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UNA REVISIÓN DE ALCANCE DE LA PROGRAMACIÓN DE EJERCICIOS DE LA ARTHRITIS FOUNDATION

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Resumo
Antecedentes: A artrite afeta 1 em cada 4 adultos nos EUA, com prevalência aumentando com a idade. O exercício é um dos tratamentos não invasivos mais eficazes para os sintomas relacionados à artrite. Para facilitar a participação em exercícios apropriados para esta população, a Arthritis Foundation criou uma série de programas de exercícios para indivíduos com artrite, incluindo o Programa de Exercícios da Arthritis Foundation (AFEP), o Programa de Exercícios Aquáticos da Arthritis Foundation (AFAP) e Pessoas com artrite podem se exercitar e caminhar. Com facilidade AFEP.
Objetivos: O objetivo deste projeto foi revisar sistematicamente a literatura revisada por pares para relatar qualitativamente os efeitos e o impacto da participação no AFEP e no AFAP entre indivíduos com artrite. Nosso objetivo foi fornecer um resumo descritivo dos resultados avaliados durante a participação nesses programas para estabelecer áreas de evidências existentes e identificar lacunas relacionadas à eficácia da AFEP e da AFAP no manejo da artrite que devem ser abordadas em estudos futuros.
Método: Duas revisões de escopo independentes foram realizadas para descrever a literatura existente sobre os efeitos da participação em 1) AFEP e 2) AFAP. Os artigos revisados incluíram avaliação dos sintomas da artrite, aptidão física, função, atividades da vida diária e adesão ao exercício.
Resultados: Oito dos 1.578 artigos da AFEP e oito dos 511 artigos da AFAP atenderam aos critérios de inclusão. A programação AFEP e AFAP encontrou melhorias gerais, mas houve resultados equívocos para muitos dos sintomas característicos da artrite, incluindo dor, flexibilidade/ADM, mobilidade funcional, força e resistência muscular, equilíbrio, capacidade aeróbica, qualidade de vida e autoeficácia.
Conclusões: Foram identificadas muitas lacunas na investigação que devem ser abordadas em estudos futuros para determinar a eficácia da AFEP e da AFAP no tratamento da artrite.
Palavras-chave: fitness, exercício aquático, função, tratamento da artrite, tratamento da dor

A Scoping Review of Arthritis Foundation Programming.
Background: Arthritis impacts 1 in 4 adults in the US with prevalence increasing with age. Exercise is one of the most effective, non-invasive treatments for arthritis-related symptoms. To facilitate participation in appropriate exercise for this population, the Arthritis Foundation created a series of exercise programs for individuals with arthritis including the A*rthritis Foundation Exercise Program (AFEP), Arthritis Foundation Aquatic Exercise Program (AFAP),* and *People with Arthritis Can Exercise and Walk With Ease AFEP*.
Goals: The goal of this project was to systematically review peer-reviewed literature to qualitatively report the effects and impact of participation in AFEP and AFAP among individuals with arthritis. Our objective was to provide a descriptive summary of the outcomes assessed when participating in these programs to establish areas of existing evidence and identify gaps related to the efficacy of AFEP and AFAP in arthritis management that should be addressed in future studies.
Method: Two independent scoping reviews were conducted to describe the existing literature on the effects of participating in 1) AFEP and 2) AFAP. Articles reviewed included assessment of arthritis symptoms, physical fitness, function, activities of daily living and exercise compliance.
Results: Seven of the 1,578 AFEP and eight of the 511 AFAP articles met the inclusion criteria. AFEP and AFAP programming found improvements overall, but there were equivocal results for many of the hallmark symptoms of arthritis, including pain, flexibility/ROM, functional mobility, muscular strength and endurance, balance, aerobic capacity, quality of life and self efficacy.
Conclusions: Many gaps in the research have been identified that should be addressed in future studies to determine the efficacy of AFEP and AFAP in arthritis management.
Keywords: fitness, aquatic exercise, function, arthritis management, pain management.

