The use of aquatic physiotherapy in the treatment of musculoskeletal upper extremity disorders: a scoping review. [Protocol].

MURRAY, L., KENNEDY, M., ALEXANDER, L., MALONE, M. and MAIR, L.

2022

The Use of Aquatic Physiotherapy in the Treatment of Musculoskeletal Upper Extremity Disorders: A Scoping Review

Authors

Lynn Murray[1] Michelle Kennedy[2] Lyndsay Alexander[3] Michael Malone[4] Lyn Mair[5]

1. Musculoskeletal Physiotherapy Services, NHS Grampian, UK
2. School of Health Sciences, Robert Gordon University, UK; Neurological Physiotherapy Services, NHS Grampian, UK
3. School of Health Sciences, Robert Gordon University, UK & Scottish Centre for Evidence-based Multi-professional practice: A JBI centre of Excellence
4. School of Health Sciences, Robert Gordon University, UK
5. Library & Knowledge Services, NHS Grampian, UK

Abstract

Objective: To identify existing literature related to aquatic exercise therapy used to manage upper extremity musculoskeletal disorders and identify key concepts, intervention components, and gaps in the evidence base.

Introduction: Musculoskeletal conditions are a global challenge with significant related disability and cost to society. Upper limb musculoskeletal conditions have been reported across the lifespan and aquatic therapy has been included as part of the management for this condition. There is a need to map the global evidence on this topic to inform subsequent research.

Inclusion criteria: **Participants** – Adults with upper extremity musculoskeletal disorders; **Concept** – Aquatic based exercise therapy, **Context** – any setting in any very highly developed nation. Published and unpublished evidence in any language accessible by Google Translate and from data base inception will be included.

Methods: JBI Scoping review methodology will guide this review. MEDLINE (Ovid), CINAHL (EBSCOHost), Embase (Ovid), CENTRAL (Cochrane Central Register of Controlled Trials) data bases and grey literature sources such as aquatic special interest groups, The Networked Digital Library Theses and Dissertations (NDTLD), e-theses online service (EThOS) and Google will be searched using a three-step search strategy. Title and abstract screening and then full text screening will be conducted by two independent reviewers for both stages. Any conflicts will be resolved by consensus or a third reviewer. Data relevant to the review question will be extracted by two independent reviewers for subsequent analysis. Descriptive content analysis will be performed and results will be presented using a range of visual methods with accompanying narratives.

Word count 226/250

Keywords

Aquatic therapy; Arm injury; Hydrotherapy; Physiotherapy

Introduction

The recent analysis of Global Burden of Disease (GBD) data demonstrated that approximately 1.71 billion people globally have musculoskeletal conditions.[1]

While the prevalence of musculoskeletal conditions varies by age and diagnosis, people of all ages everywhere around the world are affected. High-Income countries are the most affected in terms of number of people - 441 million, followed by countries in the World Health Organisation (WHO) Western Pacific Region with 427 million and South-East Asia Region with 369 million. Musculoskeletal conditions are also the biggest contributor to years lived with disability (YLDs) worldwide with approximately 149 million YLDs accounting for 17% of all YLDs worldwide.[1]

Globally, 1600 million adults aged between 15-64 years have a condition that would benefit from rehabilitation and musculoskeletal conditions contribute to two thirds of this number.[2] It is noted that 'other musculoskeletal' conditions are common with a prevalence rate of 305 million cases across the world[2] and this number will include disorders of the upper extremity. The point prevalence (26%) and lifetime estimate (67%) for shoulder pain has been reported in the general population and is common in workers over the age of 50 years.[3,4] The community prevalence of elbow pain has been reported at 5.6% and hand pain at 12.3%.[5] Additionally, shoulder and elbow incidence and prevalence for injuries and pain are common in young athletes participating in overhead sports (8-63% and 9-49% respectively).[6]

The physiotherapy management and rehabilitation of upper extremity musculoskeletal conditions includes land-based exercise,[7] manual therapy,[8] electrotherapy,[9] splinting[10,11] education[12] and water based aquatic therapy,[13] but there is no clear guidance as to which conditions benefit most from the inclusion of aquatic therapy.

The use of water for healing purposes has been used since ancient times.[14] The application of water-based therapy has been integrated within global modern healthcare for many years and there are multiple terms used to describe water based interventions. For the purposes of this scoping review protocol, the term aquatic therapy[15] will be used to encompass all the various descriptions, but other names used to describe water-based therapy include hydrotherapy,[16] water therapy,[17] pool therapy,[18] water-based exercise,[19] aquatic exercise,[20] aquatic physiotherapy,[21] aquatic physical therapy[22] and whirlpool baths[23].

