APPENDICES

APPENDIX 1

Comment in Nature Reviews Rheumatology on 'The relative contribution of mechanical stress and systemic processes in different types of osteoarthritis: the NEO study (Annals of the Rheumatic Diseases 2015;74(10):1842-7)'

Is osteoarthritis a mechanical or systemic disease?

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Osteoarthritis (OA) is a heterogeneous group of diseases with different pathogenesis in different joints. What effect do metabolic factors, inflammation and obesity have on OA in non-loadbearing structures? A new study reports that, in the absence of knee OA, systemic processes are important in the pathogenesis of hand OA.

A new paper by Visser et al.[1] examines the question of whether osteoarthritis (OA) is predominantly a biomechanical or systemic disease, and whether these mechanisms differ in hand and knee OA. They concluded that, although mechanical factors are probably more important in knee OA whether or not it coexists with hand OA, systemic processes, such as inflammation, aberrant metabolic regulation and obesity, control the pathogenesis of hand OA. How should these results be interpreted in the context of other evidence in the field?

The first thing to consider is that an increasing body of evidence shows that OA is joint failure – an outcome with myriad causes. It is now apparent that, in order to explore risk factors for OA, a joint-specific approach, such as that used by Visser et al.,[1] is needed. Although different risk factors, such as obesity and physical activity, overlap in their effect on joints, the mechanisms by which such risk factors specifically affect joints might differ. What do we know about the role of different biomechanical and systemic factors in knee OA? With the advent of sensitive, noninvasive imaging modalities such as MRI, it is now possible to visualize knee OA on a spectrum from a normal joint through to one with clinically and radiographically evident OA (Figure 1). By the time the first knee joint changes are detected by radiography, more than 10% of cartilage is already lost.[2] In addition, to better understand the role of a risk factor, its effect on structural change needs to be examined at different stages of the disease because the susceptibility of the joint to the risk factor in question might vary according to the severity of the pathological changes.

A large body of evidence based on highly sensitive MRI now shows that reduced knee cartilage volume is associated with metabolic factors, including increased fat mass and serum glucose levels. These MRI data correlate with radiographic evidence of OA and can predict increased knee pain and the risk of joint replacement.[3] Knee cartilage volume is also negatively associated with the concentration of circulating inflammatory cytokines, such as IL-6 and TNF,[4] as well as C-reactive protein (CRP), a systemic marker of inflammation.[5] Consistent with these findings, low-grade synovitis is common in patients with OA and is associated with cartilage loss.[6] Evidence also indicates that the adipokine leptin is an important mediator of the effect obesity has on knee cartilage.[7] Taken together, these data suggest that metabolism-related inflammatory factors substantially affect early stages of the pathogenesis of knee OA.

By contrast, Visser et al.[1] concluded that mechanical stress rather than systemic factors are important in knee OA. This conclusion was based on a cross-sectional examination of 6,673 participants aged 45 to 65 years, including 5,002 participants who were selected for BMI ≥27 kg/m^2, thereby providing a study group enriched for overweight individuals, and 1,671 participants selected as a reference from the general population. The definition of OA was based on the ACR clinical criteria, so no imaging was performed. Surrogates for mechanical stress (weight, fat-free mass, fat mass [adjusted for metabolic factors]) and systemic processes (metabolic syndrome, fat mass [adjusted for weight]) were used to examine the effect of mechanical stress and systemic processes, respectively, on OA. Knee OA was associated with weight and fat-free mass, adjusted for metabolic factors, with an OR of 1.49 (95% CI 1.32 to 1.68) and 2.05 (95% CI 1.60 to 2.62), respectively, but

