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Title

How is the experience of pain measured in older, community dwelling people with osteoarthritis? A systematic review of the literature.

Introduction

Osteoarthritis is a degenerative condition caused by the accumulative effect of 'wear and tear' on a joint. A loss of hyaline cartilage, bony remodeling, laxity of ligaments, capsular stretching and muscular weakness are aspects of the disease that lead to synovitis and local inflammation of the joint (1-3). Noxious stimuli in the synovium and surrounding structures activate peripheral nociceptive mechanoreceptors, transmitting pain through the spinal nerves and thalamus, to be perceived by the somatosensory cortices (3). Pain has multifaceted etiologies from within and outside of the joint (3, 4) and is influenced by psychosocial conditions (4, 5). The understanding of the mechanism of pain in osteoarthritis is evolving, with recent developments in the concept of a non-nociceptive pain mechanism (6, 7), and publications supporting the existence of a neuropathic pain component (8-10). Pain is a particularly important symptom in osteoarthritis; it **is** the main reason why people with osteoarthritis present to the doctor (11-14). Unfortunately, the experience of pain in osteoarthritis is poorly measured (15), poorly managed (16) and poorly understood (17).

In attempting to understand brain function associated with the pain experience, Melzack and Casey defined three pain dimensions: sensory-discriminative, affective-motivational and cognitive-evaluative (18, 19). The sensory-discriminative dimension comprises sensory aspects of pain experience, including intensity, location, quality and temporal aspects (19, 20). The affective-motivational dimension reflects the emotional aspects of pain including feelings of unpleasantness and distress (21). The cognitive-evaluative dimension comprises

thoughts associated with pain, analysing the cause of pain and determining appropriate behaviour in response to pain (22). Each dimension has differing neural circuitry involved, with the nociceptive, limbic and frontal cerebral cortex involved in each dimension respectively. This model for the dimensions of pain is widely accepted, and whilst first described in the 1960's, is still relevant to the experience of pain today. More recently, Melzack and Katz have postulated the neuromatrix theory of pain (19). This theory explains pain as a dynamic process involving continuous interactions between complex ascending and descending neural circuitry (19). It moves away from pain as a singular sensation, to an understanding of pain as a multidimensional experience generated by multiple influences. Recently a small, qualitative focus group found that people with osteoarthritis had many different types of painful sensations and associated symptoms (23). It identified a range of pain descriptors as well as seven dimensions of osteoarthritis pain: pain sensory description, osteoarthritis-related symptoms, pain variability profile, pain triggering factors, pain and physical activity, mood and image and general physical symptoms (23). In examining the aspects of these dimensions discovered, it is apparent that they fit within the three broader sensory, affective and cognitive dimensions of pain by Melzack and Casey (18, 19). There are no other studies that have attempted to assess multiple dimensions of the pain experience in osteoarthritis, or to specifically assess the pain experience using the multi-dimensional framework theorized by Melzack and Casey.

Attempts to measure the experience of pain rely overwhelmingly upon individual self-report (24). Accordingly, the subjectivity of the pain experience is a major limitation for measurement of pain severity and quality (25), particularly since assessment is restricted by the ability of a person to express what it is they are experiencing. Ideally, a pain measure should be sensitive, reliable, accurate, valid, useful for both clinical and experimental

conditions and able to separate the sensory aspects of pain from the affective aspects (26). The location of pain is often assessed via pain diagrams (27), and the intensity or severity of pain assessed via verbal, numerical or visual scales (28-30). Such tools allow quick and easy measurements and can be administered repeatedly (25). Biopsychosocial aspects that may influence how the pain is experienced and reported, such as ageing, expectations, attitudes and beliefs, coping, prior experiences, fear, mood, memory, social support, social context and impact on daily life, should be considered when assessing pain (31, 32). Multi-dimensional pain measures attempt to provide a more thorough assessment of the pain experience across these different perspectives (27, 29, 33, 34). The only disease specific osteoarthritis specific multidimensional measure of pain in osteoarthritis is the measure of Intermittent and Constant Osteoarthritis Pain (ICOAP), which was recently developed by the OARSI/OMERACT Initiative (35). This scale has been found to be valid and reliable and is recommended for use alongside a measure of disability when assessing the health impacts of OA (30).