Balneotherapy is a term used when discussing water-based therapy, but this applies to the use of natural thermal mineral water as opposed to ordinary water.[24] The definition of balneotherapy varies in the literature and has been described as bathing in, drinking or inhaling natural mineral waters and can include the application of peloids,[25] whereas other authors describe balneotherapy as exercise undertaken in natural thermal waters.[26] Spa therapy is another term often found in aquatic therapy literature.[24-27] The terms spa therapy, balneotherapy and hydrotherapy tend to be used interchangeably but it has been suggested that they describe three distinct types of intervention with spa therapy described as a mix of hydrotherapy, balneotherapy and a holiday atmosphere.[24]

Spa therapy will be excluded from this scoping review as this commonly refers to non-exercise-based water therapy[24] and any beneficial effects may be due to rest and relaxation in a resort atmosphere as opposed to any aquatic therapy intervention.

Aquatic therapy has multiple reported benefits including a reduction in pain, improved strength, increased joint mobility, improved fitness and balance for people with rheumatological, musculoskeletal and neurological conditions.[16] An understanding of the physical properties of water, the physiology of human immersion and the skills to analyse human movements enables physiotherapists to use water-based interventions with patients from different clinical population groups to facilitate movement and improve function.[16]

Aquatic therapy interventions can be conducted in group or individual settings[28] and a variety of treatment techniques can be applied including active exercise, passive exercise interventions and manual therapy techniques (see **Table 1**). For the purposes of this scoping review, our focus will be on the use of interventions with an aquatic exercise component, whether passive or active, as part of a therapeutic rehabilitation programme.

Table 1 Common aquatic therapy techniques / concepts

Concept / technique	Individually performed	Therapist facilitated technique	Brief description
Water-based Tai-Chi / Ai Chi[29]	•		Tai chi combined with hydrotherapy[29]
Deep Water Running[30]	•		Running performed in the deep end of the pool with the aid of a floatation vest. Aerobic exercise used for injury prevention, recovery from injury or training for cardiovascular fitness.[31]
Burdenko[17]	•		Water and land components. Exercise is performed in both shallow and deep water in the vertical position. Changes in starting position to challenge postural control and multidirectional stability, practiced at different speeds, performed in multiple directions (forward, backwards, laterally) and includes turns, jumping, and landing. Close attention to body alignment. Used in rehabilitation, conditioning, and/or training.[17]
Bad Regaz Ring Method[17]		•	Passive and active techniques performed in a supine / floated position. Based on principles of Proprioceptive Neuromuscular Facilitation[17]

Water shiatsu / Watsu™[32]		•	Supine position. Application of joint mobilisation, stretching techniques and massage whilst in water.[17,32]
Halliwick™[17]	•	•	The teaching of all people but particularly those with physical and / or learning difficulties to participate in water activities, to move in water and to swim. Uses specific therapeutic exercises for balance, core stability, swimming skills and neurodevelopmental training. Can begin with therapist led intervention and may progress to more independent exercise.[17]

Considering the healthcare costs associated with the delivery of aquatic therapy[33] and the requirement to justify clinical practice using the evidence base, it should be established whether water-based exercise is effective in delivering improved outcomes for people with upper extremity conditions. Prior to conducting a systematic review on the effectiveness of aquatic therapy in this population, it is important to map the evidence on this topic to inform the review team whether a subsequent systematic review and meta-analysis can be conducted.[34] Mapping the available evidence on aquatic therapy will be useful to establish which musculoskeletal conditions of the upper extremity have been rehabilitated using water-based exercise interventions. A scoping review will also enable the review team to identify the content of upper extremity aquatic therapy interventions as well as the health domains and outcome measures used to assess benefit.

A preliminary search of MEDLINE, the Cochrane Database of Systematic Reviews and JBI Evidence Synthesis, in addition to PROSPERO was conducted and no current or ongoing systematic or scoping reviews were identified to date that have mapped the evidence related to aquatic therapy and musculoskeletal conditions of the upper extremity. Previous systematic reviews have considered the benefit of aquatic-based therapies for fibromyalgia,[27,35] knee and hip osteoarthritis,[20] knee or hip replacement,[36] neck pain,[15] low back pain,[37] orthopaedic surgery[22] and pain relief in neurological and musculoskeletal conditions[38] but none, to our knowledge, have specifically looked at water-based interventions in upper extremity musculoskeletal conditions. One review examined the effectiveness of aquatic exercise for musculoskeletal conditions, but no studies of the upper extremity were included.[39] A poster abstract for a systematic review on the effectiveness of aquatic therapy on increasing range of motion and decreasing pain for patients with shoulder pathology[40] was located but we were unable to locate a related journal manuscript.

The objective of this scoping review is to identify existing literature related to aquatic exercise therapy used to manage upper extremity musculoskeletal disorders and identify key concepts, intervention components and gaps in the research.