was not associated with fat mass. As this study was cross-sectional, it has the potential problem of 'reverse causation': patients with knee pain might have gained weight or their body composition might have changed as a consequence of clinical knee OA. Studies examining asymptomatic individuals have correlated fat mass and markers of metabolism related-inflammation with structural changes to joints.[7] Nevertheless, these findings, in patients with clinical OA, are consistent with other data showing that biomechanical factors predominate in established OA; for example, minor degrees of knee malalignment have a more substantial pathogenic role in later rather than earlier stages of the disease.[8] With cartilage loss already present by the time OA is identified by clinical and radiographic analysis, it is not surprising to find that the local biomechanical environment in the knee has also changed and is the main factor contributing to disease progression. In contrast to the mechanical pathogenesis of knee OA, the data from Visser et al.[1] support a prominent role for metabolic factors in the aetiology of hand OA; hand OA was associated with the metabolic syndrome, adjusted for weight, with an OR of 1.46 (95% CI 1.06 to 2.02). For decades, obesity has been recognized as a risk factor for hand OA.[9] Given that we do not walk on our hands, this risk factor is circumstantial evidence against a mechanical pathogenesis for OA. The study by Visser et al.[1] further supports this concept; however, the 3rd National Health and Nutrition Examination Survey found no relationship between serum concentrations of leptin and the presence of clinical hand OA,[10] suggesting an alternative systemic pathway of OA pathogenesis. That is not to say that the results from Visser et al.[1] are definitive that systemic factors drive hand OA, or that they exclude the role of biomechanics; only muscle mass was examined as a surrogate for a mechanical effect of hand OA. One could argue that total-body muscle mass might not be a good surrogate measure of mechanical factors relevant to hand OA. Thus, further work in this area is needed.

What can we conclude? OA is not a single disease, but a heterogeneous condition, resulting from a variety of different exposures. These new data from Visser et al.[1] and others suggest that the pathogenesis of OA needs to be examined on a joint-by-joint basis. To not do so is likely to impede our understanding of the pathogenesis of OA and the identification of novel drug targets for prevention and treatment. The emerging data suggest that, although mechanical factors might have a larger role in established or late OA, systemic factors have a substantial effect on the knee joint structure in preclinical OA (Figure 1). Although mechanical factors are also involved in hand OA, the case for a systemic mechanism in the pathogenesis of this condition seems clearer. Thus, in regards to the question of whether OA is a mechanical or systemic disease, perhaps the correct answer is ... it depends.

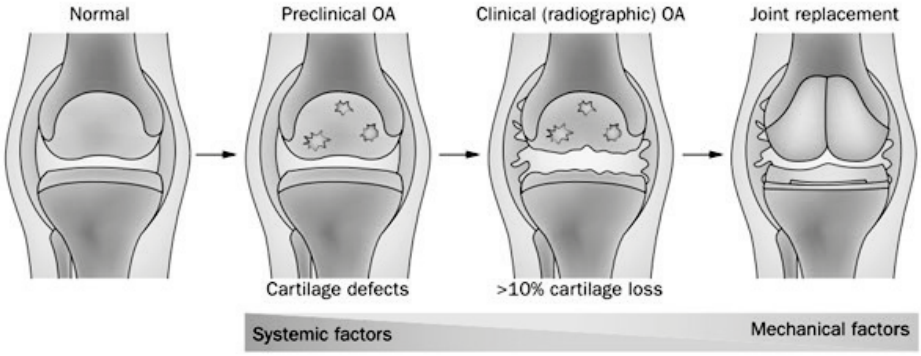

Figure 1. The spectrum of knee OA. OA can be considered as being on a spectrum from a healthy joint to preclinical disease and the beginning of cartilage damage (which is now detectable by MRI), through to radiographically evident OA and end-stage joint replacement. Systemic metabolic and inflammatory factors predominate in the early stages of knee OA, whereas mechanical factors seem to be more important in the later stages.
OA, osteoarthritis.

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APPENDIX 2

Report from the OMERACT Hand Osteoarthritis Working Group: Set of Core Domains and Preliminary Set of Instruments for Use in Clinical Trials and Observational Studies

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ABSTRACT

Objective
During OMERACT 12, a workshop was held with the aim to endorse a core set of domains for 3 settings: clinical trials of symptom and structure modification and observational studies. Additional goals were to endorse a core set of contextual factors for these settings, and to define preliminary instruments for each core domain. Finally, an agenda for future research in hand osteoarthritis (OA) was to be proposed.

Methods
Literature reviews of preliminary instruments for each core domain of the proposed core set for hand OA in the settings described above. Literature review of radiographic scoring methods and modern imaging in hand OA were also performed. Proposed contextual factors for a core set were identified through 2 Delphi exercises with participation of hand OA experts, patient partners, and OMERACT participants.

Results
Results from Delphi exercises and systematic literature reviews were presented and discussed. It was agreed that a preliminary core domain set for the setting clinical trials of symptom modification should contain at least "pain, physical function, patient global assessment, joint activity and hand strength." The settings clinical trial of structure modification and observational studies would in addition include structural damage. Preliminary instruments for the proposed domains were agreed on. A list of prioritized contextual factors was defined and endorsed for further research. A research agenda was proposed for domain instrument validation according to the OMERACT Filter 2.0.

