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RESEARCH ARTICLE

Movement quality evaluation and its correlation with recommended functional measures in hip osteoarthritis

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Abstract

Objective: Hip osteoarthritis may cause compensational movement strategies that require extra physical and mental effort. Such aberrant functioning can be captured in movement quality evaluation. The objective of this study was to explore whether movement quality, evaluated as a multiperspective phenomenon, is reflected in commonly used and recommended functional measures in this group of patients.

Methods: A cross-sectional study design was used. Baseline included 80 female and 21 male participants with hip osteoarthritis. Movement quality was evaluated by the Body Awareness Rating Scale—Movement Quality and Experience (BARS-MQE), part one, including 12 movement items. Correlation analyses (Pearson and Spearman) were performed to explore associations between BARS-MQE (sum score and single item scores), and scores on measures of physical capacity (Chair test, Stairs test, 6 minutes walking test; 6MWT), self-reported activity level (UCLA), function (HOOS subscales), pain during walking (NRS), self-efficacy (ASES) and health (EQ-5D-5L). Based on previous evidence, we hypothesized moderate associations between BARS-MQE and these measures.

Results: BARS-MQE's sum score showed moderate associations with Stairs test, 6MWT and UCLA (r = −0.425 to 0.304) and weak associations (r = 0.29 to 0.12) with ASES Pain and Symptoms, HOOS ADL, Chair test, NRS, HOOS Pain and Sports, and EQ-5D-5L. No association was found between BARS-MQE and HOOS Symptoms and Quality of life. Movement quality in item 12, *walking*, demonstrated moderate or weak association with all included measures.

Conclusion: In this study of participants diagnosed with hip osteoarthritis, movement quality evaluated by BARS-MQE was moderately reflected in measures of physical capacity and activity, but weakly reflected in self-reported measures of health problems. With its particular dynamic procedure and inclusion of the whole moving person, movement quality evaluation by the BARS-MQE was shown to provide supplementary information on functioning, scarcely captured by the commonly used and recommended measures.

1 | INTRODUCTION

Optimal movement and functional capacity are core aims in physiotherapy in order to promote patients' ability to engage with their environment in daily life (APTA, 2018). A person's movement habits can be influenced by external factors like culture, work and social life, and internal factors like symptoms and pain from the musculoskeletal system (Hodges & Tucker, 2011; Zeni, Pozzi, Abujaber, & Miller, 2015). Compensational adaptations may have short-term benefits, but potential long-term consequences as they often include asymmetry and restricted freedom of movement and may lead to dysfunctional movement habits (Hodges & Tucker, 2011). Although physiotherapists consider movement quality an important feature to address in the rehabilitation process, there are great diversities in the way they understand and describe this phenomenon (van Dijk, Smorenburg, Visser, Nijhuis-van der Sanden, & Heerkens, 2017). In the present study of patients with hip osteoarthritis, movement quality is understood as a unifying phenomenon that encompasses both physical and mental perspectives (Dropsy, 1984) as described more extensively below.

Several measurement tools have been developed to quantify clinically observed movement quality in adults with musculoskeletal conditions. In the Standardized Mensendieck Physiotherapy Test (SMT), movement quality is described as patients' cognitive self-awareness expressed in global and local body functionality, and the test includes evaluation of standing and sitting posture, specific movements/tasks, gait and respiration (Haugstad et al., 2006). SMT was not considered eligible for the present study, as its convergent validity has been found to be poor in a study of patients with chronic pain conditions, including osteoarthritis (Keessen, Maaskant, & Visser, 2018). Another tool is the Functional Movement Screen (FMS), which is used to predict athletes' ability to return to sport (Cook, Burton, Hoogenboom, & Voight, 2014). In FMS, movement quality is described as degrees of biomechanically efficient movement patterns in seven extreme body positions like deep squat, hurdle step and push-ups. Due to hip-related movement restrictions and/or symptoms, we expected that few of the patients in our sample would be able to perform the rather challenging exercises included in the FMS.

