Hydrotherapy outcome measures for people with arthritis: A systematic review

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ABSTRACT

Exercise has been shown to be effective in decreasing pain, improving function and performance of activities of daily living in people with arthritis. While hydrotherapy is often suggested as an exercise intervention, there is little evidence that it is more effective than other forms of exercise. Scoping the literature identified that a large variety of outcome measures were used. This study aimed to identify the patient reported outcome measures used for assessing the effectiveness of hydrotherapy for people with arthritis. A systematic literature review was conducted following a search of the major health databases. Upon meeting the inclusion criteria each study was quality rated using a modified scoring tool. In the 24 studies identified 35 patient reported outcome measures were used: most common were the visual analogue pain scale and the Western Ontario and McMaster Universities Osteoarthritis Index. Twenty-five patient reported outcome measures were used only once. Six of the patient reported outcome measures were arthritis-specific and eight generic measures had been validated for an arthritic population. Importantly, no patient reported outcome measure had been evaluated specifically for hydrotherapy interventions. The selection of outcome measures for hydrotherapy research appears inconsistent. This may account for the lack of high quality evidence for this intervention. Further research is warranted to develop a valid, reliable and responsive outcome measure specifically for people with arthritis undertaking hydrotherapy.

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Key words: Hydrotherapy, Arthritis, Outcome measures, Systematic review

INTRODUCTION

Arthritis is a common condition that leads to pain, loss of function and impacts on a person's quality of life (Fransen et al 2011, Furner et al 2011, Lim and Doherty 2011, Wikman et al 2011). The prevalence and impact of this disease is predicted to increase in the coming years due to the ageing population and an increase in obesity, particularly in Western cultures (Marks and Allegrante 2002, Muthuri et al 2011). Additionally, the economic impact of arthritis on the workforce is significant (Di Bonaventura et al 2011). It is therefore important to explore and engage in cost-effective interventions to reduce the impact of arthritis, particularly in older adults. A recent United States Physical Activity Guideline specifically mentioned exercise for sufferers of arthritis (Physical Activity Guidelines Advisory Committee 2008). Various exercise interventions have been found to decrease pain and improve function in patients with hip and knee arthritis (Pisters et al 2007, Roddy et al 2005). Studies have shown that after completing exercise-therapy based programmes, people with osteoarthritis have gained improvements in both their perception and performance of activities of daily living when compared with non-exercising control groups (Allegrante and Marks 2003, Deyle et al 2005, Jan et al 2009). Furthermore, it has been shown that there are limited negative side effects to well-designed exercise-therapy programmes (Allegrante and Marks 2003, Brazier et al 1996, Roddy et al 2005), providing additional support for its use as a treatment option. Hydrotherapy, a core physiotherapeutic approach, is one such intervention. Clinical experience suggests that hydrotherapy has a number of benefits when compared to land-based exercises (Bartels et al 2007). The warm temperature of hydrotherapy pools may decrease pain and stiffness, as well as promote relaxation (Bartels et al 2007, Bartels et al 2009). Buoyancy reduces the amount of load going through a joint, which enables patients to perform functional closed-chain exercises that may not be possible on land (Hinman et al 2007). In addition, correspondence with Arthritis Groups has indicated that access to hydrotherapy is the most sought after request from sufferers of arthritis (Arthritis New Zealand 2010).

Despite the proposed benefits of hydrotherapy, a number of systematic reviews have been cautious in endorsing the effectiveness of hydrotherapy. Geytenbeek (2002) identified 34 trials, that examined the effect of hydrotherapy on a number

of outcomes, including pain, strength, flexibility, functional ability, self-efficacy and affect. Fifteen studies provided moderate quality evidence to support the use of hydrotherapy (Geytenbeek 2002). Furthermore, Bartels et al (2007) concluded that while hydrotherapy has some short term benefits for hip or knee osteoarthritis, no long term effects have been documented. Additionally, Verhagen et al (2008) concluded from their review that no firm answer could be drawn on the effectiveness of 'balneotherapy' or water therapy on osteoarthritis. In a more recent review, Al-Qubaeissy et al (2012) concluded that hydrotherapy had benefit in reducing pain and improving the health status of rheumatoid arthritis patients in the short term.

The limited evidence supporting the use of hydrotherapy in the arthritic population may be due to the use of inappropriate outcome measures in hydrotherapy trials. The research to date has included a wide range of outcome measures, including impairment measures, performance measures and patient reported outcome measures (PROMs), with little consistency across studies. In particular, a variety of PROMs are utilised. PROMS are important to gain an understanding of outcomes relevant to patient's concerns and are increasingly being used to evaluate the benefits of interventions in chronic conditions (Horner and Larmer 2006, Kirwan and Tugwell 2011, Laver Fawcett 2007). It has been suggested that PROMs can be divided into eight categories: generic, self-administered, condition specific, joint specific, health status, patient specific, disease specific, and global outcome (Saltzman et al 1998). A preliminary scan of the literature found that while pain was often measured, the majority of PROMs used in hydrotherapy studies are generic, disease specific or joint specific, yet there is still considerable variation. This variability makes it difficult to compare results across studies and to determine the overall effectiveness of hydrotherapy in systematic reviews. In addition, it is often unclear in existing research, why a particular PROM has been selected and importantly, a number have not been validated for patients with arthritis. Therefore, a systematic review was undertaken to identify and evaluate the PROMs that have been used for assessing the impact of hydrotherapy interventions on adults with arthritic conditions.

METHODS

A comprehensive search of the following electronic databases was undertaken, to identify studies for inclusion in the review: EBSCO Health Databases (including MEDLINE, CINAHL, and SPORT Discus and Ovid), AMED Allied and Complementary Medicine, Scopus, Cochrane Library and PEDro. The following keywords were used: hydrotherap* or aquatic therap* or aquatic rehabilitation and arthrit* or osteoarthrit* and outcome* or measure* or evaluat* or assess* or evidence. The search was undertaken with assistance from a librarian experienced in search protocols.