Pain is a very common experience for older people (36-40), and pain from osteoarthritis is a significant cause of pain in this population (41). Pain assessment in this group may be further complicated by specific contextual factors of the older person, including communication difficulties, cognitive and sensory impairment, functional disability, multimorbidity and polypharmacy (31, 42). Thus, while there is an identified need for comprehensive assessment of the multi-dimensional experience of pain in older people with osteoarthritis, pain assessment tools must be carefully chosen when they are to be used by older people (31, 43).

The objectives of this systematic review are to identify and appraise outcome measures and measures of pain that are commonly used to assess the experience of pain by older people

with osteoarthritis, and to assess whether these measures are effective at capturing the multidimensional nature of the experience of this pain.

Methods

Selection Criteria

This review was restricted to studies published in English, during the years 1996 to 2013. Only population based observational studies (cross-sectional, case control and longitudinal) were included. Randomized controlled trials, case series and studies that translated versions of pain measures were excluded. Studies were included if: there was a diagnosis of osteoarthritis, either using clinical assessment or by self-report; the sample included older people in a community setting; and a measure of pain was used. The definition of ‘older’ was people aged 65 years or older. Studies of the symptomatology of osteoarthritis (fatigue for example) that included a measure that assessed pain were also included. Exclusion criteria included non-human studies and studies not published in English.

Search Strategy

Publications were retrieved from a computerized search of five electronic databases: PubMed, MEDLINE; EMBASE; CINAHL; and the Cochrane Database from January 1996 to March 2013. MeSH and free text terms included the diagnostic terms ‘osteoarthritis’ and ‘pain’, combined with the term ‘measurement’. Terms could be contained in the abstract/title of the publication. References of retrieved publications were manually searched for further relevant studies. Authors were contacted for additional information if required.

Quality Review

Articles were independently assessed for methodological quality by two blinded reviewers (KD and HP) using the Effective Public Health Practice Project (EPHPP) Quality Assessment Tool for Quantitative Studies (44). The EPHPP tool was judged to be useful for systematic reviews by Deeks (45) and is reported to have content and construct validity (44, 46) and excellent inter-rater agreement (47). The EPHPP assesses six domains: selection bias; study design; confounders; blinding; data collection methods; and participant dropouts. It provides a categorization of strong, moderate, or weak quality. Total global scores with no weak ratings in any domain are categorized as strong, one weak rating categorizes the study as moderate, and two or more weak ratings categorize the study as weak. The EPHPP tool was chosen based on relevance to observational studies (e.g. cross-sectional studies and cohort studies), a mixed criteria approach (factual questions and general judgment) and ease of use.

Data Extraction

Data extraction focused on how the experience of pain was measured in osteoarthritis. Study characteristics extracted included information on the year of publication, characteristics of study, design of study, demographics of study participants, diagnosis of osteoarthritis, anatomical location of osteoarthritis, outcome measures and pain measurement outcomes. A data extraction tool was developed based on the Cochrane Handbook for Systematic Reviews of Interventions (48) and peer-reviewed articles (49-52). Studies were appraised to identify dimensions of pain as defined by Melzack and Casey (18, 19).

Results

Search of Electronic Databases

A total of 630 publications were identified by the search strategy. After removing duplicates (n=20), and assessing the title against the exclusion criteria, 440 publications were excluded.

The remaining 170 publications were assessed by abstract and 119 were excluded as they did not meet inclusion criteria (study design; non-english; did not include older people; clinical populations; assessing radiological features of arthritis). The full text of 51 publications were assessed and a further 37 publications were excluded as they did not meet inclusion criteria (study design; did not diagnose arthritis; did not include older people; did not use a measure of pain). A total of 14 publications met the inclusion criteria and were included in the review (8, 13, 35, 53-63). A flow chart of the screening and selection process, using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines is presented in Figure 1. (52, 64).

