with their initial consultation on a 7-point scale (much improved to much worse).
Growth curve analyses and Spearman's rank correlations (rs) were examined for each subscale to determine: the differences in magnitude and rate of change over time; if and how patient heterogeneity influenced change scores and; the relationship between KOOS change scores and transition scales at each time-point. Six predictors were examined for each curve: gender, age at entry, waitlisted for joint replacement (WJR), unilateral or bilateral disease, baseline pain and 6 minute walk test. An a priori threshold of rs=0.4 was set as the minimum correlation for further MID analysis.
The MID for improvement in the KOOS subscales were examined using receiver operating characteristic curves (ROC) and mean score change methods (MSC). Data were dichotomised based on patients reporting they had "slightly improved" or greater on the transition scales or reporting "no change". Those reporting "slightly worse" or lower were removed from analysis. The predictive value of the transition scales were determined using the area under the curve (AUC) and the optimal cut-offs for the KOOS MID were based on a combination of optimal sensitivity and specificity.
Results: The rate of improvement in the KOOS subscales significantly fluctuated over time, thus any MID for KOOS subscales were time-specific. Further, two subscales exhibited significant predictors-time interactions, which were accounted for in the MID analyses: individuals with bilateral knee OA reported 2.39 points (95% CI 0.76 to 4.01) greater improvement in the KOOS pain subscale than their unilateral counterparts. Individuals not WJR exhibited 1.93 points (0.23 to 3.64) greater improvement on the KOOS knee-related quality of life (QoL) subscale.
Based on correlations >0.4 between the KOOS subscale and transition scales, MIDs were only examined for pain for those with bilateral knee OA at 26-weeks, pain for those with unilateral knee OA at 52-weeks, activities of daily living (ADL) at 52-weeks and QoL at 52-weeks for those WJR.
Both transition scales were fair to good predictors of improvement on the KOOS subscales (Table 1). The pain subscale at 26 weeks exhibited the largest discord between the MSC and ROC methods (Table 1): A change of 16-20 points was required for clinically important improvement when using the MSC method, compared with a change of 11.5 points using the ROC curve. The true positive and negative rates of the MIDs for the ADL and QoL subscales were >70%. For the pain subscale the true positive and negative rates were lower, indicating less precision in the estimated MIDs.
Conclusions: Establishing MIDs is pertinent to assist in determining the clinical relevance of reported changes. To ensure that patients are reporting clinically relevant improvements in the KOOS, it is advisable that the magnitude of change exceeds both the MIDs proposed by the current study and previously reported margins of error

Table 1
ROC and MSC analyses for KOOS subscales

Transition Scale	Subscale	AUC	Cut-off	Sensitivity	Specificity	MSC (95% CI)
Walking	Pain a	0.75	11.5	0.67	0.76	20.06 (8.91, 31.21)
	Pain b	0.72	4.0	0.63	0.73	8.15 (0.69, 15.91)
	ADL c	0.75	2.5	0.73	0.70	8.67 (2.85, 14.18)
	QoL d	0.79	6.5	0.68	0.86	5.6 (-5.33, 16.53)
Index knee	Pain a	0.69	11.5	0.66	0.65	16.56 (9.89, 23.23)
	Pain b	0.71	4.0	0.64	0.73	4.3 (-3.43, 12.06)
	ADL c	0.75	3.5	0.70	0.71	8.17 (2.24, 14.1)

a 26-weeks, bilateral knee OA; b 52-weeks, unilateral knee OA; c 52-weeks; d 52-weeks WJR

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DEVELOPING OSTEOARTHRITIS PHENOTYPES AND PREDICTING CHANGES IN HAND CONDITIONS OVER TIME IN OLDER PEOPLE

D.J. Green, K.P. Jordan, J. Protheroe, D.A. Van Der Windt. *Keele Univ., Staffordshire, United Kingdom*