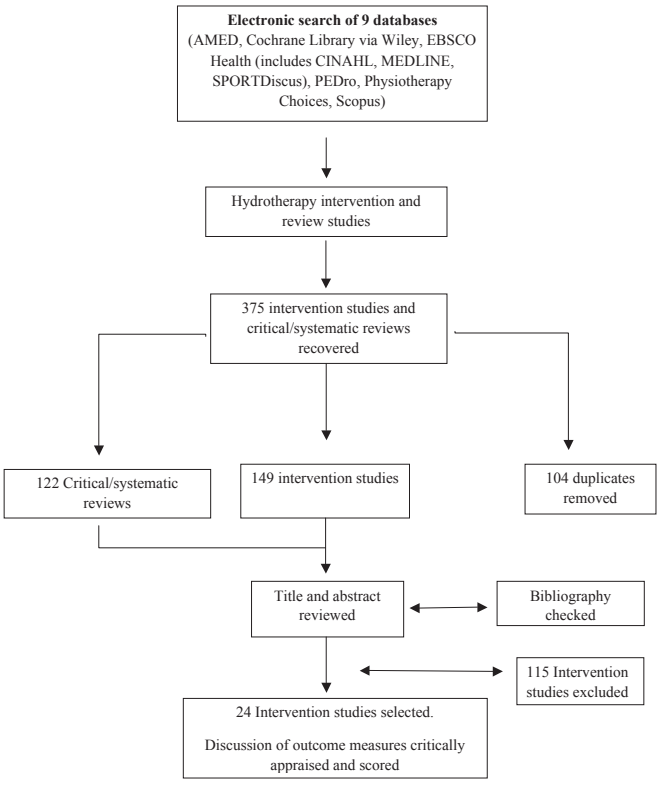
Articles were included if they investigated the effect of hydrotherapy on any form of arthritis in an adult population, who had not yet undergone joint replacement surgery. Only studies published in English were included and all studies had to have included at least one PROM or a pain visual analogue scale (VAS) as an outcome measure. There were no restrictions on publication date. Articles published up till August 2012 were included. Once duplicates were removed, the titles and abstracts of each study were reviewed based on the selection criteria. If the abstract did not provide sufficient information, the full text was reviewed. A manual search was also conducted on the reference lists of identified articles to identify any relevant articles that had been missed. All relevant studies were obtained for full evaluation.

Each study had a quality assessment undertaken using a scoring tool to evaluate the validity, reliability and responsiveness along with the rationale relevant to PROMs. The internal and external validity of each study's methods were not considered. The evaluation tool has been used previously (Larmer 2009), and consists of eight questions (see Appendix 1). Each question is scored out of two and an overall score out of sixteen can be awarded. Four reviewers (PL, JB, DOB, JD) independently extracted the data and assessed the quality of the studies. Each article was independently scored by two reviewers and a discussion with a third reviewer was held if variation occurred in scoring, so that a consensus could be reached.

RESULTS

A total of 375 intervention studies, systematic reviews and critical reviews were retrieved in the initial search (see Figure 1). One hundred and forty nine intervention studies were excluded due to not investigating hydrotherapy, not identifying outcome measures, including joint replacement or including other conditions in the study population. The 122 identified review papers were used to confirm all intervention studies had been identified. Finally, twenty four studies were identified that met the inclusion criteria (see Table 1).

Figure 1: Flow diagram of selection process of the studies



There were 17 randomised controlled trials [RCTs] (Ahern et al 1995, Arnold and Faulkner 2010, Bilberg et al 2005, Cadmus et al 2010, Cochrane et al 2005, Eversden et al 2007, Foley et al

Table 1: Hydrotherapy intervention studies

Author and Date	Study design Participants (n=) Participant characteristics	Intervention Control Dropouts (n=)(%)	Time of assessments	Patient-report outcome measures Psychometric properties identified (yes/no)	Results Quality score (/16)
Ahern et al (1995)	RCT Phase 1: n=90, Phase 2: n=30: HT: 22, control: 8 Participants had a diagnosis of either RA or OA	Phase 1: All participants received HT for 30 minutes for four consecutive days Phase 2: HT: 2 x 30 min sessions per week for 6 weeks Yes – no intervention beyond phase 1 n=18 (20%)	Assessments completed pre-intervention, after phase 1, and weeks 1, 2, 4, and 6 following randomisation. No follow up	Zung self-rating depression scale No Middlesex Hospital Questionnaire No Illness Behaviour Questionnaire No Arthritis Self-Efficacy Scale [ASES] No Health Assessment Questionnaire [HAQ] No Frenchay Activities Index No	Suggests improvements in self efficacy 7/16
Alexander et al (2001)	Observational study n=32 Participants were aged between 51 and 79 years and had a diagnosis of arthritis (OA, RA, psoriatic or fibromyalgia)	HT: 2 times per week for 12 weeks (Canadian Arthritis Society's Water Works programme) No n=0	Assessments completed pre- and post-intervention. No follow up	HAQ Yes Short Form 36 [SF-36] Yes Medical Outcomes Survey-Pain Index Yes Perceived general health measured with single item from the SF-36 Yes	Improvement in gait, flexibility and self-reported disability 12/16
Arnold and Faulkner (2010)	RCT n=79, HT: 27, HT and education: 28, control: 27 Participants were 65 years or older, had a diagnosis of hip OA and 1 fall risk factor	HT: 2 times per week for 11 weeks, HT and education: 2 times per week for 11 weeks Yes – usual activity n=18 (22%)	Assessments completed pre- and post-intervention. No follow up	Activities and Balance Confidence Questionnaire Yes Arthritis Impact Measurement Scale [AIMS2] Yes Physical Activity Scale for the Elderly [PASE] No	Combination of aquatic exercise and education improved fall risk on older adults with arthritis 13/16

Bilberg et al (2005)	RCT n=47. HT:22, control:25 Participants were aged between 20 and 65 years, RA for 1-5 years, stable medication for the past 3 months and functional class I, II or III.	HT: 45 minutes, 2 times per week for 12 weeks Yes- home programme n=4 (8%)	Assessments completed pre- and post-intervention. HT group followed up 3 months after completion	SF-36 (Physical Component Summary only) Yes AIMS2 Yes HAQ Yes	Improved muscle endurance in patients with RA. NB: Small sample size 13/16
Cadmus et al (2010)	RCT n=249, HT: 125, control: 124 Participants were aged between 55 and 75 years and had a diagnosis of hip and/or knee OA	HT: at least 2 times per week for 20 weeks (AFAP) Yes – usual activity n=23 (9%)	Assessments completed pre-intervention, at 10 weeks and at 20 weeks. No follow up	Perceived quality of life [PQOL] No ASES Yes HAQ (Disability Index) Yes Center for Epidemiological Studies Depression Scale Yes	Improved PQAL scores in obese participants 10/16
Cochrane et al (2005)	RCT n=312, HT: 153, control: 156 Participants were aged over 60 years and had a diagnosis of hip and/or knee OA	HT: at least 2 x one hour sessions per week for 1 year Yes – usual activity n=81 (26%)	Assessments completed pre-intervention, at 6 months, 12 months. Follow up at 18 months (6 months post-intervention)	Western Ontario and McMaster Universities Osteoarthritis Index [WOMAC] Yes SF-36 Yes EuroQol (EQ-VAS and EQ-5D) Yes	Improvement in pain and physical function 15/16
Eversden et al (2007)	RCT n=115 , HT: 57, land based exercises: 58 Participants were aged 18 years or older and had a diagnosis of RA	HT: 1 x 30 minute session per week for 6 weeks Yes – land-based exercises: 1 x 30 minute sessions per week for 6 weeks n=30 (26%)	Assessments completed pre-intervention, post-intervention. Follow up at 3 months (8 weeks post-intervention)	Self-rated overall effect of treatment Yes HAQ No EuroQol (EQ-VAS and EQ-5D) No	Participants reported a perceived benefit but this was not reflected in functional, QoL, or pain scores. 9/16