Conclusion
Preliminary core sets for clinical trials of symptom and structure modification and observational studies in hand osteoarthritis, including preliminary instruments and contextual factors, were agreed upon during OMERACT 12.

INTRODUCTION

Osteoarthritis (OA) is a highly prevalent musculoskeletal disorder involving all components of the joint.[1] All joints may be involved, but the hand is a predilection site. The phenotype hand OA warrants special attention, because hand OA is in itself polyarticular, making it complex to study. Moreover, hand OA is frequently accompanied by OA in other joint sites, such as the knees or hips.[2] Hand OA is not one phenotype, but comprises several subsets, such as nodal hand OA, thumb base OA, and erosive hand OA,[3,4] which are associated with different risk factors, requiring different treatment strategies. Currently, insight in underlying pathophysiologic mechanisms of hand OA is limited and insufficient treatment options exist.[5] Therefore, high-quality observational cohorts and clinical trials are warranted, requiring optimal sets of outcome measures for adequate assessment of hand OA.

In 2010 the Outcome Measures in Rheumatology (OMERACT) hand OA working group was assembled, comprising health professionals, researchers, and patient research partners (PRP), with interest and experience in hand OA, aiming at defining a set of core domains using the OMERACT framework.[6] Previously, four core domains (pain, function, patient global assessment, and imaging) for knee, hip, and hand OA trials of ≥1 year duration were defined for phase III clinical trials following the OMERACT III consensus conference.[7] An Osteoarthritis Research Society International taskforce added the following domains: mobility, deformity, inflammation, performance, stiffness, and esthetic damage.[8] However, the above-mentioned set of core domains has several shortcomings: only the clinical trial setting was addressed, patients were not involved in the process, and the core sets lacked incorporation of hand OA–specific aspects.[9,10]

First, the OMERACT hand OA group performed a Delphi exercise among hand OA group members and OMERACT participants to identify a set of core domains.[6] Potential domains were identified from a qualitative study with 10 focus groups among 56 patients with hand OA from five European countries.[11] This was done separately for four settings: clinical trials of symptom modification and structure modification, observational studies, and clinical record keeping. Results of the Delphi exercises were discussed in a special interest group (SIG) during OMERACT 11 and resulted in a proposed set of core domains.[6] Further, it was agreed during the SIG to apply the new OMERACT Filter 2.0 in the development process.[12] Further discussions were held at annual meetings of the American College of Rheumatology (ACR) in 2012 and 2013.

As a next step we proposed a workshop during OMERACT 12 with the following objectives: (1) to endorse a core domain set for three settings, clinical trials of symptom modification, of structural modification, and of observational studies, (2) to endorse a core set of contextual factors for the same settings, (3) to define a preliminary set of instruments for each core domain, and (4) to propose a research agenda for domain instrument validation according to the OMERACT Filter 2.0.

MATERIALS AND METHODS

Delphi Exercise

Prior to the OMERACT 12 meeting, we performed a Delphi exercise to reach consensus about the contextual factors that should be considered as mandatory in hand OA studies. In Delphi round 1 an initial list of 36 potential contextual factors was circulated to experts in hand OA, PRP, and OMERACT participants. The list was derived from hand OA experts, hand OA patient focus groups, OMERACT participants, and an International Classification of Functioning review.[13] Potential contextual factors, i.e., variables that are not outcomes of the study but need to be recognized (and measured) to understand the study results,[12] included demographics, OA-specific factors, physical health, mental health, physical fitness, and others. Participants were asked to divide 100 points among the contextual factors they considered important; participants were explicitly encouraged to include additional factors. Domains with high agreement (average >6 points) were kept, whereas domains with low agreement (average <1 point) were excluded. Factors with moderate agreement and suggested factors were voted on in Delphi round 2.