Review questions

1) What musculoskeletal conditions of the upper extremity are managed using aquatic exercise therapy in the adult population and what aquatic exercise concept is used?

2) What is the content of aquatic therapy interventions reported including exercise types, intervention duration, number of sessions and frequency?

3) What health domains and outcome measures are used to evaluate the benefit of aquatic therapy?

4) What has been reported about aquatic-based exercise in the management of musculoskeletal disorders affecting the upper extremity relating to acceptability, experience, views, barriers, and facilitators?

Inclusion criteria

Population

This review will consider any study that included adults over the age of 18, and of any gender, with any arm / upper extremity musculoskeletal disorder who have undertaken water-based exercise therapy intervention in the management of their condition. The term upper extremity will be used for this review and is defined as the part of the body that includes the arm, wrist and hand.[41] This encompasses the shoulder, elbow, wrist, hand, fingers and thumb joints and the scapula, clavicle, humerus, radius, ulna, carpal, metacarpal and phalanx bones. Any musculoskeletal injury, whether acute or chronic, with either a traumatic or atraumatic onset will be considered. Studies including participants with musculoskeletal shoulder impairment secondary to treatment for breast cancer will be included if the musculoskeletal condition is the condition of interest rather than lymphoedema.

This review will exclude studies evaluating aquatic interventions for those with fibromyalgia, neurological or rheumatological conditions as these conditions are multisystemic and do not specifically relate to the upper extremity.

Concept

Aquatic-based exercise therapy is known by many terms such as hydrotherapy, aquatic therapy, aquatic physiotherapy, aquatic physical therapy, aquatic exercise, aquatic exercise therapy, pool therapy, aquatic training, water exercise therapy, water-based exercise and whirlpool baths so all these terms will be included in the search. Aquatic physiotherapy is defined by the Aquatic Therapy Association of Chartered Physiotherapists (ATACP) as: “A physiotherapy programme utilising the properties of water, designed by a suitably qualified physiotherapist. The programme should be specific for an individual to maximise function which can be physical, physiological, or psychosocial.”[21]

Balneotherapy will be included if there is evidence of any exercise-based intervention utilised but excluded if no clear description of a therapeutic exercise component is described within the study. Water based Ai Chi and Tai Chi will be included as there is an exercise component[29] to these sessions as will water shiatsu / Watsu™ and other water based manual therapy techniques as there is an exercise component, although it is mainly passive.[32] Spa therapy will be excluded as this commonly refers to non-exercise-based water therapy[24] and any beneficial effects may be due to rest and relaxation in a resort atmosphere as opposed to an aquatic therapy intervention.

Any studies evaluating the water-based management of wounds will also be excluded from this scoping review.

Context

The context will include any setting (such as primary care, secondary care, or community locations) in any highly developed nation (defined as the top 66 countries in the Human Development Index[42], in order for the findings to be relevant to the UK context.

Types of sources

This scoping review will consider all study designs including quantitative, qualitative, mixed methods and systematic reviews. Quantitative studies will include randomized controlled trials, non-randomized controlled trials, before and after studies and interrupted time-series studies. In addition, observational studies such as prospective and retrospective cohort studies, case-control, analytical cross-sectional studies, case series, case reports and cross-sectional studies will be considered for inclusion.

Qualitative studies such as phenomenology, grounded theory, ethnography and qualitative descriptive will be included. In addition, systematic reviews that meet the inclusion criteria will also be considered, to map reviews on this topic and to identify any additional primary studies not sourced from the full search strategy.

Text and opinion papers will also be considered for inclusion in this scoping review as well as grey literature such as aquatic special interest groups, PhD theses, unpublished reports, or service evaluations. Poster presentations or conference abstracts will be included if they contain relevant data for extraction on the aquatic interventions relevant to the review questions.

Methods

The proposed scoping review will be conducted in accordance with JBI methodology for scoping reviews.[43] This review will be registered and shared on Open Science Frameork (ref once submitted prior to JBIES submission) and reported in accordance with the PRISMA Extension for Scoping Reviews[44]

Search strategy

The search strategy will aim to locate both published and unpublished evidence. A three-step search strategy will be utilized in this review and an information specialist has supported the development of the search strategy. Following an initial search of MEDLINE (Ovid) and CINAHL (EBSCOHost) to identify articles on the topic, text words within the titles and abstracts of relevant articles, and their index terms, were used to develop a full search strategy for MEDLINE (OVID) (Appendix 1). The full search strategy will be adapted for each database and information source. A second full search will then be conducted across all included databases and sources. Lastly, the reference lists of all included sources of evidence will be screened for additional sources of evidence. The reference lists included in relevant

systematic reviews will be examined for sources that may be relevant to the topic and authors will be contacted via email as required for information sources.

Studies published in any language that the review team can access a translation through Google translate will be included. Studies published since database inception will be considered to allow a thorough identification of literature on the topic.