Fisher et al (2004)	Observational Study n=19 Diagnosis of knee OA	HT: 3 x 45 minute sessions per week for 8 weeks No n= 1	Assessments completed pre-intervention, post-intervention.	Habitual Physical Activity Questionnaire Yes	No significant changes 7/16
Foley et al (2003)	Single blind, three arm RCT n=105, HT: 35, gym exercises: 35, control: 35 Participants were aged 50 years or over and had a diagnosis of hip or knee OA	HT: 3 x 30 minute sessions per week for 6 weeks, gym exercises: 3 x 30 minute sessions per week for 6 weeks Yes n=15 (14%)	Assessments completed pre- and post-intervention. No follow up	WOMAC No Adelaide Activities Profile No SF-12 No ASES No	No significant difference between the hydrotherapy and exercise group 10/16
Fransen et al (2007)	RCT with blinded outcomes assessment n=152, HT: 55, Tai Chi: 56, control: 41 Participants were aged between 59 and 85 years and had a diagnosis of hip or knee OA	HT: 2 x 1 hour sessions per week for 12 weeks, Tai Chi: 2 x 1 hour sessions per week for 12 weeks Yes n=11 (7%)	Assessments completed pre- and post-intervention. Follow up at 24 weeks (12 weeks post intervention)	WOMAC – pain and physical function No SF-12 (Physical Component Summary and Mental Component Summary) No Depression, Anxiety and Stress Scale No	Improvements in both hydrotherapy and Tai Chi groups but no significant difference between groups 7/16
Gill et al (2009)	Randomised, single blind, before-after trial n=82, HT: 42, land-based: 40 Participants were all adults awaiting joint replacement surgery of the hip or knee	HT: 2 x 1 hour sessions per week for 6 weeks, land-based exercises: 2 x 1 hour sessions per week for 6 weeks No n=16 (19%)	Assessments completed pre- and post-intervention. Follow up at 14 weeks (8 weeks post-intervention)	WOMAC – pain and physical function only No SF-36 (MCS only) No	No significant difference between groups 8/16
Guo et al (2009)	Observational study n=14 Participants were aged 45 years or older, had a diagnosis of OA and were attending an AFAP programme	HT: 2-3 x 30-60 minutes sessions per week, for between 6 and 12 weeks (based on AFAP programme) No n=8 (57%)	Assessments completed pre- and post-intervention. No follow-up	AIMS2-SF Yes ASES Yes	Increased participant's self-efficacy. NB: Small sample size 13/16

Hall et al (1996)	RCT with blinded outcomes assessment n=148 Participants with chronic RA	HT:2x 30 minute sessions per week, for 4 weeks Yes n=9 (6%)	Assessments completed pre- and post-intervention. Follow up at 3 months	McGill Pain Questionnaire Yes Beliefs in Pain Control Questionnaire (BPCQ) Yes AIMS 2 Yes	All groups improved although hydrotherapy participants showed greatest improvement 12/16
Hinman et al (2007)	Single-blind RCT n=71, HT: 36, control: 35 Participants were aged 50 years or older and had symptomatic hip or knee OA	HT: 2 x 45-60 minute sessions per week for 6 weeks Yes n=7 (10%)	Assessments completed pre- and post-intervention. Follow up at 12 weeks (6 weeks post-intervention)	WOMAC Yes 15-item Assessment of Quality of Life Scale Yes PASE Yes	Improved pain, physical function, strength and QoL scores than control 12/16
Lim et al (2010)	RCT n=75, HT: 26, land-based: 25, control: 24 Participants were aged 50 years or older. They were obese and had a diagnosis of knee OA	HT: 3 x 40 minute sessions per week for 8 weeks at an intensity of at least 65% maximal HR, land-based exercises: 3 x 40 minute sessions per week for 8 weeks Yes – home-based exercise n=9 (12%)	Assessments completed pre- and post-intervention. No follow up	Brief pain inventory No WOMAC No SF-36 No	HT group showed improved pain scores than land based group 7/16
Lin et al (2004)	Quasi-experimental design n=106, HT: 66, control: 40 Participants were aged 60 years or over and had a diagnosis of hip and/or knee OA	HT: 2 x 1 hour sessions per week for 12 months Yes - did not exercise, but received monthly education material and quarterly telephone calls n=24 did not complete HT intervention (36%)	Assessments completed pre- and post-intervention. No follow up	WOMAC No AIMS2 (only the subscales of social activity, support from family and friends, level of tension and mood) No	HT group showed modest improvements in physical function, pain, general mobility and flexibility. 10/16
Lund et al (2008)	Single blind RCT n=79, HT: 27, land based: 25, control: 27 Participants had a diagnosis of primary knee OA	HT: 2 x 50 minute sessions per week for 8 weeks, land based exercise: 2 x 50 minute sessions per week for 8 weeks Yes n= 9 (11%)	Assessments completed pre- and post-intervention. Follow up at 3 months post-intervention	Knee injury and osteoarthritis outcome score questionnaire [KOOS] No	Land based group showed improvements but no difference between HT and control group 4/16

Silva et al (2008)	Randomised clinical trial n=64, HT: 32, land-based: 32 Participants had diagnosis of knee OA	HT: 3 x 50 minute sessions per week for 18 weeks, land-based exercises: 3 x 50 minute sessions per week for 18 weeks No n=7 (10%)	Assessments completed pre-intervention, at week 9 and week 18. No follow up	Lequesne index for osteoarthritis of the knee Yes WOMAC Yes	Both HT and land based groups showed improvements in pain and function 11/16
Stener-Victorin et al (2004)	Prospective RCT n=45, HT: 15, EA: 15, Control: 15 Participants had a diagnosis of hip OA and were on a waiting list for total hip arthroplasty	HT in combination with education: 2 x 30 minute sessions per week for 5 weeks, EA in combination with education: 2 x 30 minute sessions per week for 5 weeks Yes – received education n=20 (44%)	Assessments completed pre- and post-intervention. Follow up at 1, 3 and 6 months post-intervention	Disability rating index No Global self-rating index No	Both HT and EA groups showed improvements in pain, functional activity and QoL scores 7/16
Suomi and Collier (2003)	RCT n=32, HT: 11, land-based: 11, Control: 10 Participants were aged between 60 and 79 years and had a diagnosis of RA or OA	HT: 2 x 45 minute sessions per week for 8 weeks, land-based exercise: 2 x 45 minute sessions per week for 8 weeks Yes n=2 (6%)	Assessments completed pre- and post-intervention. No follow up	Modified Functional Capacity Evaluation (subscales of: difficulty performing specified ADLs; and pain experienced in performing specified ADLs) Yes	Both HT and land based groups improved in physical fitness and perceived ability to perform ADL 8/16
Sylvester (1990)	RCT n=14 Participants had a diagnosis of hip OA	HT: 2 x 30 minute sessions per week for 6 weeks Yes – received shortwave diathermy and exercises n=0	Assessments completed pre-intervention and one week at completion of intervention. No follow up	Oswestry Low Back Pain Disability Questionnaire No Philadelphia Questionnaire No	HT group showed improvement in functional ability and life satisfaction. NB: Small sample size 7/16