A person-centered, multiperspective view on movement quality is implemented in the physiotherapy approach, Basic Body Awareness Therapy (BBAT), integrating biomechanical, physiological, psychological and personal aspects into movement (Skjaerven, 2019; Skjaerven, Kristoffersen, & Gard, 2008). Two evaluation tools, a Swedish and a Norwegian, are used within BBAT. The Swedish, Body Awareness Scale Movement Quality and Experience (BAS MQ-E) was developed from the original BAS (Roxendal, 1985). It includes 23 movement items representing everyday functions like walking, standing on one leg, stomping and stepping up onto a chair (Hedlund, Gyllensten, Waldegren, & Hansson, 2016). The score is based on three factors of observation, such as stability in function, centring/breathing and relating/awareness (Sunden, Ekdahl, Horstman, & Gyllensten, 2014) as well as a self-report questionnaire on body experiences, symptoms and coping strategies (Hedlund et al., 2016).

The Norwegian, Body Awareness Rating Scale–Movement Quality and Experience (BARS-MQE), which is used in the present study, was developed from the original BARS (Friis, Skatteboe, Hope, & Vaglum, 1989; Skatteboe, 2005; Skatteboe, Friis, Hope, & Vaglum, 1989). BARS-MQE includes two parts. In part one, the physiotherapist observes, evaluates and scores movement quality in 12 movement items extracted from the original BBAT program (Dropsy, 1984). The movements represent daily life functions, such as lying, sitting, standing and walking (Skjaerven, 2015). The evaluation of movement quality is focused on how balance, free breathing and awareness are integrated and expressed in the movements. Part two is a phenomenological inquiry, where the patient is invited to verbalize immediate movement experiences in each of the 12 movements. Part two is not included in the present study, but has been presented previously (Olsen, Strand, Magnussen, Sundal, & Skjaerven, 2019).

The BARS-MQE scoring criteria are rooted in research on the phenomenon of movement quality (Skjaerven, 2019), presenting a multi-perspective differentiation of movement elements and aspects visualized in the movement quality model developed for clinical use (Skjaerven et al., 2008; Skjaerven, Kristoffersen, & Gard, 2010). Unique for BARS-MQE is its health-directed process orientation. Using a specific strategy, pedagogy and vocabulary to promote functional movement (Skjaerven, Gard, Gomez-Conesa, & Catalan-Matamoros, 2019), the physiotherapist invites the patient to explore, adjust and potentially develop the movement quality through 5–10 repetitions of each movement item (Skjaerven, Gard, Sundal, & Strand, 2015). With this, the BARS-MQE evaluation includes the patients´ adaptability to a change towards more functional movement habits. When physiotherapy for patients with hip osteoarthritis is aimed to improve compensatory movement habits, it is of value to reveal the patient's ability to make contact with and utilize own possibilities for adjustment. Recognizing the wide range of aspects that contribute to a person's movement functionality, we chose BARS-MQE for the movement quality evaluation in the present study.

Hip osteoarthritis is a common musculoskeletal condition (GBD, 2017), where patients tend to develop compensational movement strategies with increased demand on other body regions, subsequently leading to additional pain and dysfunction (Rutherford, Moreside, & Wong, 2015; Tanaka et al., 2015; Zeni, et al., 2015). Patients' quality of life can also be negatively influenced by personal and social factors, such as lacking ability to interpret and deal with symptoms constructively, or experiences of lost identity in social settings (Smith et al., 2014). Thus, a bio-psycho-social approach is recommended for physiotherapy evaluation and treatment (Kolasinski et al., 2020). From such a multiperspective view on health, we aimed in the present study to investigate whether movement quality, evaluated by the BARS-MQE as a multiperspective phenomenon, is reflected in commonly used indicators of function and health in this group of patients, or if it should be evaluated as a unique characteristic of movement function. As the movements in BARS-MQE represent a broad spectre of daily-life movements, a secondary aim was to

investigate whether single movement items stood out with a particularly strong association. Research question: Is observed movement quality evaluated by the BARS-MQE (sum score and its 12 movement items, separately) associated with commonly used and recommended measures of function and health in patients diagnosed with hip osteoarthritis?

2 | METHODS

2.1 | Design

A cross-sectional design was applied to investigate association between the measures.

2.2 | Patients

The study included participants with hip osteoarthritis from a randomized controlled clinical trial (RCT) investigating effects of Basic Body Awareness Group Therapy (BBAT) (Clinical Trials ID: NCT02884531). Inclusion criteria: Adults with primary hip osteoarthritis according to the American College of Rheumatology Clinical Criteria (Altman et al., 1991), living reasonably close to the intervention site. Exclusion criteria: Health problems that preclude movement training and participation in an educational program, drug abuse, not speaking Norwegian and pregnancy between 5 and 9 months. Based on power calculation, 100 patients were required for the RCT, which is also a sufficient sample for the present correlation study (de Vet, Terwee, Mokkink, & Knol, 2011).