Literature Reviews of Instruments to Assess Hand OA Outcomes

A systematic search of the medical literature up to January 2014 was performed to identify instruments measuring pain, physical function, patient global assessment, joint activity, and hand strength and to summarize their metric properties, i.e., discrimination (reliability, sensitivity to change), feasibility, and validity. Inclusion criteria required for studies to evaluate these aspects differed per item (Visser et al, manuscript submitted).[14] Another systematic review of the medical literature up to November 2013 was performed to evaluate the use of radiography in hand OA and to assess the reliability, sensitivity to change, validity, and feasibility of the different available radiographic scoring methods.[15]

OMERACT 12 Hand OA Workshop

A plenary session was held during which presentations were given: (1) On results of the Delphi exercises concerning core domains and later discussions (MK); (2) on the Delphi exercises concerning contextual factors (PB); (3) on systematic literature searches concerning instruments to assess pain, function, patient global, hand strength, and tender joints (AWV); (4) on searches to assess structural damage by radiography (AWV); and (5) on searches to assess joint activity or disease activity at joint level and structural damage using modern imaging techniques (IKH).

Subsequently, 4 breakout sessions took place to discuss (1) core domains in outcome measures, (2) contextual factors, (3) instruments to assess patient reported outcomes and performance measures, and (4) imaging instruments. Summaries of the breakout sessions were reported back during a plenary session. During this final plenary session, votes were taken; voters could “agree,” “not agree,” or “not know.”

RESULTS

Endorsement of Domains for a Core Domain Set for 3 Settings

Based on results of the Delphi exercise and discussions during OMERACT 11, the proposed core domains included pain, physical function, patient global assessment, joint activity, health-related quality of life (HRQOL), reduced strength, pain medication, structural damage, and reduced mobility.[6] The proposed core domain set was widely discussed during a breakout session attended by 11 physicians, 2 PRP, 1 representative from industry, 2 researchers, and 2 research fellows.

Discussions touched upon similarities and differences between "reduced strength" and "physical function," and the term "hand strength" was proposed instead of "reduced strength." HRQOL was included as a core domain. However, HRQOL contains different domains, and instruments are not available. Therefore, HRQOL was included as a non-mandatory domain until disease-specific instruments are available. After discussion, the proposed domain "pain medication" was incorporated as a potential contextual factor. After the breakout session, it was proposed that in the setting of clinical trials of symptom modification, a preliminary set of core domains should at least contain pain, physical function, patient global assessment, HRQOL (although not mandatory as long as no disease-specific instruments are available), joint activity, and hand strength. In the final plenary, 47 (89%) of the voting participants agreed; 11% did not agree; and none responded "don't know."

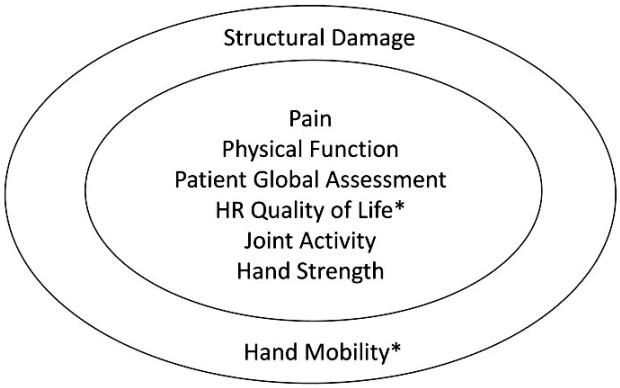

Figure 1. Preliminary set of endorsed core domains for hand osteoarthritis studies. Inner circle: Domains for all settings, i.e., clinical trials of symptom modification, clinical trials of structure modification, and observational studies. Outer circle: Domains for some settings, i.e., clinical trials of structure modification and observational studies.

*Domains not mandatory as long as no disease-specific instruments are available.

HR, health-related.

For the setting of clinical trials of structure modification, the breakout group proposed to define subdomains as radiographic damage, esthetic damage, bony damage, and deformity. Further, "reduced mobility" was discussed: whether it is distinct from or similar to physical function, as well as the current lack of an appropriate instrument; "hand mobility" was suggested as a more appropriate term. Finally, it was agreed by 41 voting participants (76%) that a preliminary set of core domains for clinical trials of structure modification contain at least the domains endorsed for clinical trials of symptom modification and structural damage and mobility; 13% did not agree and 11% did not know. Thirty-eight (72%) agreed that the preliminary set of endorsed core domains for the assessment of hand OA in observational studies is similar to that for structure modification; 11% did not agree and 17% did not know (Figure 1).