Wong and Scudds (2009)	Multiple pre-test within-subject design n=39 Participants were aged between 18 and 65 years and had a diagnosis of RA or systemic lupus erythematosus	HT: 1 x 45 minute session per week for 4 weeks, with 8 week maintenance period (based on Community Based Water Exercise Programme) Yes - participants acted as their own control in the month before the start of the programme n=8 (21%)	Assessments completed 4 weeks pre-intervention (week 0), pre-intervention (week 4), post-intervention (week 8) and post-maintenance period (week 16)	Chinese HAQ [CHAQ] Yes Chinese SF-36 Yes ASES (subscales of: self-efficacy for exercising regularly and self-efficacy for self-management behaviour) Yes	Participants improved in pain, SF-36, confidence in performing exercises and exercise participation 11/16
Wang et al (2006)	RCT n= 42 Participants were aged 25 years or older and had a diagnosis of hip or knee OA	HT: 3 x 50 minute sessions per week for 12 weeks Yes – continue own exercise programme n= 4	Assessments completed pre-intervention, week 6 and week 12 at completion of intervention. No follow up	Multidimensional Health Assessment Questionnaire (MDHAQ) Yes	Short term benefit in flexibility, strength and aerobic fitness, but no effect on physical function or pain 12/16
Wang et al (2011)	RCT with blinded assessors n= 84 Participants were aged 55 years or older and had a diagnosis of knee OA	HT: 3 x 60 minute sessions per week for 12 weeks Yes – standardised land based exercise programme and no intervention n= 6	Assessments completed pre-intervention, week 6 and week 12 at completion of intervention. No follow up	Knee injury and osteoarthritis outcome score questionnaire [KOOS] Yes	Both HT and land based groups improved in range of movement, 6 minute walk and QoL. No between group differences 14/16

ADLs = activities of daily living, AFAP = Arthritis Foundation Aquatic Programme, EA = Electro-acupuncture, HT= Hydrotherapy, OA = osteoarthritis, RA = rheumatoid arthritis, RCT= Randomised Control Trail. QoL = Quality of Life

2003, Fransen et al 2007, Hall et al 1996, Hinman et al 2007, Lim et al 2010, Lund et al 2008, Stener-Victorin et al 2004, Suomi and Collier 2003, Sylvester 1990, Wang et al 2006, Wang et al 2011), one randomised before-after trial (Gill et al 2009), three observational studies (Alexander et al 2001, Fisher et al 2004, Guo et al 2009), one quasi- experimental design (Lin et al 2004), one randomised clinical trial (Silva et al 2008) and one multiple pre-test within-subject design (Wong and Scudds 2009).

Sixteen of the 23 studies examined the effect of hydrotherapy on patients diagnosed with knee and/or hip osteoarthritis (Arnold and Faulkner 2010, Cadmus et al 2010, Cochrane et al 2005, Fisher et al 2004, Foley et al 2003, Fransen et al 2007, Guo et al 2009, Hinman et al 2007, Lim et al 2010, Lin et al 2004, Lund et al 2008, Silva et al 2008, Stener-Victorin et al 2004, Sylvester 1990, Wang et al 2006, Wang et al 2011) . Two studies (Ahern et al 1995, Suomi and Collier 2003), included participants who had been diagnosed with either rheumatoid arthritis or osteoarthritis. Three studies (Bilberg et al 2005, Eversden et al 2007, Hall et al 1996) looked exclusively at rheumatoid arthritis. Alexander et al (2001) included patients with osteoarthritis, rheumatoid arthritis, psoriatic arthritis and fibromyalgia. Wong and Scudds (2009) included patients with rheumatoid arthritis or systemic lupus erythematosus. Gill et al (2009) did not specify participants' diagnoses, but all were awaiting joint replacement surgery.

Participants in the 24 studies were aged eighteen years or over. Hydrotherapy sessions lasted between thirty and sixty minutes and were held one to three times per week. Interventions ranged in duration from four weeks to twelve months. The number of study participants ranged from six (Guo et al 2009) to 312 (Cochrane et al 2005). Eleven studies compared hydrotherapy to other interventions. Further detail on individual studies has not been provided in this review, as a critique of each study's internal or external validity was not the primary focus.

Thirty-five PROMs were used in the twenty-four studies (see Table 2). The quality of the twenty-four intervention studies varied with respect to their description of outcome measures. Quality scores ranged from 4/16 to 15/16 (see Table 1) when rated on the scoring tool. Variations of a measure were counted separately. Thus, the Arthritis Impact Measurement Scale-2 (AIMS2) has been distinguished from the AIMS2-SF and the Chinese Health Assessment Questionnaire (CHAQ) from the Health Assessment Questionnaire (HAQ). There was considerable variation in the number of PROMs included in individual studies. Four studies (Fisher et al 2004, Lund et al 2008, Suomi and Collier 2003, Wang et al 2011) utilised only one PROM while seven studies utilised two (Gill et al 2009, Guo et al 2009, Lin et al 2004, Silva et al 2008, Stener-Victorin et al 2004, Sylvester 1990, Wang et al 2006). Nine studies utilised three PROMs (Arnold and Faulkner 2010, Bilberg et al 2005, Cochrane et al 2005, Eversden et al 2007, Fransen et al 2007, Hall et al 1996, Hinman et al 2007, Lim et al 2010, Wong and Scudds 2009). Three studies utilised four (Alexander et al 2001, Cadmus et al 2010, Foley et al 2003) and one study utilised six PROMs (Ahern et al 1995).