Databases to be searched include: MEDLINE (Ovid), CINAHL (EBSCOHost), Embase (Ovid) and CENTRAL (Cochrane Central Register of Controlled Trials). In addition, sources for unpublished theses, including Ethos and the Networked Digital Library of Theses and Dissertations (NDLTD), will also be searched. An advanced search of Google will be undertaken using modified search terms to look for grey literature (with results limited to PDFs to locate reports and policies as appropriate). Global aquatic therapy Special Interest Groups (SIGs), who are members of the International Organisation of the Aquatic Physical Therapists (IOAPT) subgroup and whose countries are listed in the top 66 countries in the Human Development Index[42] will be contacted with regards to clinical interest journals and opinion/evidence from clinical experts in the field. SIGs that can be explored in English will be included as we have no translation support for non-English language searching in these forums.

Study/Source of evidence selection

Following the search, all identified citations will be uploaded into RefWorks (Legacy) then duplicates will be removed, and references will then be imported to Covidence[45] to facilitate screening.

Titles and abstracts will be independently screened by two reviewers for assessment against the inclusion criteria for the review. Relevant full text sources will then be retrieved and imported to Covidence for independent review by two reviewers. Any sources of evidence excluded at full text screening will be recorded and reasons for exclusion reported in the final review. Title and abstract and full text screening will be piloted by the review team prior to starting each stage of the screening process. Any disagreements that arise between the reviewers at each stage of screening will be resolved through discussion, or with an additional reviewer. The results of the search and the screening process will be reported in full in the final scoping review and presented in a Preferred Reporting Items for Systematic Reviews and Meta-analyses extension for scoping review (PRISMA-ScR) flow diagram.[44]

Data extraction

Data will be extracted from papers included in the scoping review by two reviewers working independently using a data extraction tool developed by the review team. A draft of this data extraction tool can be found in Appendix 2. Extracted data will include specific demographic details about the participants, as well as details relevant to the concept, context, study methods and key findings relevant to the review questions. This tool will be piloted on 2 to 3 studies by the review team and amended to ensure that all relevant data can be captured and documented.

The extracted data will include, the author(s), year of publication, study design, population sample size, aim or purpose of the study, study design or source. Participant data captured will include gender,

age, condition, ethnicity, comorbidities, time since injury and any other relevant data as necessary. Related to the concept, the type of aquatic therapy intervention and concept supporting it will be extracted and a TIDieR[46] template used to capture data including what type of aquatic exercise was used, who provided the intervention, how was the intervention delivered, intervention duration, number of sessions, and frequency of aquatic therapy. Context extracted data will include the country where the study took place and whether conducted in a public or private health system. Health outcome domains and related outcome measures will be captured as well as results, patient acceptability, experience, views, barriers, and facilitators.

The draft data extraction tool will be modified and revised iteratively as necessary during the data extraction process. Any modifications will be detailed in the scoping review. Any disagreements or queries that arise between the reviewers during data extraction will be resolved through discussion, or with an additional reviewer. If appropriate, authors of papers will be contacted to request missing or additional data, where required. In keeping with scoping review methodology,[43] no critical appraisal of methodological quality will be conducted in this review.

Data analysis and presentation

The findings of this scoping review will be presented using a range of visual strategies and avoiding the use of dense sections of text to aid interpretation.[47] Narrative text will be used alongside the visual representations to answer the review questions and objective of this scoping review. A table will be included to show the search strategies used across all databases and grey literature to support transparent duplication of the search and a (PRISMA-ScR) flow diagram[44] will be included to visually demonstrate each stage of the article screening process.[44]

The overall objective of this scoping review is to identify existing literature related to aquatic exercise therapy used to manage upper extremity musculoskeletal disorders. To meet this objective, a tabular format will be used to present the characteristics of the included articles and will summarise the author, country, study design, sample size, population details (such as gender, age, condition), concept details (type and content of aquatic therapy, health domain studied and outcome measure reported, and impacts of the intervention). Context details will also be presented to demonstrate the number of studies undertaken by year and condition. A diagrammatic representation of the countries undertaking the studies will also be included.

To answer review question 1, “What musculoskeletal conditions of the upper extremity are managed using aquatic exercise therapy in the adult population and what aquatic exercise concept is used?”, the types of upper extremity musculoskeletal conditions found in the literature will be documented in a graphical format identifying and comparing the number of studies related to each individual upper extremity injury and body area. The TIDieR[46] template findings will be represented in a visual form for representation of the evidence related to question 2, “What is the content of aquatic therapy interventions reported including exercise types, intervention duration, number of sessions and frequency?”. The content of the aquatic exercise programmes will be graphically represented to show exercise type, intervention duration, number of sessions and frequency of sessions by injury type. Stacked bar charts may be utilised to allow comparison of concept data by injury type and will allow a visual demonstration of the gaps in the findings. Health domains and outcome measures identified in the literature will be documented per upper extremity body area when answering review question 3,

"What health domains and outcome measures are used to evaluate the benefit of aquatic therapy?". This will likely be presented in a graphical or diagrammatic format depending upon the review findings.