Definition of a Preliminary Set of Instruments for Each Core Domain

Patient-reported outcomes and performance tests

In the systematic literature review, 66 studies concerning hand OA were included, in which various questionnaires, perform - ance-based instruments, and assessor-based instruments were applied. No major differences regarding metric properties were observed between the instruments, although the amount of supporting evidence varied.

The most frequently evaluated questionnaires were the Australian Canadian Hand OA Index (AUSCAN) pain subscale[16] and visual analog scale (VAS) or numerical rating scale (NRS) for pain assessment, and the AUSCAN function subscale and Functional Index of Hand OA (FIHOA)[17] for physical function assessment. Excellent reliability was shown for the AUSCAN and FIHOA and good sensitivity to change for all mentioned instruments; additionally, the FIHOA had good feasibility. No validation by comparing to a gold standard has been performed; however, good construct validity was suggested for all instruments. Grip and pinch strength to assess hand strength and palpation of tender joints to assess joint activity[18] were commonly applied. For these measures, good sensitivity to change and construct validity were established. Supporting evidence (Table 1) was presented and discussed in a breakout session, attended by 2 PRP, 1 representative from the pharmaceutical industry, 2 occupational therapists, 1 statistician, 1 epidemiologist, and several rheumatologists.

There was general agreement to use the VAS or NRS to assess pain. A single question was generally preferred over multiple pain questions. Further information is needed whether overall hand pain or joint pain specifically should be assessed, which joints should be assessed, how questions should be asked, and which anchors should be used. During voting, 49 participants (88%) agreed on either the VAS or NRS as a preliminary instrument for the self-reported pain domain; 4% did not agree; and 9% did not know. There was concern about the use of the FIHOA to assess physical function because of sex role-specific items (men use screwdrivers and women sew), cultural issues (e.g., handshake), and some items with low secular relevance, e.g., writing for a long period of time versus typing on computer. The alternative AUSCAN instrument had the disadvantage of limited access due to a mandatory fee. Therefore, it was voted by 31 participants (61%; 18% did not agree; 22% did not know) to use the FIHOA for the physical function domain for the time being. Research is warranted for a more contemporary instrument. To measure the hand strength domain, 43 participants (81%) agreed on use of grip/pinch strength as a preliminary instrument; 13% did not agree; and 6% did not know. Although it was agreed

that more studies are needed, 43 participants (75%) agreed on use of the tender joint count on palpation as a preliminary instrument to assess joint activity; 11% did not agree, and 14% did not know.

Table 1. Supporting evidence from at least 3 studies for the most frequently applied instruments for evaluation of pain, physical function or patient global assessment. From Visser et al. J Rheumatol (manuscript submitted).14

	Reliability	Sensitivity to change	Feasibility	Validity
Questionnaires				
AUSCAN	+	+	- #	+
FIHOA	+	+	+**	+
VAS pain		+		+
Performance-/assessor-based instruments				
Grip strength	+*	+		+
Pinch strength	+*	+		+
Tenderness/pain on palpation	+*	+		+*

+ established evidence

* supporting evidence in only 2 studies

** supporting evidence in only 1 study

not available in public domain

AUSCAN, Australian/Canadian Hand Osteoarthritis Index; FIHOA, Functional Index for Hand Ostearthritis; VAS, visual analogue scale.

Radiographic scoring methods

The domain structural damage includes the subdomain radiographic damage. The systematic literature review revealed 13 different scoring methods that evaluated radiographic hand OA; some scores were more extensively studied than others.[15] Data on reliability, validity, sensitivity to change, and feasibility were available. There were major differences between studies in the number of examined joints and the way scores were analyzed. The reliability of the assessed radiographic scoring methods was good for all evaluated scoring methods, although longitudinal performance was tested only for some methods. The validity of radiographic OA findings compared to that of clinical findings such as nodules and deformities was limited, but the association of radiographic findings with symptoms and hand function was better. The sensitivity to change was comparable for all evaluated scoring methods, as well as the smallest detectable change. Few studies explored the feasibility of the radiographic scoring methods. Apart from time required for scoring (longer for individual features than for composite scores), no major differences between the evaluated scoring methods was shown. The metric properties are summarized in Table 2 for the most extensive studied scores.

The systematic review served as starting point in the breakout session (attended by 2 radiologists and 13 rheumatologists) discussing imaging instruments. The group supported that radiographs provide information on structural damage measures. There was consensus on including the most widely used and currently best-validated measures in a core set for structural damage. During voting it was agreed by 46 participants (87%) to use the Kellgren-Lawrence method, the OARSI atlas, the Verbruggen-Veys method, or the Kallman method as preliminary instruments for the structural damage domain; 6% did not agree; and 8% did not know.