Ten of the 35 PROMs were utilised in more than one study (see Table 2). The most common PROMs used were the Pain Visual Analogue Scale in nine studies and the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) used in eight studies. The WOMAC measure can be scored using a five point Likert scale or a 100mm VAS scale. Three studies specifically indicated that they used the Likert scoring scale (Cochrane et al 2005, Fransen et al 2007, Lim et al 2010), while five studies (Foley et al 2003, Gill et al 2009, Hinman et al 2007, Lin et al 2004, Silva et al 2008) did not indicate what scale they used. The Health Assessment Questionnaire (HAQ) was used in six studies. The Arthritis Self-Efficacy Scale (ASES) and the Short Form (SF)-36 were used in five studies. The AIMS2 was used on four occasions and the shorter SF-12, the Knee Injury and Osteoarthritis Outcome Score (KOOS), the Physical Activity Scale for the Elderly (PASE) and the EuroQol were all used on two occasions. The remaining 25 PROMs were only used in a single study.

The 35 PROMs can be loosely classified into disease specific, joint specific and generic PROMs. Six of the 35 PROMs were specific to arthritis. These were: AIMS2, AIMS2-SF, ASES, WOMAC, KOOS and the Lequesne Index for Osteoarthritis of the Knee. The WOMAC, KOOS and Lequesne Index were designed specifically for patients with osteoarthritis; the latter two are joint specific and are used exclusively for knee osteoarthritis. The remaining 29 PROMs were generic measures. However, only the following eight generic measures have been validated for certain types of arthritis: Centre for Epidemiological Studies Depression Scale, CHAQ, EuroQol, HAQ, BPCQ, PASE, SF-12 and SF-36. Of particular note, no PROM has been designed or evaluated specifically for hydrotherapy interventions. In addition to these PROMs, a further 34 outcome measures were included in the 23 intervention studies (see Table 3). Only one study (Wong and Scudds 2009) did not include additional outcome measures. Based on the outcome scoring tool the score of individual studies ranged from 4/16 to 15/16.

DISCUSSION

This review has highlighted that there is no gold standard PROM or battery of tests commonly used in hydrotherapy intervention studies. Furthermore, no PROM was identified specifically developed for hydrotherapy intervention studies. This study showed that 35 PROMs were used in the 24 studies included in this review. However, 25 of these were only used on one occasion. A further 34 other various physical and functional outcome measures were also utilised. This wide range of outcome measures makes it difficult to compare intervention results across studies. As a result, it is perhaps not surprising that studies investigating the effects of hydrotherapy in people with arthritis provide differing results as they are likely to be measuring different aspects.

It is not always known why clinicians and researchers select a particular outcome measure. At times it would suggest that outcome measures are selected based on pragmatic decisions, such as access to an outcome measure (Tyson et al 2010, Van Peppen et al 2008). The WOMAC (Bellamy et al 1988) was the most commonly utilised PROM in the current review. The WOMAC is widely promoted for its validity, reliability and responsiveness in patients with osteoarthritis of the hip or knee (Bellamy et al 1988, Kurtais et al 2011). However, more recently concerns have been raised about its ability to measure change, showing that effect sizes are dependent on patients' baseline scores (Kersten et al 2010). In addition, the WOMAC can be scored by either the Likert or VAS scale. The Likert scoring will

Table 2: Patient-report Outcome Measures

Patient-report outcome measure	Number of times used	Studies in which outcome measure is used
Visual analogue scale	9	Ahern et al (1995); Cadmus et al (2010); Eversden et al (2007); Gill et al (2009); Hinman et al (2007); Lund et al (2008); Silva et al (2008); Stener-Victorin et al (2004); Sylvester (1990)
Western Ontario and McMaster Universities Osteoarthritis Index [WOMAC]	8	Cochrane et al (2004); Foley et al (2003); Fransen et al (2007); Gill et al (2009); Hinman et al (2007); Lim et al (2010); Lin et al (2004); Silva et al (2008)
Health Assessment Questionnaire [HAQ]	6	Ahern et al (1995); Alexander et al (2001); Bilberg et al (2005); Cadmus et al (2010); Eversden et al (2007); Wang et al (2006)
Arthritis Self-Efficacy Scale [ASES]	5	Ahern et al (1995); Cadmus et al (2010); Foley et al (2003); Guo et al (2009); Wong and Scudds (2009)
SF-36	5	Alexander et al (2001); Bilberg et al (2005); Cochrane et al (2005); Gill et al (2009); Lim et al (2010)
Arthritis Impact Measurement Scale 2 [AIMS2]	4	Arnold and Faulkner (2010); Bilberg et al (2005); Hall et al (1996); Lin et al (2004)
EuroQol	2	Cochrane et al (2005); Eversden et al (2007)
Knee Injury and Osteoarthritis Outcome Score Questionnaire [KOOS]	2	Lund et al (2008); Wang et al (2011)
Physical Activity Scale for the Elderly [PASE]	2	Arnold and Faulkner (2010); Hinman et al (2007)
SF-12	2	Foley et al (2003); Fransen et al (2007)
Activities and Balance Confidence Questionnaire	1	Arnold and Faulkner (2010)
Adelaide Activities Profile	1	Foley et al (2003)
AIMS2-SF	1	Guo (2009)
Assessment of Quality of Life Scale	1	Hinman et al (2007)
Beliefs in Pain Control Questionnaire	1	Hall et al (1996)
Brief Pain Inventory	1	Lim et al (2010)
Center for Epidemiological Studies Depression Scale	1	Cadmus et al (2010)
Chinese HAQ	1	Wong and Scudds (2009)
Chinese SF-36	1	Wong and Scudds (2009)
Depression, Anxiety and Stress Scale	1	Fransen et al (2007)
Disability Rating Index	1	Stener-Victorin et al (2004)
Frenchay Activities Index	1	Ahern et al (1995)
Global Self-Rating Index	1	Stener-Victorin et al (2004)
Habitual Physical Activity Questionnaire	1	Fisher et al (2004)
Illness Behaviour Questionnaire	1	Ahern et al (1995)
Lequesne Index (knee)	1	Silva et al (2008)
McGill Pain Questionnaire	1	Hall et al (1996)
Medical Outcomes Survey-Pain Index	1	Alexander et al (2001)
Middlesex Hospital Questionnaire	1	Ahern et al (1995)
Modified functional capacity evaluation	1	Suomi and Collier (2003)
Oswestry Low Back Pain Disability Questionnaire	1	Sylvester (1990)
Perceived Quality of Life [PQOL]	1	Cadmus et al (2010)
Philadelphia Questionnaire	1	Sylvester (1990)
Self-rated overall effect of treatment	1	Eversden et al (2007)
Zung self-rating depression scale	1	Ahern et al (1995)

give a different value than the VAS, making pooling of data across studies difficult. In this review it was found that only three of the eight studies indicated what scale they used.