Question 4, "What has been reported about aquatic-based exercise in the management of musculoskeletal disorders affecting the upper extremity relating to acceptability, experience, views, barriers and facilitators?" will be presented in either a tabular or diagrammatic form depending on the qualitative and quantitative data identified. Any gaps in this information will be represented also. Part of the overall objective of this scoping review is the identification of key concepts, evidence to map practice/research and gaps in the research and this will be described in a narrative form. The proposed data presentation described above will be amended as required once the findings from this scoping review become more evident.

Acknowledgements

None

Funding

No funding was received by any author specifically relevant to this manuscript.

Declarations

L Murray is a specialist musculoskeletal physiotherapist and leads the aquatic therapy service within NHS Grampian. LA is a member of the JBI Scoping review methodology group and Deputy Director of the Scottish Centre for Evidence-based, Multi-professional Practice: a JBI Centre of Excellence. L Mair is an information Specialist within NHS Grampian.

Author contributions

All authors contributed to the authorship of this manuscript.

Conflicts of interest

There are no conflicts of interest in this project.

References

(1) World Health Organisation. Musculoskeletal health fact sheet. [Internet] World Health Organisation; 2022 [Cited 2022 August 11]; Available at: https://www.who.int/news-room/fact-sheets/detail/musculoskeletal-conditions.

(2) Cieza A, Causey K, Kamenov K, Hanson SW, Chatterji S, Vos T. Global estimates of the need for rehabilitation based on the Global Burden of Disease study 2019: a systematic analysis for the Global Burden of Disease Study 2019. Lancet 2020;396(10267):2006-2017.

(3) Luime JJ, Koes BW, Hendriksen I, Burdorf A, Verhagen AP, Miedema HS, et al. Prevalence and incidence of shoulder pain in the general population; a systematic review. Scand J Rheumatol 2004;33(2):73-81.

(4) Hodgetts CJ, Leboeuf-Yde C, Beynon A, Walker BF. Shoulder pain prevalence by age and within occupational groups: a systematic review. Archives of Physiotherapy 2021 Nov 4;11(1):24.

(5) Urwin M, Symmons D, Allison T, Brammah T, Busby H, Roxby M, et al. Estimating the burden of musculoskeletal disorders in the community: the comparative prevalence of symptoms at different anatomical sites, and the relation to social deprivation. Ann Rheum Dis 1998;57(11):649-655.

(6) Kraan RBJ, de Nobel D, Eygendaal D, Daams J, Kuijer, P. Paul F. M, Maas M. Incidence, prevalence, and risk factors for elbow and shoulder overuse injuries in youth athletes: A systematic review. Translational sports medicine 2019;2(4):186-195.

(7) Mulders MAM, Sulkers GSI, Videler AJ, Strackee SD, Smeulders MJC. Long-Term Functional Results of a Wrist Exercise Program for Patients with Palmar Midcarpal Instability. Journal of wrist surgery; Jnl Wrist Surg 2018;7(3):211-218.

(8) Stathopoulos N, Dimitriadis Z, Koumantakis GA. Effectiveness of Mulligan's mobilization with movement techniques on pain and disability of peripheral joints: a systematic review with meta-analysis between 2008–2017. Physiotherapy 2019;105(1):1-9.

(9) Page MJ, Green S, Mrocki MA, Surace SJ, Deitch J, McBain B, et al. Electrotherapy modalities for rotator cuff disease. Cochrane Database Syst Rev 2016;2016(6):CD012225.

(10) Buhler M, Chapple CM, Stebbings S, Sangelaji B, Baxter GD. Effectiveness of splinting for pain and function in people with thumb carpometacarpal osteoarthritis: a systematic review with meta-analysis. Osteoarthritis and Cartilage 2019;27(4):547-559.

(11) Struijs P, Smidt N, Arola H, van Dijk CN, Buchbinder R, Assendelft W. Orthotic devices for the treatment of tennis elbow. Cochrane Database of Systematic Reviews 2002(1).

(12) Jones S, Hanchard N, Hamilton S, Rangan A. A qualitative study of patients' perceptions and priorities when living with primary frozen shoulder. BMJ open; BMJ Open 2013;3(9):e003452.

(13) Brady B, Redfern J, Macdougal G, Williams J. The addition of aquatic therapy to rehabilitation following surgical rotator cuff repair: a feasibility study. Physiother Res Int 2008;13(3):153-161.

(14) Jackson R. Waters and spas in the classical world. Med Hist Suppl 1990(10):1-13.