Study Characteristics

Eleven discrete studies were reviewed. Four publications selected for review (56-58, 61) used data from the baseline assessment of the PraxArt project, and therefore were analysed as one study to minimize duplication. The PraxArt project was a prospective cluster-randomized, open, three-armed intervention study that evaluated the impact of a comprehensive evidence based medical education intervention for 75 general practitioners on individual care and quality of life on patients suffering from osteoarthritis(65). Seven of the studies were cross-sectional (8, 13, 35, 53-58, 61), two were longitudinal cohort studies (60, 63), one was an observational study (59) and one was a case control study (62). There were two studies from the United Kingdom (54, 60), and Canada (8, 35), and one study from each from the United States (53), Belgium (55), Germany (56-58, 61), Netherlands (59), Finland (13), Norway (62) and Australia (63). Most studies had modest sample sizes, ranging from 100 (35) to 2113 (54).

Participants were all adults, aged over 18 years. As per inclusion criteria, the sample in each

study included older people and the average age of participants ranged from 50 (55) to 76 years (8). Participants were primarily from larger population based studies such as North Staffordshire Osteoarthritis Project (54), PraxArt project (56-58, 61), Genetics, Arthrosis and Progression study (59), North West Adelaide Health Study (63), hand osteoarthritis cohort (62), from an established community based hip/knee arthritis cohort (8) and a prospective survey (55). Two further studies had participants presenting to orthopaedic clinics (53, 60) or a mix of community persons and those presenting to clinical practice (13, 35). In all but one study, the majority of the participants were female (8, 13, 35, 54-63).

Osteoarthritis definition

A diagnosis of osteoarthritis was made via self-report in five studies (8, 35, 54, 55, 63). The American College of Rheumatology (ACR) clinical classification criteria were used in three studies (56-59, 61, 62), and a combination of the Kellgren-Lawrence grading scale and ACR criteria (13) or the Kellgren-Lawrence grading scale alone (53) or radiographic and clinical examination in one study each (60).

How was pain measured?

A total of 21 outcome measures were used in the studies in this review. They included seven arthritis specific outcome measures, four health related quality of life (HRQoL) outcome measures, three generic pain outcome measures and seven 'other' outcome measures. The most commonly used outcome measures were the SF-36/RAND in seven studies (13, 53, 55, 59, 60, 62, 63), the WOMAC in five studies (8, 13, 35, 59, 60), the AIMS2 /AIMS2-SF in three studies (54, 56-58, 61, 62) and pain intensity VAS in two studies (60, 62). The other 17 outcome measures were used in one study each. All studies but one used more than one outcome measure, with most studies using a combination of an arthritis specific outcome

measure combined with a HRQoL measure (13, 53, 59, 60, 62, 63). Only one study used an arthritis specific outcome measure combined with a pain specific outcome measure (8).

A total of 13 measures of pain were used in the studies in this review. The most commonly used measure of pain was the WOMAC pain sub scale in five studies (8, 13, 35, 59, 60), followed by the SF-36/RAND bodily pain scale in four studies (13, 55, 60, 62), and the AIMS2 pain, symptom and affect subscales in three studies (54, 56-58, 61, 62). A VAS for pain intensity was reported on in two studies,(60, 62) and measures of pain reported in one study each included the AOS (53), the AUSCAN pain subscale (63), the HOOS symptoms subscale (35), the IPQ-R (54), the KOOS symptom subscale (35), a modified painDETECT score (8), the PCS score (8), SES pain and symptom scores (62) and the Von Korff CPG (8).

Dimensions of pain

Outcome measures and measures of pain were analysed to see whether the dimensions of pain defined by Melzack and Casey had been captured (see Table 2). Sensory-discriminative dimensions of pain measured in the studies included intensity (8, 35, 59, 62), severity (8, 13, 35, 53, 54, 56-63) and quality (8). The measures used to assess intensity and severity were AOS pain subscale, AIMS2 pain subscale, AIMS symptom scale, VAS pain intensity score, WOMAC pain subscale, HOOS symptom subscale, KOOS symptom subscale, SF-36 bodily pain sub scale and CPG pain intensity score. Descriptors of pain quality were reported in one study (8). Affective-motivational dimensions of pain included mood (8, 13, 35, 56-58, 61, 62), fear (35), coping (56-58, 61, 62) and catastrophizing (8). Measures used to assess these dimensions were the AIMS affect subscale, BDI and CES-D for depression, individual questionnaire items and the Pain Catastrophizing Scale. Cognitive-evaluative dimensions of pain were assessed in two studies (54, 62) and included attitudes / beliefs, prior experiences /

memory and efficacy. The measures to assess cognitive-evaluative dimensions of pain included the IPQ-R (consequences, control and cure and illness coherence) (54) and the self efficacy scale (62).

