures**

The Dutch versions of the WOMAC and the SF-36 were used. Both questionnaires were proven valid and reliable in total hip arthroplasty patients. The WOMAC is a disease-specific self-report outcome measure of hip arthroplasty. It consists of three subscales, two of which were used in this study: WOMAC physical functioning (WOMAC-PF; 17 items) and WOMAC pain (WOMAC-P; 5 items). Responses were given on a 5-point Likert scale. The SF-36 is a generic health-related quality of life
measure. Of the eight SF-36 subscales, physical functioning (SF-36 PF; 10 items) and pain (SF-36 P; 5 items) were used in this study. All scores were recoded into a 100-points scale, with a higher score representing better physical functioning or less pain. Gait analysis was done with the DynaPort System. This is an ambulatory system that uses accelerometers which are attached to the patients by a belt over their clothes. Patients had to walk over 20 meters at preferred speed in a normal hospital corridor. Several movement features can be determined from the accelerometer signals. Walking speed was used in this study.

Data analysis
Descriptive statistics (mean, SD) were used to describe the scores on the outcome measures at the three measurement times. Pearson’s correlation coefficients were calculated between the WOMAC physical functioning and pain score, the SF-36 physical functioning and pain score, and walking speed preoperatively and 6 and 26 weeks postoperatively. Factor analyses were applied on the preoperative data to explore the hypothesis that the self-report outcome measures (physical functioning as well as pain scales) all load on the same factor while the performance-based outcome measure loads on a different factor, and on the postoperative data to explore the hypothesis that the self-report as well as the performance-based physical functioning measures load on one factor and the pain measures on the other factor. A principal component analysis with Promax rotation was used with a forced 2-factor solution. The Statistical Package for Social Sciences version 12.0 was used for data analysis. A p-value lower than 0.05 was considered statistically significant.

Results
Mean WOMAC-PF, WOMAC-P, SF-36 PF, SF-36 P and walking speed all improved after surgery. The values at the three assessment times are displayed in Table 1. For WOMAC-PF, WOMAC-P and SF-36 P, most improvement was seen between the preoperative and short-term postoperative measurement times. SF-36 PF showed equal improvement between the three measurement times, while walking speed improved

<table>
<thead>
<tr>
<th></th>
<th>Preoperative</th>
<th>Short-term postoperative</th>
<th>Long-term postoperative</th>
</tr>
</thead>
<tbody>
<tr>
<td>WOMAC-PF</td>
<td>46.9 (16.5)</td>
<td>72.8 (17.2)</td>
<td>78.4 (14.9)</td>
</tr>
<tr>
<td>WOMAC-P</td>
<td>50.4 (19.0)</td>
<td>84.1 (14.4)</td>
<td>84.9 (16.7)</td>
</tr>
<tr>
<td>SF-36 PF</td>
<td>37.6 (18.8)</td>
<td>50.4 (21.1)</td>
<td>65.5 (22.7)</td>
</tr>
<tr>
<td>SF-36 P</td>
<td>39.4 (19.7)</td>
<td>59.7 (23.0)</td>
<td>69.5 (24.0)</td>
</tr>
<tr>
<td>WS (m/s)</td>
<td>0.93 (0.20)</td>
<td>0.94 (0.19)</td>
<td>1.12 (0.20)</td>
</tr>
</tbody>
</table>

NOTE. Preoperative walking speed was calculated over 69 patients, as 6 measurements were missing due to technical problems.

Abbreviations: PF = physical functioning; P = pain; WS = walking speed.

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most between the two postoperative measurements.

Pearsons’ correlation coefficients between the WOMAC-PF, WOMAC-P, SF-36 PF, SF-36 P and walking speed at the preoperative and short-term and long-term postoperative assessments are displayed in Tables 2a-c. Preoperatively, weak, non-significant correlations were seen between walking speed and the physical functioning scales of the WOMAC and SF-36 as well as between walking speed and the pain scales. Correlations between WOMAC-PF and the pain scales of the WOMAC and SF-36 were higher than the correlations between SF-36 PF and the pain scales. Short-term postoperatively, correlations between walking speed and the physical functioning and pain scales of the WOMAC and SF-36 were higher compared to the preoperative

Table 2a.
Pearsons’ correlation coefficients between the outcome measures preoperatively.