(15) Corvillo I, Armijo F, Álvarez-Badillo A, Armijo O, Varela E, Maraver F. Efficacy of aquatic therapy for neck pain: a systematic review. Int J Biometeorol 2019;64(6):915-925.

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

(17) Carayannopoulos AG, Han A, Burdenko IN. The benefits of combining water and land-based therapy. Journal of exercise rehabilitation; J Exerc Rehabil 2020;16(1):20-26.

(18) Laedermann A, Kadri F, Cikes A. Evaluation of 3 different rehabilitation protocols after rotator cuff repair, and the effectiveness of pool therapy: a randomized control study. Orthopaedic journal of sports medicine 2021;9(2):2325967121.

(19) Dziedzic K, PhD., Jordan, Joanne L., BSc,M.Sc, M.A., Foster, Nadine E., DPhil,B.Sc (Hons). Land- and water-based exercise therapies for musculoskeletal conditions. Best practice & research. Clinical rheumatology; Best Pract Res Clin Rheumatol 2008;22(3):407-418.

(20) Bartels EM, Juhl CB, Christensen R, Hagen KB, Danneskiold-Samsøe B, Dagfinrud H, et al. Aquatic exercise for the treatment of knee and hip osteoarthritis. Cochrane Database Syst Rev 2016;2016(3):CD005523.

(21) Aquatic Therapy Association of Chartered Physiotherapists. Guidance on Aquatic Physiotherapy Practice 2021. London. The Chartered Society of Physiotherapy 2021.

(22) Villalta EM, B.Phys, Peiris CL, B.Phys. Early Aquatic Physical Therapy Improves Function and Does Not Increase Risk of Wound-Related Adverse Events for Adults After Orthopedic Surgery: A Systematic Review and Meta-Analysis. Arch Phys Med Rehabil 2013;94(1):138-148.

(23) Szekeres M, MacDermid JC, Birmingham T, Grewal R, Lalone E. The Effect of Therapeutic Whirlpool and Hot Packs on Hand Volume During Rehabilitation After Distal Radius Fracture: A Blinded Randomized Controlled Trial. Hand (New York, N.Y.) 2017 May;12(3):265-271.

(24) Bender T, Karagülle Z, Bálint G,P., Gutenbrunner C, Bálint P,V., Sukenik S. Hydrotherapy, balneotherapy, and spa treatment in pain management. Rheumatol Int 2005;25(3):220-224.

(25) Verhagen AP, Cardoso JR, Bierma-Zeinstra SMA. Aquatic exercise & balneotherapy in musculoskeletal conditions. Best Practice & Research Clinical Rheumatology 2012;26(3):335-343.

(26) Yolgösteren E, Külekçioğlu S. The effectiveness of balneotherapy and thermal aquatic exercise in postoperative persistent lumbar pain syndrome. Int J Biometeorol 2021;65(12):2137-2145.

(27) Naumann J, Sadaghiani C. Therapeutic benefit of balneotherapy and hydrotherapy in the management of fibromyalgia syndrome: a qualitative systematic review and meta-analysis of randomized controlled trials. Arthritis research & therapy; Arthritis Res Ther 2014;16(4):R141.

(28) Australian Physiotherapy Association Aquatic Physiotherapy Group. Guidelines for physiotherapists working in and/or managing hydrotherapy pools. 2nd ed. Camberwell. Australian Physiotherapy Association. 2015.

(29) Macías-Hernández SI, Vázquez-Torres L, Morones-Alba J, Coronado-Zarco R, de Los Angeles Soria-Bastida, María, Cruz-Medina E, et al. Water-based Tai Chi : theoretical benefits in musculoskeletal diseases. Current evidence. Journal of exercise rehabilitation; J Exerc Rehabil 2015;11(3):120-124.

(30) Cuesta-Vargas A, García-Romero JC, Arroyo-Morales M, Diego-Acosta A, Daly DJ. Exercise, manual therapy, and education with or without high-intensity deep-water running for nonspecific chronic low back pain: a pragmatic randomized controlled trial. Am J Phys Med Rehabil 2011;90(7):526-538.

(31) Reilly T, Dowzer CN, Cable N. The physiology of deep-water running. Journal of sports sciences 2003 Dec 1;21(12):959-972.

(32) Schitter AM, Fleckenstein J, Frei P, Taeymans J, Kurpiers N, Radlinger L. Applications, indications, and effects of passive hydrotherapy WATSU (WaterShiatsu)—A systematic review and meta-analysis. PloS one 2020;15(3):e0229705.

(33) Teng M, Zhou HJ, Lin L, Lim PH, Yeo D, Goh S, et al. Cost-effectiveness of hydrotherapy versus land-based therapy in patients with musculoskeletal disorders in Singapore. Journal of public health (Oxford, England) 2019 Jun 1;41(2):391-398.