Table 2. Supporting evidence for most frequently applied radiographic scoring methods. Modified from Visser et al. Osteoarthritis Cartilage 2014;22:1710-2315; with permission.

	Reliability	Sensitivity to change	Feasibility	Validity
Composite score				
KL[17]	+	+	+	+
Individual features				
Anatomical phases18	+	+	+	
OARSI19	+	+	+	+
Kallman20	+		+	+

+ established evidence

KL, Kellgren-Lawrence; OARSI, Osteoarthritis Research Society International.

Modern imaging methods

Updated literature overviews[19] of ultrasonography (US) and magnetic resonance imaging (MRI) scoring systems and metric properties were presented; the data were limited. US enables a dynamic image of joints and allows visualization of osteophytes, but also marginal erosions and synovitis. US studies of patients with hand OA have reported high prevalence of greyscale synovitis, while power Doppler activity is less frequent. One preliminary US scoring system has been developed for hand OA including assessment of synovitis (greyscale hypertrophy/effusion and power Doppler) and osteophytes on semiquantitative scales.[20] An US atlas for assessment of osteophytes was developed with excellent intra- and inter-reader reliability.[21] Preliminary studies have shown that validity and sensitivity in comparison with radiography of US seems good; however, more data are needed.[22]

MRI provides a multiplanar image of all joint components; it is the only imaging modality enabling the visualization of bone marrow lesions (BML). Synovitis, based on gadolinium enhancement, is frequent in patients with hand OA; the frequency of BML varies. A preliminary MRI scoring system, which includes assessment of osteophytes, joint space narrowing, erosions, cysts, malalignment, synovitis, flexor tenosynovitis, BML, collateral ligament pathology and BML at insertion sites, has shown good reliability.[23] Lately, this scoring system was revised by OMERACT.[24] Knowledge about validity is limited.

In the breakout group, modern imaging techniques were discussed. The group noted that US and MRI provide information about inflammation and structural damage, with the benefit of multiplanar visualization and highlighting of the complex multitissue pathology in OA. It was felt that experience from rheumatoid arthritis could be transferred, although caution should be taken, especially, when evaluating very small joints. The group noted that knowledge is needed concerning metric properties of these modern imaging modalities. This notion was supported during voting: 98% of voting participants agreed to have US and MRI on the research agenda.

Endorsement of a preliminary core set of contextual factors for 3 settings.
The Delphi round 1 and 2 had 54 and 21 respondents, respectively. Age and sex as contextual factors reached high agreement across all settings in round 1, whereas hand OA subsets reached high agreement solely for the setting of symptom modification trials. Ethnicity, alcohol consumption, previous surgery for OA in locations other than hands, energy functions, control of voluntary movements, and effects of weather were excluded from further voting owing to low agreement. In round 2, body mass index (BMI), hand OA symptom duration, and hand OA subsets reached high agreement for all settings. Treatment for OA, comorbidities, OA in other specified joint sites, and fulfillment of the ACR Hand OA criteria reached high agreement for some settings and moderate agreement for others (Table 3).

Table 3. Candidate contextual factors for hand OA studies that resulted from Delphi exercises.

	Symptom Modiciation Trials	**Structure Modification Trials**	**Observational Studies**
Age	9.3*	9.3*	9.4*
Sex	8.3*	8.2*	8.3*
Body mass index	7.7	9.2	8.4
Handedness	5.6	5.6	5.5
Postmenopausal state	4.2	3.8	3.4
Socioeconomic status	3.1	2.4	3.8
Smoking	3.3	2.5	2.7
Current occupation	4.7	5.0	4.2
Work absenteeism/pension due to OA	2.0	1.8	1.8
Hand OA subsets	6.1*	16.5	8.3
Symptom duration	8.9	8.6	7.9
Disease duration	5.1	5.0	4.1
Secondary OA	0.7	2.0	1.9
Previous trauma of the hands	1.6	2.3	1.9
OA in other specified joint sites	6.5	5.2	6.7
Treatment for OA	8.3	6.5	5.8
Previous specified surgery for hand OA	3.1	3.5	2.7
Use of orthotics for hand OA	3.3	2.4	2.1
Previous surgery for OA other location	0.3	1.5	1.1
Family history of hand OA	2.2	2.8	3.8
Hand exercise	2.0	2.8	1.8
Comorbidities	6.8	4.9	5.2
Impairment of body functions due to comorbidities	2.5	NA	NA
Treatment for comorbidities	1.2	NA	NA
Sleep functions	1.2	0.2	0.7
Emotional functions	2.0	0.2	0.5
Coping and illness perceptions	3.2	0.7	2.8