<table>
<thead>
<tr>
<th></th>
<th>WOMAC-PF</th>
<th>WOMAC-P</th>
<th>SF-36 PF</th>
<th>SF-36 P</th>
<th>WS</th>
</tr>
</thead>
<tbody>
<tr>
<td>WOMAC-PF</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WOMAC-P</td>
<td>0.68**</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SF-36 PF</td>
<td>0.49**</td>
<td>0.27*</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SF-36 P</td>
<td>0.58**</td>
<td>0.67**</td>
<td>0.36**</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>WS</td>
<td>0.13</td>
<td>-0.07</td>
<td>0.19</td>
<td>0.12</td>
<td>1.00</td>
</tr>
</tbody>
</table>

Abbreviations: PF = physical functioning; P = pain; WS = walking speed.

Table 2b.
Pearsons’ correlation coefficients between the outcome measures short-term postoperatively.

<table>
<thead>
<tr>
<th></th>
<th>WOMAC-PF</th>
<th>WOMAC-P</th>
<th>SF-36 PF</th>
<th>SF-36 P</th>
<th>WS</th>
</tr>
</thead>
<tbody>
<tr>
<td>WOMAC-PF</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WOMAC-P</td>
<td>0.67**</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SF-36 PF</td>
<td>0.62**</td>
<td>0.19</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SF-36 P</td>
<td>0.54**</td>
<td>0.44**</td>
<td>0.34**</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>WS</td>
<td>0.36**</td>
<td>0.19</td>
<td>0.23*</td>
<td>0.29*</td>
<td>1.00</td>
</tr>
</tbody>
</table>

Abbreviations: PF = physical functioning; P = pain; WS = walking speed.

Table 2c.
Pearsons’ correlation coefficients between the outcome measures long-term postoperatively.

<table>
<thead>
<tr>
<th></th>
<th>WOMAC-PF</th>
<th>WOMAC-P</th>
<th>SF-36 PF</th>
<th>SF-36 P</th>
<th>WS</th>
</tr>
</thead>
<tbody>
<tr>
<td>WOMAC-PF</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WOMAC-P</td>
<td>0.73**</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SF-36 PF</td>
<td>0.79**</td>
<td>0.64**</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SF-36 P</td>
<td>0.60**</td>
<td>0.69**</td>
<td>0.54**</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>WS</td>
<td>0.50**</td>
<td>0.29*</td>
<td>0.50**</td>
<td>0.25*</td>
<td>1.00</td>
</tr>
</tbody>
</table>

Abbreviations: PF = physical functioning; P = pain; WS = walking speed.
correlations. Correlations between the physical functioning and pain scales of the WOMAC and SF-36 were very similar to the preoperative correlations. Long-term postoperatively, the correlations between walking speed and the physical functioning scales of the WOMAC and SF-36 were 0.50, while correlations between walking speed and the pain scales were 0.25. Correlations between WOMAC-PF and the pain scales of the WOMAC and SF-36 were as high as the correlations between SF-36 PF and the pain scales.

Preoperatively, principal components analysis resulted in 2 factors with an eigenvalue over 1.00 (2.54 and 1.09 for factors 1 and 2, respectively). The two factors together explained 72.8% of the variance (50.9% by factor 1, 21.9% by factor 2). Both WOMAC subscales loaded on factor 1 as well as the SF-36 P subscale. Walking speed loaded on factor 2. SF-36 PF loaded almost equally on both factors (0.54 vs. 0.56). Short-term postoperatively, the first factor (eigenvalue 2.6) explained 53.0% of the variance. The second factor explained an additional 16.9% of the variance (eigenvalue 0.85). All self-reported scales loaded on factor 1 (0.66-0.92), while walking speed loaded on factor 2 (0.95). Long-term postoperatively, the first factor (eigenvalue 3.2) explained 63.7% of the variance. The second factor (eigenvalue 0.85) explained an additional 17.0% of the variance. WOMAC-PF and SF-36 PF loaded over 0.70 on both factors, while WOMAC-P and SF-36 P loaded on factor 1 (0.90 and 0.86) and walking speed on factor 2 (0.93).
Table 3a.
Factor analysis preoperatively (principal component analysis with promax rotation, forced 2-factor solution).