2.3 | Data collection

All measures were collected in the same session for each participant and by the same therapist. First, movement quality was evaluated and thereafter, the three physical capacity tests were conducted. Finally, the participants filled in self-report questionnaires on pain during walking, level of physical activity, self-efficacy, perceived health and hip-related functional problems. Assessment was performed before randomization, hence the assessor and the patients were blinded to group allocation. Baseline data from all participants of the RCT (n = 101) were included.

2.4 | Asessment tools

2.4.1 | The Body Awareness Rating Scale – Movement Quality and Experience

The most functional movement quality observed during each of the 12 movement sequences is scored on an ordinal scale from 1 (dysfunctional movement quality) to 7 (very good functional movement quality) (Skjaerven et al., 2008, 2015). The sum score of the 12 movements ranges from 12 to 84. In a study of patients with long-lasting musculoskeletal disorders and mental health problems, reliability of the BARS-MQE was found to be high, with ICCs of inter-tester and test–retest reliability 0.99 and 0.96, respectively. BARS-MQE was found to discriminate between patients and healthy persons. It also correlated moderately with the general perceived self-efficacy scale (GPSES) and most subscales of the Short-Form Health Survey (SF-36) (Skjaerven et al., 2015).

2.5 | Assessment tools examined for association with BARS-MQE

2.5.1 | Physical capacity tests

Chair test: the number of repeated rising from and sitting down on a chair during 30 s is counted. High intra-rater and inter-rater reliability has been found in patients with hip/knee osteoarthritis, with ICC = 0.85 and 0.86, respectively (Dobson et al., 2017). *Stairs test*: the time, by seconds, used to walk up and down 18 steps × 3 is measured (Tveter, Dagfinrud, Moseng, & Holm, 2014). *6 minutes walking test (6MWT)*: the walking distance during six minutes is measured in meters. High inter-rater and intra-rater reliability has been found in patients with hip/knee osteoarthritis, with ICC = 0.94 and 0.93, respectively (Dobson et al., 2017).

2.5.2 | Self-report questionnaires

Pain intensity during walking within the last week was assessed by a 0–10 point *Numeric Rating Scale (NRS)*. High test–retest reliability has been reported in patients with knee osteoarthritis (ICC = 0.95) (Alghadir, Anwer, Iqbal, & Iqbal, 2018). The *University of California Los Angeles activity score (UCLA)* was used to assess the self-reported level of physical activity during the last month on a 10-point ordinal scale from totally sedentary (dependent on other persons) to regularly participating in high-intensity physical activities (running, tennis, skiing, heavy work, hiking, etc.) (Naal, Impellizzeri, & Leunig, 2009). Criterion validity was indicated as UCLA strongly correlates with steps/day as recorded by pedometer (Zahiri, Schmalzried, Szuszczewicz, & Amstutz, 1998). Excellent test–retest reliability has been reported (k_w = 0.80, 95% CI, 0.70–0.90), and UCLA was found able to discriminate between active and inactive patients with hip OA (Naal et al., 2009). The *Hip Osteoarthritis Outcome Score (HOOS)* is an instrument to assess the patients' opinions about their hip and associated problems, as perceived during the last week (Klassbo, Larsson, & Mannevik, 2003). It contains questions of five domains: pain (P), symptoms (S), Activities of Daily Life (A), sport and recreation (SP) and hip-related quality of life (QL) (Nilsdotter, Lohmander, Klassbo, & Roos, 2003). Each item is answered on a Likert scale (no, mild, moderate, severe and extreme) and scored from 0 to 4. The sum score of each domain is transformed to a