Methodological quality

Based on the EPHPP tool, the methodological quality of four publications were strong (8, 13, 56-59, 61), with six publications rated as moderate (35, 53, 60, 62, 63) and one publication rated as weak (55). The methodological quality scores of the studies are presented in [Table 1](#).

Discussion

The aim of this systematic review was to identify and critically appraise how the experience of pain is measured in older, community dwelling people with osteoarthritis. In total 14 publications were identified, though these were based on only eleven studies. Studies came from nine different countries and were primarily cross-sectional studies from within large, established population based studies. Collectively, 21 different health, arthritis specific and pain outcome measures had been employed, with 13 measures of pain used to assess pain in studies. Even though many measures were used, measuring more than one dimension of pain was seldom attempted. This review shows that measures used in population-based studies have not been effective at capturing the multidimensional nature of the experience of pain in osteoarthritis.

Measures of pain in osteoarthritis

The majority of studies reviewed used an osteoarthritis disease specific outcome measure in an attempt to assess pain. The measure of pain consisted of sub scales, enabling calculations for pain, symptoms, activities of daily living, sport and recreational activities and quality of

life. The most commonly used outcome measure was the WOMAC, in which the five item pain subscale assesses the severity of pain experienced whilst walking, using stairs, in bed, sitting or lying, and standing (66). The AIMS2/AIMS2-SF was used in three studies. The AIMS2/AIMS2-SF pain scale questions frequency and severity of pain, with the affect scale questioning mood and coping (67). The pain sub scales of the KOOS and HOOS assess pain frequency and pain severity on movement or activities (66, 68), and similarly the AUSCAN has a pain subscale to assess severity of pain on movement or activities. The AOS is a visual analog based scale to evaluate patient pain and disability (69). The ICOAP has recently been developed to evaluate the pain experience in people with hip or knee osteoarthritis by assessing intensity, frequency, duration and pain episodes (constant and intermittent pain) in osteoarthritis (35). It is valid, reliable and recommended for use with a measure of disability (30). A generic, health outcome measure, the SF-36/RAND, was used in seven studies, with the two item bodily pain scale that measures bodily pain intensity and interference of pain with normal activities reported on in four studies (13, 60, 62, 70). Stand alone pain outcome measures, the mPD-Q, SLANSS and Von Korff CPG were used in one study (8). The mPD-Q, developed from modifications of the painDETECT (71), was piloted and validated against the S-LANSS for use in an epidemiological study on knee osteoarthritis (8). The mPD-Q was used to evaluate the prevalence of neuropathic pain symptoms and correlate scores in osteoarthritis. The Von Korff CPG assesses pain severity associated with intensity and disability in chronic pain populations (30).

This review shows that the most commonly used measures of pain do not effectively assess the multidimensional nature of the experience of pain in osteoarthritis. Apart from the ICOAP and AIMS2/AIMS2-SF, they primarily assess the uni dimensional experience of intensity or severity. This finding is consistent with both chronic pain research, with pain

intensity the single most widely assessed outcome domain in trials (72, 73), and with clinical trials of osteoarthritis, where pain assessment is mostly minimized to pain intensity (74). Qualitative studies have also found that existing measures do not evaluate the pain experience in osteoarthritis (75), knee osteoarthritis (15) and hand osteoarthritis (76). Following this trend, measures used in epidemiological studies in this review also have not evaluated the pain in osteoarthritis. Within the relevant literature, the McGill Pain Questionnaire is the most widely used measure of pain (77), specifically assessing sensory and affective qualities of pain (19, 78). The scale is reliable, valid and available in a short form as well as a form to measure the qualities of both neuropathic and non-neuropathic pain (19, 78). It has been recommended for use alongside the WOMAC and SF-36 to measure the experience of pain in osteoarthritis (79), however not one study included in our review used this measure of pain. Attention should be paid to comprehensively measuring the multidimensional nature of the experience of pain in an attempt to gain a greater understanding of the occurrence and impact of pain in people with osteoarthritis.