<table>
<thead>
<tr>
<th></th>
<th>Factor 1</th>
<th>Factor 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>WOMAC-PF</td>
<td>0.88</td>
<td>0.26</td>
</tr>
<tr>
<td>WOMAC-P</td>
<td>0.87</td>
<td>-0.08</td>
</tr>
<tr>
<td>SF-36 PF</td>
<td>0.54</td>
<td>0.56</td>
</tr>
<tr>
<td>SF-36 P</td>
<td>0.83</td>
<td>0.19</td>
</tr>
<tr>
<td>WS</td>
<td>0.04</td>
<td>0.91</td>
</tr>
</tbody>
</table>

*NOTE. Factor loadings >0.50 are in bold.*

Abbreviations: PF = physical functioning; P = pain; WS = walking speed.

Table 3b.
Factor analysis short-term postoperatively (principal component analysis with promax rotation, forced 2-factor solution).

<table>
<thead>
<tr>
<th></th>
<th>Factor 1</th>
<th>Factor 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>WOMAC-PF</td>
<td>0.92</td>
<td>0.40</td>
</tr>
<tr>
<td>WOMAC-P</td>
<td>0.80</td>
<td>0.05</td>
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<tr>
<td>SF-36 PF</td>
<td>0.66</td>
<td>0.45</td>
</tr>
<tr>
<td>SF-36 P</td>
<td>0.73</td>
<td>0.41</td>
</tr>
<tr>
<td>WS</td>
<td>0.32</td>
<td>0.95</td>
</tr>
</tbody>
</table>

*NOTE. Factor loadings >0.50 are in bold.*

Abbreviations: PF = physical functioning; P = pain; WS = walking speed.

Table 3c.
Factor analysis long-term postoperatively (principal component analysis with promax rotation, forced 2-factor solution).

<table>
<thead>
<tr>
<th></th>
<th>Factor 1</th>
<th>Factor 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>WOMAC-PF</td>
<td>0.85</td>
<td>0.72</td>
</tr>
<tr>
<td>WOMAC-P</td>
<td>0.90</td>
<td>0.42</td>
</tr>
<tr>
<td>SF-36 PF</td>
<td>0.77</td>
<td>0.74</td>
</tr>
<tr>
<td>SF-36 P</td>
<td>0.86</td>
<td>0.31</td>
</tr>
<tr>
<td>WS</td>
<td>0.35</td>
<td>0.93</td>
</tr>
</tbody>
</table>

*NOTE. Factor loadings >0.50 are in bold.*

Abbreviations: PF = physical functioning; P = pain; WS = walking speed.
Discussion

Aim of the study was to determine the relationship between the WOMAC and SF-36 physical functioning scales as self-report outcome measures and walking speed as performance-based outcome measure in total hip arthroplasty patients before surgery as well as short-term and long-term postoperatively, and secondly to determine if the influence of pain on self-report measures explained the expected discrepancy between the self-report and the performance-based measures. The results of the study show that the correlations are low preoperatively, while moderate correlations are seen between walking speed and the WOMAC and SF-36 physical functioning subscales short-term as well as long-term postoperatively, which is in conformity with our hypothesis. This improvement in the correlation between self-report and performance-based physical functioning with disappearing pain and the moderate-to-high correlations that are seen between the self-report physical functioning and pain scales is evidence for the important role of pain as explanation for the discrepancy between self-report and performance-based physical functioning. This is partially confirmed in the factor analysis. Preoperatively the self-report measures load on one factor, while walking speed loads on the other factor, as hypothesized. Short-term postoperatively, however, the same loadings were seen as preoperatively, while long-term postoperatively the self-report physical functioning scales load on both factors; our hypothesis was that postoperatively the pain scales would load on one factor and all physical functioning measures on the other. The latter is only seen long-term postoperatively: both self-report measures and the performance-based measure load on factor two.

The fact that pain is determined with the same questionnaires that are used to assess self-report physical functioning can be considered a limitation of the study. As a result, the correlation between pain and physical functioning could be higher than if pain were determined with another measure, for example a visual analogue scale (VAS). On the other hand, pain is assessed with the WOMAC as well as with the SF-36, and the correlation between physical functioning and pain within one questionnaire is almost equally high as that between the two questionnaires. Another remark needs to be made about the fact that walking speed is used as a performance-based measure of physical functioning. Although walking is highly important in everyday life and therefore closely linked to overall functioning, in order to function well physically a person needs more than good walking abilities alone. Walking speed has been related to independent living and the ability to perform various activities of daily living, like safely crossing a traffic intersection and risk of falling. Therefore, walking speed can be used as a measure of overall physical functioning. Moreover, walking speed has been used in other studies comparing self-report and performance-based measures in total hip and knee arthroplasty patients. The correlation between walking speed and a self-report measure was comparable with the correlation found when another performance-based measure was used in the same study, like stair-climbing or rising from a chair.5,15,16