(34) Peters MDJ, Godfrey C, McInerney P, Munn Z, Tricco AC, Khalil, H. Chapter 11: Scoping Reviews (2020 version). JBI Manual for Evidence Synthesis, JBI, 2020.

(35) Bidonde J, Busch AJ, Webber SC, Schachter CL, Danyliw A, Overend TJ, et al. Aquatic exercise training for fibromyalgia. Cochrane Database of Systematic Reviews 2014(10).

(36) Gibson AJ, Shields N. Effects of Aquatic Therapy and Land-Based Therapy versus Land-Based Therapy Alone on Range of Motion, Edema, and Function after Hip or Knee Replacement: A Systematic Review and Meta-analysis. Physiother Can 2015;67(2):133-141.

(37) Olson DA, Kolber MJ, Patel C, Pabian P, Hanney WJ. Aquatic Exercise for Treatment of Low-Back Pain: A Systematic Review of Randomized Controlled Trials. American journal of lifestyle medicine 2013;7(2):154-160.

(38) Hall, Jane, PhD,M.Phil, M.C.S.P., Swinkels, Annette,PhD., M.C.S.P., Briddon, Jason,M.A., M.C.L.I.P., McCabe, Candida S.,PhD., R.G.N. Does Aquatic Exercise Relieve Pain in Adults With Neurologic or Musculoskeletal Disease? A Systematic Review and Meta-Analysis of Randomized Controlled Trials. Arch Phys Med Rehabil 2008;89(5):873-883.

(39) Barker AL, PhD., Talevski, Jason,B.Health Sci (Public Health), Morello RT, M.P.H., Brand CA, M.P.H., Rahmann AE, PhD., Urquhart DM, PhD. Effectiveness of Aquatic Exercise for Musculoskeletal Conditions: A Meta-Analysis. Arch Phys Med Rehabil 2014;95(9):1776-1786.

(40) Leininger, P.M., Kearney, D.P., Lumia, R.J., Siegel, E.F. and Szemenyei, S. Effectiveness of Aquatic Therapy on Increasing Range of Motion and Decreasing Pain in the Rehabilitation of Patients With Shoulder Pathologies: A Systematic Review. The Journal of Aquatic Physical Therapy 2018;26(3):45.

(41) Comprehensive Cancer Information - National Cancer Institute. 1980; Available at: https://www.cancer.gov/. Accessed Apr 21, 2022.

(42) United Nations Development Programme. Human Development Report 2020: The Next Frontier—Human Development and the Anthropocene. 2020 December 15.

(43) Peters MDJ, Marnie C, Tricco AC, Pollock D, Munn Z, Alexander L, et al. Updated methodological guidance for the conduct of scoping reviews. JBI evidence implementation 2021 Mar;19(1):3-10.

(44) Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, et al. PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation. Annals of internal medicine 2018 Oct 2,;169(7):467-473.

(45) Veritas Health Innovation, Melbourne, Australia. Covidence systematic review software. Available at www.covidence.org.

(46) Hoffmann TC, Glasziou PP, Boutron I, Milne R, Perera R, Moher D, et al. Better reporting of interventions: template for intervention description and replication (TIDieR) checklist and guide. BMJ : British Medical Journal 2014 Mar 7,;348(mar07 3):g1687.

(47) Lockwood C, dos Santos KB, Pap R. Practical Guidance for Knowledge Synthesis: Scoping Review Methods. Asian nursing research 2019;13(5):287-294.

Appendices

Appendix I: Search strategy

Database:

Ovid MEDLINE(R) ALL <1946 to May 09, 2022>

#	Query	Results from 10 May 2022
1	Hydrotherapy/	2,622
2	Aquatic Therapy/	13
3	Balneology/	5,898
4	(hydrotherap* or balneotherapy or balneology or balneopathy).ab,kf,ti.	4,250
5	((aqua* adj4 exercis*) or (aqua* adj4 therap*) or (aqua* adj4 physiotherap*) or (aqua* adj4 physical therap*) or (aqua* adj4 rehabilitat*) or (aqua* adj4 train*)).ab,kf,ti.	1,228
6	((water* adj4 exercis*) or (water* adj4 therap*) or (water* adj4 physiotherap*) or (water* adj4 physical therap*) or (water* adj4 rehabilitat*) or (water* adj4 train*)).ab,kf,ti.	5,123
7	((aqua* adj4 ai chi) or (aqua* adj4 aichi) or (aqua* adj4 tai chi) or (aqua* adj4 taichi) or (aqua* adj4 running) or (aqua* adj4 aerobic*) or (aqua* adj4 fitness)).ab,kf,ti.	284
8	((water* adj4 ai chi) or (water* adj4 aichi) or (water* adj4 tai chi) or (water* adj4 taichi) or (water* adj4 shiatsu) or Halliwick* or Burdenko* or "Bad Ragaz*" or watershiatsu or watsu or deep water running or (water* adj4 aerobic*) or (water* adj4 fitness)).ab,kf,ti.	1,204
9	(pool therap* or whirlpool or water bath*).ab,kf,ti.	5,647
10	or/1-9	21.040
11	upper extremity/ or arm/ or axilla/ or elbow/ or forearm/ or hand/ or fingers/ or thumb/ or metacarpus/ or shoulder/ or wrist/	180,406
12	"bones of upper extremity"/ or arm bones/ or humerus/ or humeral head/ or radius/ or ulna/ or olecranon process/ or clavicle/ or hand bones/ or carpal bones/ or capitate bone/ or hamate bone/ or lunate bone/ or pisiform bone/ or scaphoid bone/ or trapezium bone/ or trapezoid bone/ or triquetrum bone/ or finger phalanges/ or metacarpal bones/ or scapula/ or acromion/ or coracoid process/ or glenoid cavity/	50,084