Table 3. *Continued*

	Symptom Modiciation Trials	Structure Modification Trials	Observational Studies
Activities/hobbies requiring intensive use of the hands	2.7	3.5	1.7
Lower extremity exercise	0.2	0.3	0.2
Mental status	0.9	NA	0.6
Fulfilling ACR hand OA criteria	6.2	NA	4.1
Nutritional habits	NA	0.8	0.3
Degree of catastrophizing	1.7	NA	NA
Frustration	NA	0.2	NA
Use of stress management techniques	NA	NA	0.5
Activity limitation	NA	NA	1.6

* Candidate contextual factors with high agreement from Delphi round. Dark grey shading: high agreement (average score >6); light grey shading: moderate agreement (average score between 1 and 6); no shading: low agreement (average score <1).

ACR, American College of Rheumatology; NA, not applicable; OA, osteoarthritis.

Results of the Delphi exercise were discussed in a breakout session, among 6 rheumatologists, 1 occupational therapist, and 1 PRP. The group discussed generic issues regarding contextual factors and hand OA–specific issues. On a general level, there is a methodological need for validation of contextual factors. It was felt that a "core" contextual factor requires rigorous evidence that this factor influences the result of disease/drug on core outcome. However, there is no current consensus on the level of evidence required. Overall, the group held the opinion that the Delphi exercise was complex, with a large list of candidate contextual factors. The 100-point approach of the Delphi exercise and the choice of cutoff were debated. Although the results from the Delphi exercise were thought to be more informative than decisive, the breakout group agreed that the factors with high agreement from the Delphi exercise represent candidate contextual factors; i.e., age, sex, BMI, hand OA subsets, hand OA symptom duration, treatment for OA, OA in other specified joint sites, fulfillment of the ACR hand OA criteria, and comorbidities. The vast majority of voting participants [50 (93%)] agreed to continue research on the prioritized candidate contextual factors. Breakout group discussions and later voting supported the suggestion of 1 common set of contextual factors in hand OA across different settings [41 voting participants (75%) agreed; 9 (16%) did not agree; 5 (9%) did not know].

DISCUSSION

Discussions and voting during the consensus meeting at OMERACT 12 resulted in a preliminary set of core domains and subdomains, from which the majority was similar for 3 settings. The (sub)domains were distributed over the core area life impact and pathophysiological manifestations, according to the OMERACT filter 2.0, as depicted in Table 4. Preliminary instruments were identified for some (sub)domains. But for several others, research is needed to define disease-specific instruments. The results are summarized in Table 5. Candidate contextual factors have been identified, but need further investigation. Several items were introduced for further research (Table 6).

Table 4. Preliminary core outcomes measurement set according to the OMERACT Filter 2.0.

Death	**Life impact**	**Pathophysiological Manifestations**
Adverse event	• Pain	• Pain
	• Physical function	• Physical function
	• Patiënt global assessment	• Patiënt global assessment
	• Hand strength	• Joint activity (tender joints, soft swollen joints*)
	• HRQOL*	• Hand strength
		• Structural damage (radiographic damage, aesthetic damage*, body damage*, deformity*)
		• Hand mobility*
Candidate contextual factors		
• Age		
• Sex		
• BMI		
• Fulfillment ACR hand OA criteria		
• Hand OA subsets		
• Symptom duration		
• OA at other joint sites		
• Concomitant treatment for OA		
• Comorbidities		

* Domains not mandatory as long as no disease-specific instruments are available.

ACR, American College of Rheumatology; BMI, body mass index; HRQOL, health-related quality of life; OA, osteoarthritis.

Table 5. Preliminary set of core (sub) domains with preliminary instruments.