normalized scale from 0 (extreme problems) to 100 (no problems). HOOS has shown high test–retest reliability (ICC for subscales ranging from 0.78 to 0.91) (Klassbo et al., 2003). Construct validity has been supported by high correlations with the Oxford Hip Score (r_s = 0.822$_)$ and the SF-36 (r_s = –0.664) (Arbab, van Ochten, Schnurr, Bouillon, & Konig, 2017). The *Arthritis Self-efficacy Scale (ASES)* is a questionnaire about self-efficacy regarding pain, symptoms and physical function for patients with arthritis (Lorig, Chastain, Ung, Shoor, & Holman, 1989). The subcategories, Pain and Symptoms, were included in the present study. The sub-category, Pain, consists of five questions, each to be answered on a Likert scale (1–5) from very unsure to very sure (sum-score from 5 (worst) to 25 (best). The sub-category, Symptoms, consists of six questions, with a sum-score from 6 (worst) to 30 (best). High test–retest reliability has been reported, r = 0.87 for pain and 0.90 for symptoms (Lorig et al., 1989), as well as evidence for validity (Brekke, Hjortdahl, & Kvien, 2003). Finally, the *EuroQol (EQ-5D-5L)* is a generic health index comprising a five-part questionnaire and a visual analogue self-rating scale (EuroQol, 1990). The five dimensions concern mobility, self-care, usual activities, pain/discomfort and anxiety/depression, each scored on a five-point scale from no problem (score 1) to extreme problems (score 5). An EQ index is calculated, ranging from 0.0 (worst health) to 1.0 (best health). The EQ VAS records the respondents' self-rated health on a vertical, visual analogue 0–100 scale (Best to worst imaginable health state). Test–retest reliability has been reported in patients referred for hip or knee replacement, ICC for the five items ranging from 0.61 to 0.77 (Conner-Spady et al., 2015).

2.6 | Analysis

Descriptive statistics was used to present demographic characteristics and test scores. Pearson and Spearman correlation analyses were used to examine the pairwise association between the BARS-MQE (total score and item scores) and scores of the included measures of function and health. Linearity was indicated, and Pearson (r) correlation coefficients were, therefore, presented. The interpretation of correlations followed guidelines suggested by Cohen (1988); low: r = 0.10–0.29, moderate: r = 0.30–0.49 and high: r = 0.50–1.0. Percentile bootstrap 95% confidence intervals were calculated. Statistical packages used: IBM SPSS Statistics 24 (Pallant, 2016) and R 3.5.1 (R Core Team, 2019).

For further guidance in the interpretation of the study results, we used information from a previous study of 50 patients with long-lasting musculoskeletal and mental health problems. In that study,

TABLE 1 Demographic characteristics and test scores at baseline, (n = 101)

Variables	*n*	Mean (SD)	Min–max
Demographic variables			
Sex; female, n (%)	101	80.0 (79.2)	
Age, years	101	63.1 (10.8)	23–83
Body mass index (BMI)	101	25.6 (3.6)	19.3–35.5
Observational movement quality evaluation			
BARS-MQE total, scale 12–84 (best)	101	46.6 (6.5)	27–60
Physical capacity tests			
Chair test, number of raise in 30 sec	101	14.1 (4.7)	0–24
Stairs test, sec;	101	60.2 (23.6)	31–154
6MWT (meters in 6 min)	101	493.6 (103.9)	210–804
Questionnaires			
NRS pain during walking, scale 0–10	100	4.1 (2.0)	0–9
UCLA, scale 1–10 (best)	101	6.3 (2.1)	2–10
HOOS P, scale 0–100 (best)	101	57.4 (16.4)	12.5–87.5
HOOS S, scale 0–100 (best)	101	50.8 (20.3)	15–100
HOOS A, scale 0–100 (best)	101	67.3 (17.2)	29.4–100
HOOS SP, scale 0–100 (best)	101	55.5 (20.0)	6.2–100
HOOS QL, scale 0–100 (best)	101	46.3 (16.6)	0.0–81.2
ASES pain, scale 5–25 (best)	101	17.5 (4.9)	5–25
ASES symptoms, scale 5–30 (best)	101	22.8 (4.6)	10–30
EQ-5D-5 L, index 0–1 (best)	101	0.68 (0.13)	0.05–1.00
EQ-5D-5 L, scale (VAS) 0–100 (best)	101	68.8 (16.4)	20–97

Abbreviations: 6MWT, six minute walk test; A, activities of daily life; ASES, Arthritis Self-efficacy Scale; BARS-MQE, Body Awareness Rating Scale–Movement Quality and Experience; EQ-5D-5L, EuroQol with five questions; HOOS, Hip Osteoarthritis Outcome Scale with subscales; NRS, Numeric Rating Scale; P, pain; QL, quality of life; S, symptoms; SP, sports/recreation; UCLA, University of California Los Angeles Activity Score.