13	shoulder injuries/ or rotator cuff injuries/ or shoulder dislocation/ or shoulder fractures/ or bankart lesions/ or shoulder impingement syndrome/	20,961
14	arm injuries/ or forearm injuries/ or radius fractures/ or ulna fractures/ or humeral fractures/ or tennis elbow/ or monteggia's fracture/ or colles' fracture/	28,925
15	shoulder pain/	5,529
16	deltoid muscle/ or pectoralis muscles/ or rotator cuff/	12,289
17	acromioclavicular joint/ or elbow joint/ or hand joints/ or carpal joints/ or carpometacarpal joints/ or finger joint/ or metacarpophalangeal joint/ or palmar plate/ or wrist joint/ or triangular fibrocartilage/ or shoulder joint/	55,513
18	bursitis/	3,722
19	brachial plexus/ or median nerve/ or musculocutaneous nerve/ or radial nerve/ or ulnar nerve/	25,714
20	elbow tendinopathy/	57
21	median neuropathy/ or carpal tunnel syndrome/ or radial neuropathy/ or ulnar neuropathies/ or cubital tunnel syndrome/ or ulnar nerve compression syndromes/	11,882
22	Wrist Injuries/	6,652
23	hand injuries/ or finger injuries/	18,946
24	de quervain disease/ or trigger finger disorder/	848
25	Dupuytren Contracture/	2,844
26	(upper extremit* or upper limb* or shoulder* or arm or arms or axilla or forearm* or wrist* or hand or hands or finger* or forefinger* or thumb* or digit or digits).ab,kf,ti.	969,666
27	(humerus or humeral or radius or radial head or ulna or ulnar or ulnal or olecranon or clavicle or hamate or lunate or capitate or pisiform or scaphoid or trapezium or trapezoid or triquetrum or phalan* or metacarp* or carpal or carpus or scapula or acromion or coracoid or glenoid or glenohumeral or radioulnar or radiocarpal or acromioclavicular or sternoclavicular or glenoid or labral or labrum).ab,kf,ti.	173,725
28	(bankart* or SLAP lesion* or SLAP tear or monteggia* or perilunate).ab,kf,ti.	3,688
29	(rotator cuff* or deltoid or pectoralis or biceps or triceps).ab,kf,ti.	46,010
30	bursitis.ab,kf,ti.	3,252
31	(brachial plexus or median nerve or musculocutaneous nerve).ab,kf,ti.	22,561

32	elbow*.ab,kf,ti.	37,659
33	adhesive capsulitis.ab,kf,ti.	1,142
34	(interphalangeal or inter phalangeal or metacarpophalangeal or carpometacarpal or metacarpophalangeal or radiocarpal or palmar plate* or volar plate* or triangular fibrocartilage).ab,kf,ti.	15,654
35	("de quervain*" or dequervain* or trigger finger*).ab,kf,ti.	1,800
36	dupuytren*.ab,kf,ti.	3,135
37	(flexor* or extensor*).ab,kf,ti.	51,088
38	or/11-37	1,218,400
39	10 and 38	1,234

Appendix II: Data extraction instrument

		Extracted Data
Author, Year		
Country		
Private or public health		
Study design/source		
Aim/purpose		
Participants	Gender	
	Age	
	Condition	
	Ethnicity	
	Comorbidities	
	Time since injury/Chronicity	
	Other	
TIDieR Template	Brief name of intervention	

	Why	
	What	
	Who provided	
	How	
	Where/setting	
	When and how much	
	Tailoring	
	Modifications	
	How well planned	
	How well actual	
Domain		
Outcome measures		
Results		
Patient acceptability		
Patient experience		
Views		
Barriers		
Facilitators		
Author conclusions		
Comments		