Purpose: Osteoarthritis (OA) is the most frequent cause of hand pain and disability in older people. There is though a lack of knowledge about the characteristics and patterns of hand OA over time. The aim of this study was to define functional classifications (phenotypes) of hand OA that could be meaningful in a primary care setting, and investigate what factors predict future deterioration or improvement of the condition.
Methods: The study population stemmed from the NorStOP (North Staffordshire Osteoarthritis Project), a large population-based prospective cohort study. Information on hand pain and problems was collected from people aged 50 and over using questionnaires at baseline, 3 years and 6 years. All participants who responded at all 3 time points were included for analysis.
Phenotypes of hand OA were identified using Latent Transition Analysis, a longitudinal technique that is employed to define distinct population sub-groups based on characteristics of hand problems using cross-sectional data, while also incorporating change over time. The selection of variables for the analysis was driven by previous research and advice from our Research User Group to also incorporate patient perception regarding important features of hand problems. The final model was further tested to investigate if the phenotype definitions had a similar interpretation over time.
Factors that could potentially predict significant changes in hand conditions over time were investigated, including gender, age, widespread pain, anxiety, depression, sleep problems, living status, BMI and other demographic factors.
Results: 5,617 participants responded at baseline, 3 years and 6 years (54.0% female, mean age 62.6 (SD=8.2)), of which 3,308 (58.9%) reported hand problems on at least one occasion. 11 variables were considered for analysis to develop the sub-groups. Removing variables that did not improve the classification of the model or distinction between sub-groups, led to a model based on 8 variables including 3 pain and 5 function measures. The optimal model separated the population into 5 phenotypes of hand problems at baseline: 'least affected', 'high pain', 'poor gross function', 'high pain and poor gross function' and 'severely affected'.
The greatest movement was seen for those with 'high pain' at baseline transitioning into the least affected group (42% between baseline and 3 years, 48% between 3 years and 6 years), and those that developed a substantial increase in pain levels whilst maintaining their poor gross functional impairments (33% between baseline and 3 years, 27% between 3 years and 6 years). Stability was high in the 'least affected' state (87% remaining in this state at both times) and 'severely affected' state (68% from baseline to 3 years and 73% from 3 years to 6 years).
The proportion of individuals being classified in any of the non-'least affected' states at baseline was increased for females, older ages, those that live alone, had widespread pain, higher anxiety and depression , reported more sleep problems or had poor general health perception.
Being female was significantly associated with transitioning from the 'least affected' state to any of the states with functional issues at both transition times (Relative-Risk Ratios (RRR): range between 1.73 and 2.51, p-values <0.001). The presence of widespread pain was also significantly associated with transitioning into any of the pain or functional states compared to being in the 'least affected' state (RRR ranging between 1.66 and 2.06, p-values <0.003). Finally, poor self-perceived general health was significantly associated with predicting transitions into more severe hand problem states.
Conclusions: This work has defined phenotypes of patients with hand OA, based on self-report answers to brief pain and functional items. In addition, it provides evidence that there is movement a between some phenotypes, but little improvement into less severe phenotypes once a member of the severely affected group. Females, those with widespread pain and those with poor general health are at greatest risk of worsening hand conditions. The results provide information to clinicians regarding the features of distinct functional sub-groups of hand OA patients, and further understanding about the course of the condition.

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LOW BACK PAIN AND PSYCHOSOCIAL FACTORS ARE NOT PREDICTIVE OF FUTURE PAIN IMPACT IN HIP AND KNEE OSTEOARTHRITIS

L. Carlesso †·‡, G. Hawker §·‖, E. Waugh §·‖, A. Davis †·§. † *Univ. Hlth.Network, Toronto, ON, Canada;* ‡ *McMaster Univ., Hamilton, ON, Canada;* § *Univ. of Toronto, Toronto, ON, Canada;* ‖ *Women's Coll. Hosp., Toronto, ON, Canada*

Purpose: The association of comorbid low back pain (LBP) with hip and knee osteoarthritis (OA) is reported in the literature as having an additive effect on patient reported OA pain severity and functional limitations. It is also established in both LBP and OA populations that psychosocial variables are associated with poorer outcomes. It is unknown if the additive effect of LBP to hip/knee OA differs depending on baseline psychosocial factors. Further, the combination of LBP and