TABLE 2 Scores on single movement items in the BARS-MQE (n = 101)

Items		Mean (SD), min–max
1 lying	Contact with the ground	4.3 (0.8), 1.5–5.5
2 lying	Closing legs together	3.9 (0.8), 1.5–5.0
3 lying	Symmetrical stretching	3.7 (1.0), 1.0–5.5
4 lying	Asymmetrical stretching	3.6 (1.0), 1.0–5.0
5 sitting	Sitting balance	4.6 (0.8), 2.5–6.0
6 standing	Up-down along the vertical axis	4.0 (0.7), 2.0–5.0
7 standing	Sideways movement	3.5 (0.8), 1.5–5.5
8 standing	Turning around the vertical axis	4.0 (0.8), 2.5–5.5
9 standing	Arm movement	3.8 (0.9), 2.0–6.0
10 standing	Flexing/extending the trunk	3.5 (0.9), 1.5–5.5
11 standing	Relational movement	3.8 (0.8), 1.5–5.5
12 walking	Walking	3.8 (0.7), 2.0–5.0

Abbreviation: BARS-MQE, Body Awareness Rating Scale–Movement Quality and Experience.

movement quality by BARS-MQE was found to be moderately associated with self-reported quality of life assessed by the Short-Form Health Survey (SF-36), subscales for physical and mental function, and self-efficacy assessed by the General Perceived Self-efficacy Scale (GPSES) (Skjaerven et al., 2015). We, therefore, generally hypothesized moderate associations between movement quality by the BARS-MQE and measures of physical capacity, self-efficacy and quality of life in our study.

3 | RESULTS

Descriptive data on patient characteristics and test scores from the participants, 21 men and 80 women aged 23–83 years, are presented in Table 1. The sum score of BARS-MQE was normally distributed and ranged between 27 (mostly dysfunctional movement quality) and 60 (good functional movement quality). The highest mean score on single movement items was found in item 5, *sitting balance*, and the lowest mean scores were found in standing item 7, *sideways movement*, and item 10, *flexing/extending the trunk*, see Table 2.

3.1 | Associations between the BARS-MQE sum score and physical tests and self-report questionnaires

Movement quality, evaluated by the BARS-MQE sum score, was found to be moderately associated with the Stairs test (r = .42), 6MWT (r = .37) and UCLA (r = .30). Weak association was found between the BARS-MQE sum score and the Chairs test, NRS walking, ASES pain, ASES symptoms, EQ index, EQ VAS, HOOS P, HOOS A and HOOS SP, and no association was found with HOOS S and HOOS QL, see Figure 1.

3.2 | Association between single items of BARS-MQE and physical tests and self-report questionnaires

Movement quality in item 12, *walking*, was moderately associated with several assessment tools like the Stairs test, 6MWT, UCLA, ASES pain, NRS walking and Chairs test (r ranging from .43 to .30), while it showed weak association with the remaining measures, see Figure 1. Movement quality in item 7, *sideways movement*, item 9, *arm movement*, and item 11, *relational movement* (all in standing), was moderately associated with Stairs test and 6MWT, and item 11 was additionally found to be moderately associated with the UCLA. Item 1, *contact with the ground* (lying), was moderately associated with the 6MWT. For the remaining measures, movement quality of single BARS-MQE items showed weak or no association.

4 | DISCUSSION

In this study, we investigated the association between movement quality, analysed and evaluated by BARS-MQE, and recommended physical capacity tests and self-report questionnaires in patients with hip osteoarthritis. Movement quality was found with moderate or weak association with most of the measures of function and health, and generally strongest association with measures of physical capacity and activity (*Stairs test*, *6MWT* and *UCLA)*. Movement quality in BARS-MQE item 12, *walking*, was found to be of particular interest, as it showed moderate or weak association with all the included measures of function and health. The findings support our hypothesis of moderate association between movement quality evaluation and physical capacity tests, but the associations with measures of quality of life and self-efficacy were weaker than expected. Movement quality is, apparently, to a limited degree reflected in commonly used functional measures in patients with hip osteoarthritis. In the following, we will discuss our findings in relation to baseline scores and the constructs assessed by the included measures.