Dimensions of pain measured

This review has appraised how dimensions of pain are captured by outcome measures (See Table 2.). Across studies, the sensory-discriminative dimension of pain was quite well captured; with intensity and severity the most commonly measured pain dimensions. This corresponds with evidence that intensity is the component most often measured in clinical practice and pain management outcomes research (80). Pain intensity was measured by two VAS scales and the Von Korff CPG intensity score. Pain severity was commonly measured with osteoarthritis disease specific outcome measures the AOS, AIMS2/AIMS2-SF, AUSCAN, HOOS, KOOS and WOMAC pain subscales. Pain quality was only reported in one study (8), where one quarter of patients had neuropathic symptoms localized to their

knees as measured by the MPD-Q and S-LANSS. Pain quality is an important dimension for both the individual and the practitioner. For example, the report of burning, itching and pins and needles are indicative of possible neuropathic pain due to central sensitization and even different signs of neuropathic pain (heat hyperalgesia and cold allodynia for instance) can have different pathophysiologic mechanisms (81). As such assessing the quality of pain can be useful in clinical assessment to distinguish possible neuropathic pain from nociceptive pain (82). Focus group research has examined qualities of pain in chronic joint pain and osteoarthritis (75, 83, 84), with one study finding that 34% of participants with knee osteoarthritis used neuropathic pain descriptors to characterize their pain (9). In our review, notably, Hochman et al., broadly assessed the sensory dimension of pain by using the Von Korff CPG, WOMAC pain subscale and mPD-Q/S-LANSS to measure intensity, severity and quality respectively (8). Future studies should assess all aspects of the sensory-discriminative dimension of pain, and move past the uni dimensional measurement of pain severity. This will assist in a better understanding and measurement of pain, possibly identifying non-nociceptive pain mechanisms by way of descriptors of pain and their pathophysiological mechanism (4, 6, 85).

The affective-motivational dimension of pain was captured, with mood and coping assessed by the AIMS2/AIMS2-SF affect subscale in two studies (56-58, 61, 62) and fear, mood and coping assessed by an individual item in one study (35). The affective-motivational dimension of pain is important in the measurement of the experience of pain as both negative and positive affect reflect differences in pain facilitation (86). Finally, the cognitive-evaluative dimension of pain was captured in one study by using the IPQ-R to report illness perceptions in self reported hand osteoarthritis (54), and another study by using the Self-Efficacy Scale (SES) to assess the patients perceived ability to influence pain and symptoms

(62). The latter should be commended for assessing the Melzack and Casey's three dimensions of pain (sensory, affective and cognitive) with three different measures (VAS, AIMS2 affect scale and the SES) (62).

Measures of pain in older people

Pain assessment tools should be carefully chosen when designing research in older populations due to the specific characteristics of the older population (31, 42). The WOMAC has been the most extensively used disease specific outcome measure used in older rheumatological populations, and this was the case in this systematic review in which five studies used it (8, 13, 35, 59, 60). The AIMS2/AIMS2-SF has been adapted for use as an osteoarthritis disease-specific instrument for use with frail geriatric populations (87) and was used in three studies (54, 56-58, 61, 62). The AUSCAN has been shown to be a valid and reliable measure of hand problems in a community-dwelling population of older adults (88), however out of the three studies to examine hand osteoarthritis in this systematic review, only one study used the AUSCAN (70). In seven studies the SF-36/RAND was used even though the literature states that in older adults with chronic conditions the SF-36 BPS shows measurement bias (89-91). Unfavourably, the SF-36 BPS was the sole report of pain in one study (55). The VAS has limitations in older people including low face validity (92), unscorable data for administrators (92), difficulties understanding and completing the scale (30), and is generally less preferred by older people (31). The VAS was however was used by two studies in this review to measure pain intensity (60, 62). Whilst numerical ratings scales and verbal descriptor scales are preferred over visual analog scale and should be the first choice for pain intensity measurement for the elderly (92), pain measures with categorical scales are preferred by older persons and have the greatest utility, reliability, and validity (93). The most widely used and well accepted measure for the assessment experience of pain