OA has been shown to be associated with poorer health status, indicating a need to further our understanding of the effect of LBP in the hip/knee OA population by moving beyond the constructs of pain and disability. The purpose of this study was to determine if having persistent low back pain (LBP) as well as adverse psychosocial factors, were predictive of future pain impact in people with hip and knee OA. We hypothesized that pain impact would be associated with pain catastrophizing, depression, anxiety, fatigue, and social support and that LBP and psychosocial factors would be predictive of future pain impact.
Methods: We analyzed data from an established population-based cohort of residents from Ontario, Canada who were 55 years or older and reported symptomatic hip/knee OA. Initial recruitment occurred between 1995 and 1997 through screening of 100% of the population in two Ontario communities. An initial cohort of n=2411 was followed annually using telephone interviews. The current study utilized data collected in 2006 (baseline) and 2008 (follow-up). Participants with inflammatory arthritis or a prior total joint replacement were excluded resulting in an analyzable sample of 462. The primary outcome was pain impact at follow-up using the Pain Impact Questionnaire 6 item version, a measure of pain severity, interference, impact and health related quality of life. The following standardized baseline measures were independent variables: Pain Catastrophizing Scale, the Centre for Epidemiologic Studies Depression Scale, The Hospital Anxiety and Depression Scale -anxiety subscale, Profile of Moods States - fatigue inertia subscale, the abbreviated Lubben Social Network Scale and the Western Ontario and McMaster Universities' Osteoarthritis Index (WOMAC). Persistent LBP in the past year (no/yes) was identified from a comorbidities questionnaire. Bivariate analyses compared participants with and without LBP. Next a sequential series of four linear regression analyses were conducted in the following order: 1. Psychosocial variables; 2. Psychosocial variables and LBP; 3. Psychosocial variables, LBP and demographics (age, sex, marital status, education); and 4. Psychosocial variables, LBP, demographics and disease-related variables (WOMAC summary score, knee pain, hip pain, hip and knee pain, BMI, number of comorbidities, multiple joint pain).
Results: The mean age of the 462 was 76 years (range 58 to 96), 77% were female and 35% reported LBP at baseline. Bivariate analyses revealed all psychosocial variables were significantly worse in those with LBP ($p<0.05$). In regression analyses, while baseline LBP was not predictive of future pain impact [ß 1.54(-0.04, 3.12) $p=0.06$], both greater pain catastrophizing [ß 0.20(0.09, 0.31) $p<0.001$)] and greater fatigue [ß 0.26 (0.08, 0.44) $p=(0.005)$)] were independent predictors of greater pain impact at follow up. However, these associations became non-significant when the WOMAC summary score was added to the model.
Conclusions: In a population-based cohort with hip and knee OA, baseline WOMAC summary score was the only independent significant predictor of future pain impact, suggesting that treatment be focused on limiting pain severity and functional limitations. Addressing pain catastrophizing and fatigue may also limit pain impact.

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ISOMETRIC HIP ABDUCTION STRENGTH IS NOT RELATED TO SINGLE-LIMB MINI SQUAT PERFORMANCE IN PARTICIPANTS WITH KNEE AND HIP PAIN