Mean scores on the 6MWT and Chairs test were similar to those reported in a previous study of patients with hip osteoarthritis (Bieler, Magnusson, Kjaer, & Beyer, 2014), indicating that our sample is likely to be representative for the patient population regarding physical capacity. Compared with normative BARS-MQE scores of 55 points, as reported in a previous study (Skjaerven et al., 2015), patients included in our sample scored lower (mean 46.6 points) on movement quality. This was expected since compensational movement patterns are common in hip osteoarthritis (Eitzen et al., 2015; Lin et al., 2015). The range of movement quality scores was from 27 to 60. According to the BARS-MQE manual, a score of 27 points is characterized by an unstable vertical axis, lack of rhythm and elasticity, weak intention and direction in the movement, inappropriate amount of energy used, and lack of unity

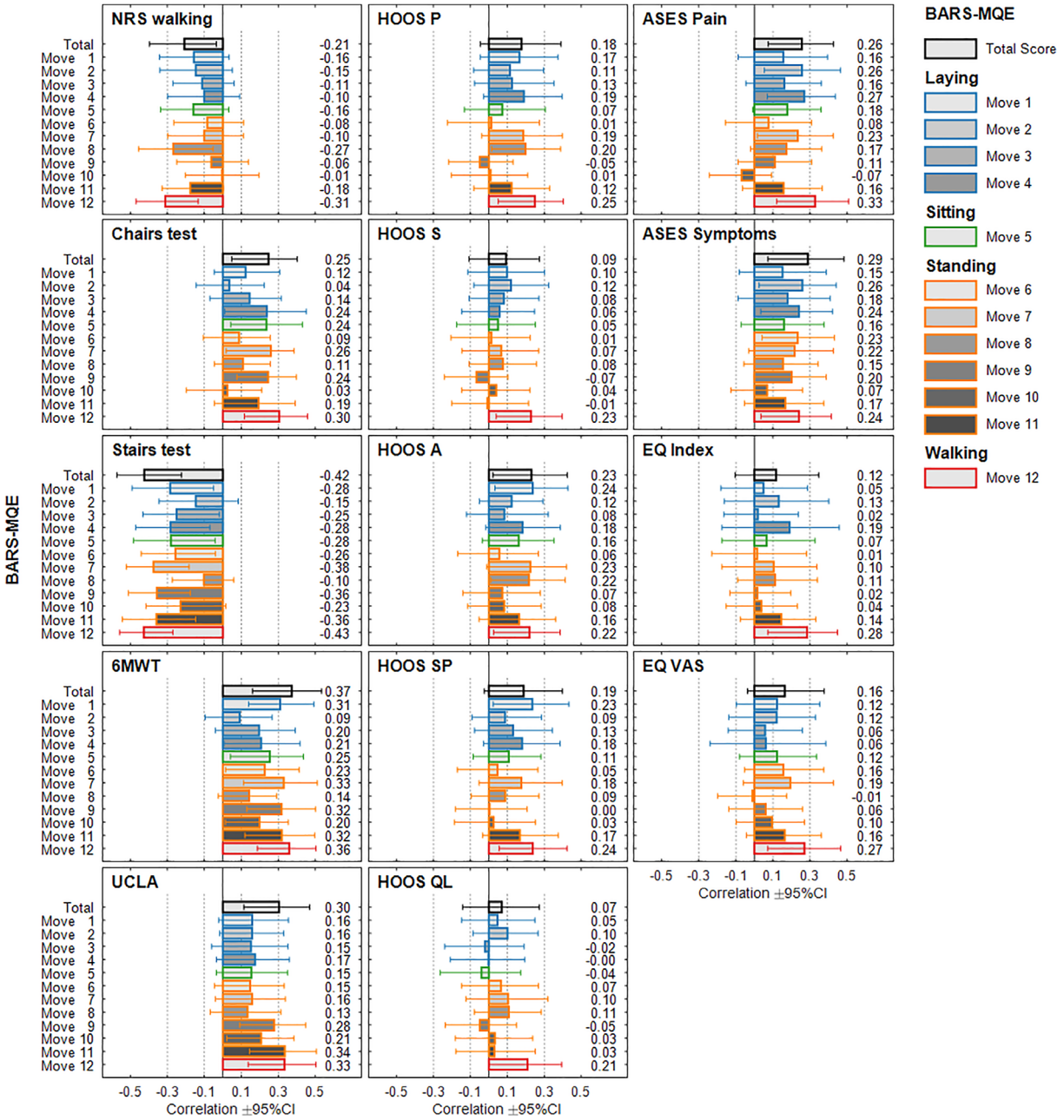

FIGURE 1 Strenght of correlation (Pearson's *r*) between BARS-MQE sum score (total) or scores of separate BARS-MQE items (Move 1 to 12) and test scores of Numeric Rating Scale (NRS) for pain during walking, Chairs test, Stairs test, 6-minutes' walk test (6MWT), University of California Los Angeles Activity Score (UCLA), Hip Osteoarthritis Outcome Score (HOOS) subscales pain (P), symptoms (S), Activities of daily life (ADL), sports/recreational (SP), quality of life (QoL), Arthritis Self-efficacy Scale (ASES) subscales pain and symptoms, EuroQol (EQ5D) Index and VAS scale in 101 patients with hip osteoarthritis. Negative/positive directions and 95% confidence intervals of correlations (bootstrap) are illustrated using box-and-whisker plots

between center-periphery and upper/lower body. A movement quality score of 60 points, on the other hand, reflects a well balanced, stable and free vertical axis, functional form, flow, elasticity and rhytm, intentional clarity, appropriate use of energy, unity and integration in the whole moving person. This shows that movement quality can vary substantially between patients with hip OA.

4.1 | BARS-MQE versus physical capacity tests

BARS-MQE sum score was found with moderate association with the Stairs test and 6MWT, which was in line with our hypothesis, but only weak association with the Chair test. Moderate association was expected since basic elements of movement quality, like dynamic stability and movement co-ordination, are regarded supportive for the

effectiveness of physical tasks (Shumway-Cook & Woollacott, 2017). Sunden et al. (2014), showed even higher association between the 6MWT and movement quality assessed by the BAS MQ-E ($r = -.557$) in their study of patients with hip osteoarthritis. Weak association with the Chair test may be due to the fact that the particular function of rising up from a sitting position is not implemented in the BARS-MQE. Although patients with hip osteoarthritis tend to compensate by unloading the involved limb when performing the sit-to-stand test (Eitzen, Fernandes, Nordsletten, Snyder-Mackler, & Risberg, 2014), such compensations may not be captured by the BARS-MQE.