Two other specific osteoarthritis questionnaires – the KOOS and the Lequesne Index for Osteoarthritis of the Knee – were also used. Both the KOOS and the Lequesne Index have been reported to have sound psychometric properties for arthritic populations (Lequesne et al 1987, Bellamy, 1988, Roos et al 1998, Veenhof et al 2006), so they could be considered appropriate outcome measures for the population in question. However, because the KOOS was only used on two occasions and the Lequesne Index only on one occasion, they are of limited value here as they do not enable inter-study

Table 3: Other outcomes measures utilised in hydrotherapy intervention studies

Questionnaire	Number of times used	Studies utilising outcome measure
Isometric muscle strength	8	Bilberg et al (2005); Cochrane et al (2005); Fisher et al (2004); Foley et al (2003); Hinman et al (2007); Lin et al (2004); Suomi and Collier (2003); Wang et al (2006)
Flexibility	8	Ahern et al (1995); Alexander et al (2001); Hall et al (1996); Lin et al (2004); Suomi and Collier (2003); Sylvester (1990); Wang et al (2006); Wang et al (2011)
Six minute walk test	5	Arnold and Faulkner (2010); Foley et al (2003); Hinman et al (2007); Wang et al (2006); Wang et al (2011)
Chair stand	4	Arnold and Faulkner (2010); Bilberg et al (2005); Gill et al (2009); Lin et al (2004)
Grip strength	4	Ahern et al (1995); Alexander et al (2001); Bilberg et al (2005); Hall et al (1996)
Stair climb	4	Ahern et al (1995); Cochrane et al (2005); Fransen et al (2007); Lin et al (2004)
Body mass index /body fat proportion	3	Alexander et al (2001); Arnold and Faulkner (2010); Lim et al (2010)
Isokinetic muscle strength	3	Fisher et al (2004); Lim et al (2010); Lund et al (2008)
Timed up and go	3	Fransen et al (2007); Hinman et al (2007); Suomi and Collier (2003)
50 foot walk test	3	Fransen et al (2007); Gill et al (2009); Silva et al (2008)
Change in drug use	2	Foley et al (2003); Silva et al (2008)
8 foot walk test	2	Cochrane et al (2005); Lin et al (2004)
Aerobic capacity	1	Bilberg et al (2005)
Active shoulder elevation	1	Bilberg et al (2005)
Balance (standing using Balance Master Pro)	1	Lund et al (2008)
Berg balance scale	1	Arnold and Faulkner (2010)
Biceps strength through full range of motion	1	Suomi and Collier (2003)
Coordination ("soda pop" test)	1	Suomi and Collier (2003)
C-reactive protein	1	Hall et al (1996)
Disease Activity Score	1	Bilberg et al (2005)
Dual task function [timed up and go with cognitive task]	1	Arnold and Faulkner (2010)
Gait variables	1	Alexander et al (2001)
Global assessment of change	1	Gill et al (2009)
Index of Muscle Function	1	Bilberg et al (2005)
Isometric shoulder endurance	1	Bilberg et al (2005)
Jette Functional Status Index	1	Fisher et al (2004);
Open ended questions about hydrotherapy benefits	1	Guo et al (2009)
Perceived Exertion Rating	1	Fisher et al (2004);
Step test	1	Hinman et al (2007)
Ritchie articular index	1	Hall et al (1996)
Tender and swollen joints checklist	1	Cadmus et al (2010)
10m walk test	1	Eversden et al (2007)
25m walk test	1	Ahern et al (1995)
880-yard walk test	1	Suomi and Collier (2003)

comparisons. The EuroQol is recommended by the National Health Service in the UK for the routine collection of PROMs (Department of Health 2008) and was used on two occasions (Cochrane et al 2005, Eversden et al 2007). However, two other UK recommended arthritis-specific measures, the Oxford Hip Score and the Oxford Knee Score, were not used in any study.

Of interest, one study specifically investigated the sensitivity to change in PROMs for hydrotherapy (Lineker et al 2000). This study was not included in this review due to the inclusion of non-arthritis participants. The researchers conducted focus groups with participants to identify outcome measures that were sensitive to change prior to starting a ten week exercise programme. The study found that while pain measures were sensitive to change, the two specific arthritis outcome measures, the WOMAC and AIMS2 were not.

Furthermore, it should be noted that greater consistency in the use of outcome measures is not all that is required. A PROM only has value if it is valid, reliable and responsive in the target

population (Laver Fawcett 2007) and these psychometric properties should be carefully considered before using it in research trials or clinical practice (Larmer 2009). The scoring tool identified that many studies failed to provide this assurance. Indeed, the majority of hydrotherapy intervention studies included in this review did not provide sufficient detail about the psychometric properties of the PROM they used.

In summary, it is possible that the selection of unsuitable outcome measures have affected hydrotherapy research, accounting for the lack of high quality evidence for this intervention. Further research is warranted to develop a valid, reliable and responsive outcome measure specifically for people with arthritis undertaking hydrotherapy.

KEY POINTS

- Hydrotherapy is often suggested as an exercise intervention for people with arthritis.
- Few studies have been able to demonstrate that water-based exercises are superior to other forms of exercise.
- Inappropriate outcome measures may have affected hydrotherapy research, possibly accounting for the lack of high quality evidence for this intervention.
- Further research is warranted to develop a valid, reliable and responsive outcome measure specifically for arthritic people undertaking hydrotherapy

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REFERENCES

Ahern M, Nicholls E, Simionata E, Clark M, Bond M (1995) Clinical and psychological effects of hydrotherapy in rheumatic diseases. *Clinical Rehabilitation* 9(3): 204-212.

Al-Qubaeissy KY, Fatoye FA, Goodwin PC, Yohannes AM (2012) The Effectiveness of Hydrotherapy in the Management of Rheumatoid Arthritis: A Systematic Review. *Musculoskeletal Care* 11(1): 3-18.

Alexander MJL, Butcher JE, MacDonald PB (2001) Effect of a water exercise program on walking gait, flexibility, strength, self-reported disability and other psycho-social measures of older individuals with arthritis. *Physiotherapy Canada* 53(3): 203-211.

Allegrante JP, Marks R (2003) Self-efficacy in management of osteoarthritis. *Rheumatic Diseases Clinics of North America* 29(4): 747-768, vi-vii.

Arnold CM, Faulkner RA (2010) The effect of aquatic exercise and education on lowering fall risk in older adults with hip osteoarthritis. *Journal of Aging and Physical Activity* 18(3): 245-260.

Arthritis New Zealand (2010) Hydrotherapy. http://www.arthritis.org.nz/?s=hydrotherapy&x=5&y=8 [Accessed June 10, 2011].

Bartels EM, Lund H, Hagen KB, Dagfinrud H, Christensen R, Danneskiold-Samsoe B (2007) Aquatic exercise for the treatment of knee and hip osteoarthritis. *Cochrane Database of Systematic Reviews* 2007(4): CD005523.

Bartels EM, Lund H, Hagen KB, Dagfinrud H, Christensen R, Danneskiold-Samsøe B (2009) Aquatic exercise for the treatment of knee and hip osteoarthritis. *Cochrane Database of Systematic Reviews* 2009(1): CD005523.