L. Fleng Sandal, J. Bloch Thorlund, E.M. Roos. *Univ. of Southern Denmark, Odense M, Denmark*

Purpose: The single-limb mini squat (SLMS) test is a clinical test resembling activities of daily living assessing movement quality rather than movement quantity during single-limb squatting. A previous study investigating validity of the SLMS test, by comparing two- and three-dimensional biomechanics of the lower limb, found that a knee-medial-to-foot position was mainly caused by an increased internal hip rotation during three-dimensional analysis rather than knee valgus movement. This study aimed to investigate if a knee-medial-to-foot position during the SLMS was associated with reduced isometric hip abduction strength.
Methods: Participants above 35 years, with persistent knee or hip pain for more than 3 months were recruited. The SLMS test was conducted with the participants standing with the long axis of the foot aligned to the stem of a "T", marked by tape on the floor. The second toe was placed on the stem of the "T". A table with adjustable height was placed in front of the participants to provide fingertip support for balance. Participants bend their knee, without bending forward from the hip, until they were no longer able to see the line along the toes and then return to full extension. This was repeated 5 times at a speed of 20 squats/min. The contralateral leg was kept with the hip and knee slightly flexed. Practice trials preceded measurements. Participants were scored as having a knee-over-foot or knee-medial-to-foot position. Joint position was assessed by looking at alignment between the patella and the 2nd toe of the foot during knee flexion. If the knee aligned medial to the 2nd toe in three or more trials, the joint position was scored as knee-medial-to-foot. Maximal isometric hip abduction strength was tested using dynamometry (Powertrack Commander, Echo). Participants lay on their back on an examination couch with their leg strait and were asked to press their lateral malleoli away from their body. A suction cup was mounted on a door behind the examination couch. A strain gauge was placed in between the suction cup and a fixation belt placed on the participants' ankle. The distance from the trochanter major on the femoral bone to the middle of the fixation belt was measured. Isometric muscle strength was measured as torque (Nm) and normalized to bodyweight. Two practice trials preceded three maximal voluntary contractions, each separated by 60 sec. Assumptions for normality in the isometric strength data were checked.
Results: Ninety-nine participants were tested; age 59 ± 10.0 years (SD), 62 had knee problems, 61 were female. All participants performed the SLMS test on both legs. The most painful leg was used in this analysis. Forty-six of 99 participants had a knee-medial-to-foot position. Unpaired t-tests showed no difference in isometric strength in hip abduction in relation to joint position during SLMS test for either knee or hip as primary complaint, or for the total sample (table 1).
Conclusions: No difference was observed in isometric hip abduction muscle strength for participants with a knee medial-to-foot compared to a knee-over-foot position in the SLMS test. These results indicate that the increased internal hip rotation previously observed in those with a knee-medial-to-foot position during the SLMS test is not caused by reduced isometric hip abduction strength. Strength training to improve hip abduction strength may therefore not change the knee-medial-to-foot position.

Table 1
isometric strength in hip abduction in relation to knee position during single-limb mini squat

	Knee-over-foot (95% CI)	Knee-medial-to-foot (95% CI)	p-value
Knee (n=62), $Nm*kg^{-1}$	0.84 (0.71 to 0.98)	0.87 (0.74 to 1.01)	p<0.75
Hip (n=37), $Nm*kg^{-1}$	0.83 (0.64 to 1.02)	0.79 (0.62 to 0.97)	p<0.78
Combined (n=99), $Nm*kg^{-1}$	0.84 (0.73 to 0.95)	0.85 (0.74 to 0.95)	p<0.91

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EXPLORING THE REASONS FOR THE SENSITIVITY TO CHANGE OF A PATIENT PREFERENCE MEASURE COMPARED WITH THE KOOS QUESTIONNAIRE IN PATELLOFEMORAL OSTEOARTHRITIS

M.J. Parkes †, M.J. Callaghan †, D.T. Felson ‡. † *The Univ. of Manchester, Manchester, United Kingdom;* ‡ *Boston Univ., Boston, MA, USA*

Purpose: To detect the efficacy of treatments for OA, it is necessary to use the outcome with greatest sensitivity to change. Widely used surveys such as the KOOS and WOMAC have a limited list of activities that cause pain but may not cover all activity related pain that could be affected by treatment. The BRACE trial (ISRCTN50380458), a randomized trial of a patellofemoral brace vs. no treatment in patellofemoral OA used the 'pain on nominated activity' visual analogue scale (VASNA), a patient preference measure where each patient selects an activity which aggravates their pain the most, and then rates severity of pain in this activity throughout the trial. The trials also collected data using the Knee Osteoarthritis Outcome Score (KOOS). We found that the patient preference measure was moderately more sensitive to change to the effect of treatment than the KOOS pain scale (Ann Rheum Dis, 2015, in press). We now investigate how activities reported by patients in the VASNA overlap with activities covered by the KOOS pain scale, with the hypothesis that nominated activity related pain not covered by KOOS items accounted for the increased sensitivity to change of the patient preference measure over KOOS.
Methods: Activities nominated by BRACE trial patients as the activity that aggravated their pain the most were coded into common 'themes'. For example, patients reporting 'going upstairs', or 'using the stairs' would be categorised more generally as 'stairs'. We then matched these