Domains	Subdomains	Instruments Settings	
		Clinical Trials of Symptom Modification	Clinical Trials of Structure Modification and Observational Studies
Pain		Pain VAS/NRS	Pain VAS/NRS
Physical function		FIHOA	FIHOA
Patient global assessment		Research	Research
Joint activity	Tender joints	Tender joint count	Tender joint count
	Soft swollen joints	Research	Research
Hand strength		Grip/pinch strength	Grip/pinch strength
HRQOL*		Research	Research
Structural damage	Radiographic damage		Kellgren Lawrence or Verbruggen-Veys or Kallman or OARSI
		Aesthetic damage*	Research
		Body damage*	Research
		Deformity*	Research
Hand mobility*			Research

* Domains not mandatory as long as no disease-specific instruments are available.
VAS/NRS: visual analog scale/numerical rating scale; FIHOA: Functional Index for Hand Osteoarthritis; OARSI: Osteoarthritis Research Society International.

Table 6. Future research for domain instrument validation according to the OMERACT Filter 2.0.

- A definition for each contextual factor in hand OA should be formulated
- Performance of a literature review to assess the level of evidence for the different candidate contextual factors
- Identification or development of potential instruments to assess contextual factors, where applicable
- Disease-specific instruments have to be developed for the (sub)domains HRQOL, aesthetic damage, bony damage, deformity, and hand mobility
- Development and testing of VAS/NRS questions to measure the domain pain
- Development of a new measure for hand pain in analogy to knee and hip pain (Intermittent and Constant OA Pain for the hand)
- Evaluation of instruments that are commonly used by hand therapists, such as the DASH, PRWHE, and Michigan Hand Outcome Questionnaire, for use in hand OA.
- Investigation what hand OA contributes to grip strength or pinch strength relative to other conditions that affect hand strength or function
- Performance of qualitative interviews: how to measure patient global assessment
- Investigation of the subdomain tender joints
- Further evaluation of the instrument to assess tender joints (Doyle index), with respect to validation in OA — e.g., what is the added value of joint count to other domains, like pain. How many joints and which ones should be incorporated in the tender joint count? How should the tender joint count be performed? Is there a floor effect?
- To develop instruments to assess soft swollen joints and bony damage
- Investigation of the value of patient-performed joint count (e.g., self-complete homunculus) versus physician-performed joint count
- Investigation of the metric properties of US and MRI
- Investigation of the value of CT

CT, computerized tomography; DASH, Disabilities of the Arm Shoulder and Hand; HRQOL, health-related quality of life; MRI, magnetic resonance imaging; OA, osteoarthritis; PRWHE, Patient-rated Wrist Hand Evaluation; US, ultrasound; VAS/NRS, visual analog scale/numerical rating scale.

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CURRICULUM VITAE

Willemien Visser werd op 19 maart 1986 geboren in Alkmaar. Na het behalen van haar VWO diploma in 2004 aan het Trinitas College te Heerhugowaard is zij gestart met de studie Geneeskunde aan de Universiteit Leiden. Vanaf het derde jaar van haar studie deed zij onderzoek bij de afdeling reumatologie in het Leids Universitair Medisch Centrum (LUMC), gericht op pijn en functionele beperkingen in hand artrose.
In 2008 werd dit voortgezet als wetenschapsstage naar ziekte perceptie in hand artrose. Na het doorlopen van de co-schappen deed zij in 2010 een tweede wetenschapsstage naar de genetische predispositie van gewrichtsschade in reumatoïde artritis, dit onderzoek werd vanuit de afdeling reumatologie in het LUMC verricht in het Landspitali University Hospital in Reykjavik, IJsland. In 2011 behaalde zij het arts-examen aan de Universiteit Leiden.
Vanaf februari 2011 was zij als arts-onderzoeker verbonden aan de afdeling reumatologie van het LUMC. Onder leiding van prof.dr. M. Kloppenburg en prof.dr. F.R. Rosendaal werkte zij aan het onderzoek beschreven in dit proefschrift. Tevens heeft zij tijdens deze periode een start gemaakt met de opleiding tot epidemioloog B via de afdeling klinische epidemiologie (opleider: prof.dr. F.R. Rosendaal).
In mei 2014 is zij begonnen aan de opleiding tot reumatoloog in het LUMC (opleider: prof. dr. T.W.J. Huizinga). Momenteel volgt zij de vooropleiding interne geneeskunde in het Medisch Centrum Haaglanden te Den Haag (opleider: dr. A.H. Bootsma). Naar verwachting zal zij haar opleiding tot reumatoloog in 2020 afronden.

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