Bellamy N, Buchanan WW, Goldsmith CH, Campbell J, Stitt LW (1988) Validation study of WOMAC: a health status instrument for measuring clinically important patient relevant outcomes to antirheumatic drug therapy in patients with osteoarthritis of the hip or knee. *Journal of Rheumatology* 15(12): 1833-1840.

Bilberg A, Ahlmen M, Mannerkorpi K (2005) Moderately intensive exercise in a temperate pool for patients with rheumatoid arthritis: a randomized controlled study. *Rheumatology* 44(4): 502-508.

Brazier JE, Walters SJ, Nicholl JP, Kohler B (1996) Using the SF-36 and euroqol on an elderly population. *Quality of Life Research* 5(2): 195-204.

Cadmus L, Patrick MB, Maciejewski ML, Topolski T, Belza B, Patrick DL (2010) Community-based aquatic exercise and quality of life in persons with osteoarthritis. *Medicine and Science in Sports and Exercise* 42(1): 8-15.

Cochrane T, Davey RC, Matthes Edwards SM (2005) Randomised controlled trial of the cost-effectiveness of water-based therapy for lower limb osteoarthritis. *Health Technology Assessment* 9(31): iii-iv, ix-xi, 1-114.

Department of Health (2008) Guidance on the routine collection of Patient Reported Outcome Measures (PROMs). For the NHS in England 2009/10. [Accessed January 14, 2012]

Deyle GD, Allison SC, Matekel RL, Ryder MG, Stang JM, Gohdes DD, Hutton JP, Henderson NE, Garber MB (2005) Physical therapy treatment effectiveness for osteoarthritis of the knee: a randomized comparison of supervised clinical exercise and manual therapy procedures versus a home exercise program. *Physical Therapy* 85(12): 1301-1317.

Di Bonaventura MD, Gupta S, McDonald MM, Sadosky A (2011) Evaluating the health and economic impact of osteoarthritis pain in the workforce: results from the National Health and Wellness Survey. *BMC Musculoskelet Disorders* 12(1): 83.

Eversden L, Maggs F, Nightingale P, Jobanputra P (2007) A pragmatic randomised controlled trial of hydrotherapy and land exercises on overall well being and quality of life in rheumatoid arthritis. *BMC Musculoskeletal Disorders* 8: 23.

Fisher NM, Dolan DM, Brenner C, Pendergast DR (2004) Quantitative effects of a water exercise program on functional and physiological capacity in subjects with knee osteoarthritis: a pilot study. *Sport Sciences for Health* 1(1): 17-24.

Foley A, Halbert J, Hewitt T, Crotty M (2003) Does hydrotherapy improve strength and physical function in patients with osteoarthritis--a randomised controlled trial comparing a gym based and a hydrotherapy based strengthening programme. *Annals of the Rheumatic Diseases* 62(12): 1162-1167.

Fransen M, Bridgett L, March L, Hoy D, Penserga E, Brooks P (2011) The epidemiology of osteoarthritis in Asia. *International Journal of Rheumatic Diseases* 14(2): 113-121.

Fransen M, Nairn L, Winstanley J, Lam P, Edmonds J (2007) Physical activity for osteoarthritis management: a randomized controlled clinical trial evaluating hydrotherapy or Tai Chi classes. *Arthritis and Rheumatism* 57(3): 407-414.

Furner SE, Hootman JM, Helmick CG, Bolen J, Zack MM (2011) Health-related quality of life of U.S. adults with arthritis: analysis of data from the behavioral risk factor surveillance system, 2003, 2005, and 2007. *Arthritis Care and Research* 63(6): 788-799.

Geytenbeek J (2002) Evidence for effective hydrotherapy. *Physiotherapy* 88(9): 514-529.

Gill SD, McBurney H, Schulz DL (2009) Land-based versus pool-based exercise for people awaiting joint replacement surgery of the hip or knee: results of a randomized controlled trial. *Archives of Physical Medicine and Rehabilitation* 90(3): 388-394.

Guo L, Yang H, Malkin MM (2009) Self-efficacy and arthritis impact on health: the effect of an Arthritis Foundation Aquatic Program. *American Journal of Recreation Therapy* 8(4): 9-19.

Hall J, Skevington SM, Maddison PJ, Chapman K (1996) A randomized and controlled trial of hydrotherapy in rheumatoid arthritis. *Arthritis Care and Research* 9(3): 206-215.

Hinman RS, Heywood SE, Day AR (2007) Aquatic physical therapy for hip and knee osteoarthritis: results of a single-blind randomized controlled trial. *Physical Therapy* 87(1): 32-43.

Horner D, Larmer PJ (2006) Health outcome measures. *New Zealand Journal of Physiotherapy* 34(1): 17-24.

Jan MH, Lin CH, Lin YF, Lin JJ, Lin DH (2009) Effects of weight-bearing versus nonweight-bearing exercise on function, walking speed, and position sense in participants with knee osteoarthritis: a randomized controlled trial. *Archives of Physical Medicine and Rehabilitation* 90(6): 897-904.

Kersten P, White PJ, Tennant A (2010) The visual analogue WOMAC 3.0 scale - Internal validity and responsiveness of the VAS version. *BMC Musculoskeletal Disorders* 11: 80-91.

Kirwan JR, Tugwell PS (2011) Overview of the Patient Perspective at OMERACT 10 - Conceptualizing Methods for Developing Patient-Reported Outcomes. *Journal of Rheumatology* 38(8): 1699-1701.

Kurtais Y, Oztuna D, Kucukdeveci AA, Kutlay S, Hafiz M, Tennant A (2011) Reliability, construct validity and measurement potential of the ICF comprehensive core set for osteoarthritis. *BMC Musculoskeletal Disorders* 12: 255.

Larmer PJ (2009) Ankle sprains: An investigation into patient perceptions and performance of physical tasks following acute ankle sprains using a mixed methods approach [Doctoral thesis, Auckland University of Technology]. http://aut.researchgateway.ac.nz/handle/10292/766 [Accessed December 18, 2012].

Laver Fawcett A (2007) Principles of Assessment and Outcome Measurement for Occupational Therapists and Physiotherapists: Theory, Skills and Application. Chichester: John Wiley & Sons Ltd.

Lequesne MG, Mery C, Samson M, Gerard P (1987) Indexes of severity for osteoarthritis of the hip and knee. Validation - value in comparison with other assessment tests. *Scandinavian Journal of Rheumatology* 65(Suppl 2): 85-89.

Lim AY, Doherty M (2011) What of guidelines for osteoarthritis? *International Journal of Rheumatic Diseases* 14(2): 136-144.