in older persons is the McGill Pain Questionnaire (MPQ). It uses a verbal rating scale, is validated for use with older people, and internal consistency, convergent, discriminant, and construct validity, and factor structure have been demonstrated (31, 93-95). A review of the literature also shows the Brief Pain Inventory (96), the Pain Disability Index (97) and the Multidimensional Pain Inventory (98) are also recommended measures of pain in older populations (31, 93). None of these were utilised in the studies that met the inclusion criteria for this review. Systematic research efforts have only just started to focus on the reliability and validity of common pain assessment tools when used in older populations (99). Additionally, format and other practicalities such as the length of the questionnaire, written and oral instructions, font size, time to sufficiently process the question are important considerations in the selection of measures used to measure the experience of pain in older people (43, 100, 101).

Conclusions

This systematic review found that measures of pain used in epidemiological studies do not adequately capture the multidimensional nature of the experience of pain in osteoarthritis. Measures of pain predominantly assessed uni-dimensional characteristics such as intensity or severity. There is a fraught complexity in the multidimensionality of the experience of pain in osteoarthritis and this is reflected in the multiplicity of pathophysiological mechanisms at work. Future epidemiological studies exploring osteoarthritis pain in older people should attempt to capture this multidimensionality by employing multiple valid and reliable outcome measures that capture specific dimensions of the pain experience.

Authors' contributions

All authors were involved in the conception and design of the study. Data were extracted,

analysed and interpreted by KD and HP. All authors were involved in the drafting of the article and revising it for important intellectual content. All authors read and approved the final manuscript.

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Competing Interests

The authors declare that they have no conflicts of interest in the preparation of this manuscript.

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Figure 1. A flow chart of the PRISMA screening and selection process.

Tables

Table 1. Characteristics and methodological quality grade of the 11 included studies, ordered by publication date.

Author	Study Design	Participants (n); demographics	Age of sample (years)	Diagnosis of osteoarthritis	Outcome measures	Pain measurement	EPHPP Grade
Saltzman <i>et al.</i> , 2006 (53)	Cross sectional study	Patients to orthopaedic surgery ankle clinic (n = 195); female 45.1%	Post-traumatic ankle OA 52±14.2; primary OA 62±13.7	Kellgren-Lawrence grade 3 or 4	SF-36, Ankle Osteoarthritis Scale	AOS: 61±23	2
Hill <i>et al.</i> , 2007 (54)	Cross sectional study	Older adult population with hand problems, as a part of the larger NorSTOP (n =	65.4 ± 9.6	Self report	AIMS2, IPQ-R	AIMS2 pain: 4.39 ±2.4 IPQ-R: timeline cyclical: 12.18±3.6; acute/chronic:	2

		2113); female 56.1%				23.98±4.2; consequences: 15.24±4.9; personal control: 17.11±3.8; emotional representations: 14.13±4.4; illness coherence: 11.76±3.7; psychological attribution: 12.26±3.6; identity: 2.72±2.0	
Rabenda <i>et al.</i> , 2007 (55)	Prospective cross sectional study	City council staff indicating presence of OA or osteoporosis (n = 1811); female 57.4%	OA group 50.7± 6.6; OA- OP group 53.1±6.3	Self report	SF-36	Could not be extracted, in figure format	3

						AIMS2-SF symptom	
						subscale: total	
						4.71±2.42; hip men	
						4.2±2.1, hip female	
						4.4±2.1; knee men	
						4.7±2.8; knee women	
Rosemann <i>et al.</i> , 2007 (56, 58) (57, 61)	Cross sectional study	Patients with hip or	Males	ACR clinical classification	PHQ-9, AIMS2-SF	5.1±2.9	1
		knee OA from the	65.2±14.8;				
		PraxArt project (n =	females				
		1021); female 66.0%	66.6±15.3			AIMS2-SF affect	
						subscale: total	
						2.77±1.51; hip men	
						2.39±1.42, hip female	
						2.81±1.48; knee men	
						2.52±1.50; knee	
						women 3.01±1.59	
Botha-	Prospective	Participants of the	60.0 (55.5-	ACR clinical	RAND-36,	Baseline: WOMAC	1