The associations between movement quality, evaluated by the BARS-MQE, and physical capacity tests were generally not high, which may be due to differences in the instruments' construct, communication, guidance and scoring procedure. First, while the BARS-MQE score is based on the physiotherapists' movement analysis and clinical reasoning (Skatteboe, 2005; Skjaerven et al., 2008, 2015), the scores of physical capacity are based on simple recordings using a stop-watch. Second, the BARS-MQE provides a specific movement vocabulary (Skjaerven et al., 2019) and interaction between physiotherapist and patient, guiding the patient to develop and adjust to emerging movement quality. In the physical capacity tests, on the other hand, the patients are instructed to move as fast as they can within safe limits (Tveter et al., 2014) and are likely to be less aware of subtle movement nuances when trying to achieve a best possible time score. Indeed, from observing our patients performing the physical tests, we had the impression that a higher speed often enhanced their compensational movement habits, for example, with increased limping or shoulder elevation. Therefore, one might say that tests of physical capacity expose patients movement compensations during physically demanding tasks, while the BARS-MQE provides a platform for patients to become aware of and activate functional movement potentials in safe, small and slow movements. With regard to fundamental differences in focus, communication, guidance and procedure, strong associations between scores on BARS-MQE and physical capacity test might not be expected.

Regarding single BARS-MQE items, four items that require the combination of hip joint movement and weight-bearing (items 7, 9, 11 and 12) were found moderately associated with the Stairs test and the 6MWT, and item 12 was moderately associated also with the Chair test. As weight-bearing and -shifting can be challenging for patients with hip osteoarthritis (Leigh, Osis, & Ferber, 2016), at least a moderate association was expected. There are strong similarities between the activity of walking in item 12 and walking over time in the 6MWT. The scoring of movement quality in item 12 is, however, not only based on the way walking is performed, but also includes an evaluation of the patient's ability to relate to the physical room (walking in a circle). This aspect of adjusting to surroundings may be of particular importance while walking up/down stairs, and may explain why we found the strongest association between item 12 and the Stairs test ($r = -.43$).