Lim JY, Tchai E, Jang SN (2010) Effectiveness of Aquatic Exercise for Obese Patients with Knee Osteoarthritis: A Randomized Controlled Trial. *Physical Medicine and Rehabilitation* 2(8): 723-731.

Lin SY, Davey RC, Cochrane T (2004) Community rehabilitation for older adults with osteoarthritis of the lower limb: a controlled clinical trial. *Clinical Rehabilitation* 18(1): 92-101.

Lineker SC, Badley EM, Hawker G, Wilkins A (2000) Determining sensitivity to change in outcome measures used to evaluate hydrotherapy exercise programs for people with rheumatic diseases. *Arthritis Care and Research* 13(1): 62-65.

Lund H, Weile U, Christensen R, Rostock B, Downey A, Bartels EM, Danneskiold-Samsoe B, Bliddal H (2008) A randomized controlled trial of aquatic and land-based exercise in patients with knee osteoarthritis. *Journal of Rehabilitation Medicine* 40(2): 137-144.

Marks R, Allegrante JP (2002) Body mass indices in patients with disabling hip osteoarthritis. *Arthritis Research* 4(2): 112-116.

Muthuri SG, Hui M, Doherty M, Zhang W (2011) What if we prevent obesity? Risk reduction in knee osteoarthritis estimated through a meta-analysis of observational studies. *Arthritis Care and Research* 63(7): 982-990.

Physical Activity Guidelines Advisory Committee (2008) Physical Activity Guidelines Advisory Committee Report, 2008. http://www.health.gov/paguidelines/report/pdf/committeereport.pdf [Accessed December 16, 2012].

Pisters MF, Veenhof C, van Meeteren NL, Ostelo RW, de Bakker DH, Schellevis FG, Dekker J (2007) Long-term effectiveness of exercise therapy in patients with osteoarthritis of the hip or knee: a systematic review. *Arthritis and Rheumatism* 57(7): 1245-1253.

Roddy E, Zhang W, Doherty M (2005) Aerobic walking or strengthening exercise for osteoarthritis of the knee? A systematic review. *Annals of the Rheumatic Diseases* 64(4): 544-548.

Roos EM, Roos HP, Lohmander LS, Ekdahl C, Beynnon BD (1998) Knee Injury and Osteoarthritis Outcome Score (KOOS)--development of a self-administered outcome measure. *Journal of Orthopaedic and Sports Physical Therapy* 28(2): 88-96.

Saltzman CL, Mueller C, Zwior-Maron K, Hoffman RD (1998) A primer on lower extremity outcome measurement instruments. *Iowa Orthopaedic Journal* 18: 101-111.

Silva LE, Valim V, Pessanha AP, Oliveira LM, Myamoto S, Jones A, Natour J (2008) Hydrotherapy versus conventional land-based exercise for the management of patients with osteoarthritis of the knee: a randomized clinical trial. *Physical Therapy* 88(1): 12-21.

Stener-Victorin E, Kruse-Smidje C, Jung K (2004) Comparison between electro-acupuncture and hydrotherapy, both in combination with patient education and patient education alone, on the symptomatic treatment of osteoarthritis of the hip. *Clinical Journal of Pain* 20(3): 179-185.

Suomi R, Collier D (2003) Effects of arthritis exercise programs on functional fitness and perceived activities of daily living measures in older adults with arthritis. *Archives of Physical Medicine and Rehabilitation* 84(11): 1589-1594.

Sylvester KL (1990) Investigation of the effect of hydrotherapy in the treatment of osteoarthritic hips. *Clinical Rehabilitation* 4: 223-228.

Tyson S, Greenhalgh J, Long AF, Flynn R (2010) The use of measurement tools in clinical practice: an observational study of neurorehabilitation. *Clinical Rehabilitation* 24(1): 74-81.

Van Peppen RPS, Maissan FJF, Van Genderen FR, Van Dolder R, Van Meeteren NLU (2008) Outcome measures in physiotherapy management of patients with stroke: a survey into self-reported use, and barriers to and facilitators for use. *Physiotherapy Research International* 13(4): 255-270.

Veenhof C, Bijlsma JW, van den Ende CH, van Dijk GM, Pisters MF, Dekker J (2006) Psychometric evaluation of osteoarthritis questionnaires: a systematic review of the literature. *Arthritis and Rheumatism* 55(3): 480-492.

Verhagen A, Bierma-Zeinstra S, Lambeck J, Cardoso JR, de Bie R, Boers M, de Vet HC (2008) Balneotherapy for osteoarthritis. A cochrane review. *Journal of Rheumatology* 35(6): 1118-1123.

Wang TJ, Belza B, Elaine Thompson F, Whitney JD, Bennett K (2006) Effects of aquatic exercise on flexibility, strength and aerobic fitness in adults with osteoarthritis of the hip or knee. *Journal of Advanced Nursing* 57(2): 141-152.

Wang TJ, Lee SC, Liang SY, Tung HH, Wu SF, Lin YP (2011) Comparing the efficacy of aquatic exercises and land-based exercises for patients with knee osteoarthritis. *Journal of Clinical Nursing* 20(17-18): 2609-2622.

Wikman A, Wardle J, Steptoe A (2011) Quality of life and affective well-being in middle-aged and older people with chronic medical illnesses: a cross-sectional population based study. *PLoS One* 6(4): e18952.

Wong LKY, Scudds RJ (2009) The Effects of a Community-based Water Exercise Programme on Health Outcomes for Chinese People With Rheumatic Disease. *Hong Kong Physiotherapy Journal* 27: 39-47.

Appendix 1: Modified Scoring System for Outcome studies

A. Were the outcome measure questionnaires used clearly defined?

2 = clearly defined.

1 = inadequately defined.

0 = not defined.

B. Was there justifcation provided for choosing the outcomes?

2 = Yes and comprehensive

1 = Partial

0 = No or unclear

C. Was there evidence that the questionnaire been validated?

2 = Validity described.

1 = Referred to previous validity.

0 = Not mentioned or had not been validated.

D. Was there evidence that questionnaire had undergone reliability testing?

2 = Reliability described and high.

1 = Referred to previous reliability studies only.

0 = Not mentioned or no reliability undertaken.

E. Was there evidence that that the questionnaire's responsiveness?

2 = Responsiveness described and high.

1 = Referred to previous responsiveness studies only.

0 = Responsiveness was poor or not mentioned.

F. Was the questionnaire relevant to the author's research question?

2 = Questionnaire specific and highly relevant.

1 = General questionnaire only.

0 = Unclear.

G. Was there evidence that the questionnaire has been used widely?

2 = Questionnaire widely used.

1 = Questionnaire infrequently used.

0 = First time used or modified questionnaire.

H. Could clinicians easily use the questionnaires?

2 = Used often and easily performed.

1 = Used rarely or difficult to perform.

0 = Unable to assess if relevant in the clinical setting.