Scheepers <i>et al.</i> , 2008 (59)	observational study	Genetics, Arthrosis and Progression study with symptomatic knee of hip OA (n = 115); female 92%	66.5)	classification	WOMAC	pain subscale 29.2 ±21.6; after two years: WOMAC pain subscale 32.0 ±26.7
						HOOS symptom subscale: 62.8±22.5
Hawker <i>et al.</i> , 2008 (35)	Cross sectional study	Patients and participants with hip or knee OA (n = 100); female 78%	Combined: 74.8 (51-93); hip: 72.1 (52-87); knee 75.4 (51-93)	Self report	ICOAP, HOOS, KOOS, WOMAC, Late Life Function and Disability Instrument.	KOOS symptom subscale: 57.8±20.0 WOMAC pain subscale: Hip: 7.8±3.3; knee: 8.2±4.4; combined 8.1±4.2

		Participants and patients with unilateral or bilateral hip OA (n = 118)				
Juhakoski <i>et al.</i> , 2008 (13)	Cross sectional study	Finland; female 70%; unilateral or bilateral hip OA with KL grade of ≥ 1 , pain in hip region within the last month; total hip replacement; RA; cognitive impairment; major surgical operation within t	66.7 $\pm$ 6.5 (55-80)	Kellgren & Lawrence grade ≥ 1 and ACR clinical classification	Beck Depression Inventory, RAND-36, Self-reported Life Satisfaction Scale, WOMAC	RAND-36 bodily pain: 57.5 $\pm$ 18.3 WOMAC pain subscale 25.2 $\pm$ 18.0 1

						SF-36 pain: all	
						24.2±19.7; hip	
						20.7±18.4; knee	
						27.1±20.5	
McHugh <i>et al.</i> , 2008 (60)	Longitudinal cohort study	Participants from regional orthopaedic centre with hip or knee OA listed for joint replacement (n = 160); female 59%	68 (IQR 60, 76), range (40-86)	Radiographic and clinical examination; listed for total joint replacement	SF-36, VAS, WOMAC	VAS pain: All 7.0±2.2; hip 7.1±2.3; knee 6.9±2.2	2
						WOMAC pain subscale: all 11.2±3.5; hip 11.7±3.9; knee 10.9±3.1	
Slatkowsky-Christensen <i>et al.</i> , 2009	Case Control	Patients with hand OA (n = 389); female 100%	OA: 61.6 (50-71)	Referral to an outpatient rheumatology	AIMS2, HAQ, MHAQ, SES, SF-36, VAS	AIMS2: symptom subscale 5.52±2.28; affect subscale	2

(62)				department	3.75±1.61	
				within previous		
				two years. 159	SES: pain 55.3±20.7;	
				patients	symptoms 68.0±16.7	
				fulfilled ACR		
				clinical	SF-36: pain 40.4±18.6;	
				classification	mental 68.9±19.0	
				criteria		
					VAS pain 38.6±21.7	
<hr/>						
Cole <i>et al.</i> , 2011 (63)	Longitudinal cohort study	Participants of the North West Adelaide Health Study (n = 477); female 58.1%	20-49 8.1%, 50-59 19.8%, 60-69 24.7%, ≥70 20.8%	Self report	AUSCAN, SF- 36	AUSCAN pain subscale males 6.8 (5.5-8.1); females 7.3 (6.5-8.2)
<hr/>						
Hochman <i>et al.</i> , 2011 (8)	Cross sectional study	Community based participants with moderate to severe	76.0 (67.0- 99.0)	Self report	CES-D, Modified painDETECT,	Modified painDETECT: 12.0 (0- 38.0)
<hr/>						

hip or knee arthritis	PCS, SLANSS,	
symptoms (n = 171);	Von Korff	PCS: 5.0 (0-41.0)
female: 77.2%	Chronic Pain	
	Grade,	Von Korff Chronic
	WOMAC	Pain Grade pain
		intensity score: 53.3
		(6.7-100.0)
		WOMAC pain
		subscale: 10.1±3.7