Interestingly, we found that movement quality scores in lying movements were generally not higher (better) than those in weightbearing activities, standing and walking (Table 2). There is little previous research describing the consequences that compensational movement habits may have on the upper body in patients with hip osteoarthritis. However, increased pelvic tilt and sideways leaning of the trunk, during walking, are commonly observed in this condition (Meyer et al., 2015), and may have consequences for breathing and for muscular functions in the upper body. As evaluated by the BARS-MQE, blocked breathing and muscular stiffness in the trunk can be observed in movement aspects like elasticity, rhythm, energy and unity also in lying movements. By including the whole moving person from head to feet, movement quality evaluation by the BARS-MQE may thereby complement measures of physical capacity for a broader evaluation.

4.2 | BARS-MQE versus self-report questionnaires on function and health

The association between movement quality and level of physical activity (UCLA) was found to be moderate. This could be expected, based on the assumption that patients who exercise regularly also activate more of their movement potential, hence more functional movement quality, than sedentary persons. As for measures of self-reported function and health, their association with the movement quality scores were mainly weak. This was unexpected, based on previously reported moderate associations between BARS-MQE scores and measures of quality of life (SF-36) and self-efficacy (GPSES) in patients with non-specific musculoskeletal and mental problems (Skjaerven et al., 2015). Explanations for these diverging findings may be differences in the patient populations, and that SF-36 and GPSES, both, are generic questionnaires, unlike the hip-focused questionnaires used in the present study. While the BARS-MQE movement quality evaluation was health-oriented, most of the questionnaires were focused on pain or functional problems related to the hip. Similar to our findings, Sunden et al. (2014) found that movement quality evaluated by the BAS MQ-E was strongest when associated with questionnaires that concerned physical activity, such as HOOS SP and SF-36 (physical component) in patients with hip osteoarthritis. Similarly, in the present study, week or no association was found between movement quality and most HOOS subscales. When including the whole moving person in movement quality evaluation, strong associations with questionnaires on hip-specific problems might not be expected.

Another reflection is that the BARS-MQE score is built on the immediate here-and-now setting, (Skatteboe et al., 1989), which has a different focus than pro- and retrospect reflections on health and function as they are requested in self-report questionnaires. Results from previous studies show that patients' responses to questionnaires may be re-calibrated by recent health-related events like symptom fluctuations, even if their physical function not necessarily changed as a result of those events (Daltroy, Larson, Eaton, Phillips, & Liang, 1999; Terwee et al., 2006). Recent symptom fluctuations (Cross et al., 2017) may have influenced participants' responses to questionnaires in the present study, but not necessarily influenced their movement quality.

4.3 | Methodological considerations

The validity of the study findings is strengthened by a rather large sample size (n = 101). During data collection, the BARS-MQE movement quality evaluation was conducted prior to physical tests and self-report questionnaires and was, therefore, not influenced by any of the other measurements. Patients' responses on self-reports may, however, have been influenced by their experiences from the immediate foregoing physical tests, as described by Daltroy et al. (1999) and Magnussen, Strand, and Lygren (2004).

There are some limitations to this study. Although, generally, more women than men have hip osteoarthritis (Prieto-Alhambra et al., 2014), the proportion of females was larger in our sample than the general population and may have influenced our results. Furthermore, in lack of a gold-standard for movement quality evaluation and sufficient literature to formulate evidence-based a priori hypotheses, the present study was of an exploratory nature. More research is needed to provide evidence for the relevance of movement quality evaluation in patients with hip osteoarthritis.

5 | CONCLUSION AND IMPLICATIONS FOR PHYSIOTHERAPY PRACTICE

In the BARS-MQE movement quality evaluation, the whole moving person is included. In this study, the participants diagnosed with hip osteoarthritis were found to have less functional movement quality than non-symptomatic persons examined in a previous study, showing that the condition has an impact on movement quality, although with substantial variability. Movement quality was moderately reflected in measures of physical capacity and activity, but weakly reflected in measures of self-reported health problems. With its particular procedure of revealing movement resources as well as restrictions, the BARS-MQE was found to demonstrate supplementary characteristics of functioning and health than captured by recommended and commonly used measures in hip osteoarthritis.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

ETHICS

The Norwegian Regional Committees for Medical and Health Research Ethics approved the study (number 2013/2252/REK). The participants signed an informed consent form.

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