When looking at the mean values of the performance-based outcome measure
before and after surgery, walking speed is almost the same preoperatively and short-
term postoperatively (0.93 and 0.94 m/s). The self-report physical functioning
measures, on the other hand, show most improvement between these measurement
times. This is most pronounced in the WOMAC as well as for the SF-36, when the
unequal time interval between the three measurements is considered (6 weeks vs. 20
weeks). The same pattern is seen in the pain measures, again most pronounced in the
WOMAC, where almost no improvement is reported between the two postoperative
measurements. The difference between the WOMAC and SF-36 outcomes can be
explained by the fact that the WOMAC is a disease-specific measure and the SF-36 a
generic outcome measure. The WOMAC asks for difficulties with specific activities
that are problematic for arthritic patients, while in the SF-36 overall health is assessed.
This can also explain why the WOMAC scores are higher than the SF-36 scores at the
final measurement time.

In validation research, a correlation of 0.50 or higher between two instruments
that aim to measure the same construct is considered satisfactory. The correlations
between the WOMAC and SF-36 physical functioning subscales and walking speed
are 0.50 only at the long-term postoperative assessment. Before surgery and short-
term postoperatively lower correlations were found, indicating that the self-report and
performance-based measures do not determine the same construct but a different aspect
of recovery. The influence of pain seems to be most pronounced at these measurement
times. Considering the high correlations between the physical functioning and pain
subscales, especially of the WOMAC and to a lesser extent of the SF-36, pain — or
the sudden disappearance of pain shortly after surgery — is measured too when the
aim is to assess solely physical functioning. An explanation can be that patients are
in a lot of pain before surgery, but shortly after surgery that pain tends to disappear
immediately, besides some wound pain. As a consequence, patients underrate their
physical functioning before surgery, while after surgery they tend to overrate it. This
could explain the fact that correlations shortly after surgery are not as high as the
long-term postoperative ones. Long-term postoperatively, patients experience no more
pain for a while, which could account for their perceived physical functioning level
correlating better with the performance-based measure. Patients seem to be unable
to separate pain and physical functioning when pain is present or a sudden change in
pain has occurred. This is confirmed by the factor analysis, where not until long-term
postoperatively walking speed and the physical functioning scales of the WOMAC
and SF-36 load on factor two, while the pain scales do not.

The results of our study are comparable with the results of other research into the
relationship between self-report and performance-based measures, albeit determined
at different moments or one single moment in time in osteoarthritis patients and total
hip and knee arthroplasty patients. Long-term postoperatively, correlations around
0.50 (0.34–0.63) are found in research into knee patients, which is highly similar to
our 6-month results in total hip arthroplasty patients. The preoperative values
we found are lower than in other research, where correlations are reported between
0.34 and 0.54 in hip as well as knee patients. Lin et al., for example, report a correlation of 0.48 between walking speed and WOMAC physical functioning in 106 hip and knee osteoarthritis (OA) patients. These patients had confirmed OA, but did not receive treatment and were not scheduled for surgery. A possible explanation would therefore be that they have less pain and as a result a higher correlation; they do however rate their pain equally to our patients preoperatively on the WOMAC pain subscale. Another explanation could be that the perceived physical functioning of the patients in our study was influenced by their knowledge that they were scheduled for surgery.

**Conclusion**

The correlations between self-report and performance-based measures of physical functioning are poor before total hip arthroplasty. We do however see higher correlations, especially long-term postoperatively; the short-term postoperative correlations are slightly higher than the preoperative ones. Pain and the diminishing pain after surgery seem to be explanatory factors in the discrepancy between self-report and performance-based outcome measures. Patients appear to have problems with separating pain and physical functioning. For practice, this implies that when one is interested in physical functioning exclusively, a performance-based measure should be considered. If the opinion of the patient about his physical functioning is important, self-report measures can be used. One must realize though that with the same measure other factors, such as pain, are measured as well. The results of this study support the recommendation to use a performance-based and a disease-specific and generic self-report outcome measure to obtain a complete insight into recovery after total hip arthroplasty.
References


Chapter 6

Suppliers
b. SPSS Inc, Chicago, IL, USA.