WOMAC: Western Ontario and MacMaster Universities Arthritis Index; SF-36: Medical Outcomes Study: 36 Item Short Form Survey; OA: osteoarthritis; AUSCAN: AUStralian CANadian Osteoarthritis Hand Index; NorSTOP: North Staffordshire Osteoarthritis Project; AIMS2: Arthritis Impact Measurement Scale 2; ACR: American College of Rheumatology; AIMS2-SF: Arthritis Impact Measurement Scale 2 – Short Form; ICOAP: Measure of Intermittent and Constant Osteoarthritis Pain; HOOS: Hip disability and Osteoarthritis Outcome Score; KOOS: Knee injury and Osteoarthritis Outcome Score; VAS: visual analog scale; IQR: Inter-quartile range; P4: 4-item pain intensity measure.

Table 2. Dimensions of the osteoarthritis pain experience measured by eleven studies included in this review.

Author	Dimensions of Pain									
	Sensory – discriminative			Affective –motivational				Cognitive – evaluative		
	Intensity	Severity	Quality	Mood	Fear	Coping	Catastrophizing	Attitudes	Prior	Efficacy
								/ Beliefs	experiences / Memory	
Saltzman <i>et al.</i> , 2006 (53)	No	AOS pain subscale.	No	No	No	No	No	No	No	No
Hill <i>et al.</i> , 2007 (54)	No	AIMS2 pain subscale	No	No	No	No	No	IPQ-R items: Consequences, Control/cure, Illness coherence		
Rabenda <i>et al.</i> , 2007	No	No	No	No	No	No	No	No	No	No

(55)										
Rosemann <i>et al.</i> , 2007					AIMS2-					
(58)	No	AIMS2-SF symptom scale	No	AIMS2-SF affect scale	No	SF affect scale	No	No	No	No
(56)	(61)									
Botha-Scheepers <i>et al.</i> , 2008										
(59)	Pain intensity total score	WOMAC pain subscale	No	No	No	No	No	No	No	No
Two items: How intense has your constant/pain that comes and goes been'										
Two items:		WOMAC pain subscale;								
How intense		subscale;								
has your		HOOS								
constant/pain		Two items: 'how frustrated or annoyed/upset or worried have you been by your hip/knee problems'								
(35)	that comes	symptom subscale;	No					No	No	No
and goes		KOOS								
been'		symptom								

		subscale								
Juhakoski <i>et al.</i> , 2008 (13)	No	WOMAC pain subscale	N	BDI (≤ 14 normal mood, ≥ 15 depression)	No	No	No	No	No	No
McHugh <i>et al.</i> , 2008 (60)	No	WOMAC pain subscale; HOOS symptom subscale; KOOS symptom subscale	No	No	No	No	No	No	No	No
Slatkowsky-Christensen <i>et al.</i> , 2009	VAS pain	AIMS2 pain subscale	No	AIMS2 affect scale	No	AIMS2 affect scale	No	SES	No	SES

(62)										
Cole <i>et al.</i> , 2011 (63)	No	AUSCAN pain subscale	No	No	No	No	No	No	No	No
mPD-Q										
Hochman <i>et al.</i> , 2011 (8)	CPG pain intensity score	WOMAC pain subscale	items; S- LANSS items	CES- Depression	No	No	Pain Catastrophizing Scale	No	No	No

AOS: Ankle Osteoarthritis Scale; IPQ-R: Illness perceptions Questionnaire – Revised; AIMS2: Arthritis Impact Measurement Scale 2; AIMS2-SF: Arthritis Impact Measurement Scale 2 – Short Form; WOMAC: Western Ontario and MacMaster Universities Arthritis Index; HOOS: Hip disability and Osteoarthritis Outcome Score; KOOS: Knee injury and Osteoarthritis Outcome Score; BDI: Beck Depression Index; IQR: Inter-quartile range; VAS: visual analog scale; AUSCAN: AUStralian CANadian Osteoarthritis Hand Index; mPD-Q: modified painDETECT questionnaire; CES-D: Centre for Epidemiological Studies Depression Scale.