Resumen: Una revisión exploratoria de la programación de la Arthritis Foundation.
Antecedentes: La artritis afecta a 1 de cada 4 adultos en los EE. UU. y la prevalencia aumenta con la edad. El ejercicio es uno de los tratamientos no invasivos más eficaces para los síntomas relacionados con la artritis. Para facilitar la participación en el ejercicio adecuado para esta población, la Arthritis Foundation creó una serie de programas de ejercicios para personas con artritis, incluidos el Programa de ejercicios de la Arthritis Foundation (AFEP), el Programa de ejercicios acuáticos de la Arthritis Foundation (AFAP) y la AFEP Las personas con artritis pueden hacer ejercicio y caminar con facilidad.
Objetivos: El objetivo de este proyecto fue revisar sistemáticamente la literatura revisada por pares para informar cualitativamente los efectos y el impacto de la participación en AFEP y AFAP entre las personas con artritis. Nuestro objetivo fue proporcionar un resumen descriptivo de los resultados evaluados al participar en estos programas para establecer áreas de evidencia existente e identificar brechas relacionadas con la eficacia de AFEP y AFAP en el manejo de la artritis que deben abordarse en estudios futuros.
Método: Se realizaron dos revisiones exploratorias independientes para describir la literatura existente sobre los efectos de participar en 1) AFEP y 2) AFAP. Los artículos revisados incluyeron la evaluación de los síntomas de la artritis, la aptitud física, la función, las actividades de la vida diaria y el cumplimiento del ejercicio.
Resultados: Ocho de los 1.578 artículos de la AFEP y ocho de los 511 de la AFAP cumplieron los criterios de inclusión. La programación de AFEP y AFAP encontró mejoras en general, pero hubo resultados equívocos para muchos de los síntomas característicos de la artritis, incluido el dolor, la flexibilidad/ROM, la movilidad funcional, la fuerza y resistencia muscular, el equilibrio, la capacidad aeróbica, la calidad de vida y la autoeficacia.
Conclusiones: Se han identificado muchas lagunas en la investigación que deben abordarse en futuros estudios para determinar la eficacia de la AFEP y la AFAP en el manejo de la artritis.
Palabras clave: fitness, ejercicio acuático, función, manejo de la artritis, manejo del dolor.

Introduction

Arthritis is an overarching term for a collection of more than 100 diseases and disorders that have different pathologies, but often similar signs and symptoms. Arthritis affects nearly a quarter of the population (Barbour et al., 2017) from children to older adults, and recent estimates indicate increased prevalence over the next few decades (Hootman et al., 2016). While arthritis impacts a wide spectrum of ages, prevalence and impact are noted to increase with age (Barbour et al., 2017). Symptoms range in severity and can typically include pain, redness, swelling, decreased mobility, diminished function, and increased risk of developing additional chronic diseases such as hypertension, heart disease, diabetes, and cancer (Barbour et al., 2017). These hallmark symptoms often lead to limitations in completing common activities of daily living (ADL) with nearly half (43.5%) of individuals diagnosed with arthritis reporting some limitation in their daily lives (Barbour et al., 2017). Pain is noted to be the primary symptom resulting in motivation to seek medical care and concluding in disability (Barbour et al. 2016; Kennedy et al., 2014).

With no cure available, management of arthritis and its related symptoms is multifactorial, commonly including medication (e.g., NSAIDs, corticosteroids, analgesics, and disease-modifying antirheumatic drugs) as well as nonpharmacological treatments comprised of therapy, surgery, weight loss, and exercise. Indeed, exercise is one of the most effective, non-invasive treatments for arthritis-related symptoms (Ambrose & Golightly, 2015). Habitual exercise elicits many favorable outcomes for those affected by arthritis including reducing pain, increasing the range of motion of affected joints, improving strength, and increasing mobility (Lee et al., 2006; Valderrabano & Steiger, 2011). Resistance training can increase muscle strength and power, which can help with joint stability (Hall et al., 2017), while aerobic exercise, such as walking, cycling, and aquatic classes can reduce pain and improve functional status and gait (Resnick, 2001).

To facilitate the adoption of appropriate exercise for this population, the Arthritis Foundation created a series of exercise programs for individuals with arthritis including the Ar*thritis Foundation Exercise Program (AFEP), Arthritis Foundation Aquatic Exercise Program (AFAP), Walk With Ease AFEP,* and previously *People with Arthritis Can Exercise (PACE).* The *Arthritis Foundation Exercise Program* (AFEP) is a land-based exercise program designed to provide individuals with arthritis a safe program to manage and reduce the symptoms of arthritis. It includes a warm-up, a main segment that can include cardiovascular, strengthening, range of motion, balance, flexibility, and coordination exercises, and finishes with a cool-down. AFEP is designed to be adjusted to various needs of those with arthritis and arthritis-related diseases while focusing on flexibility, strength, balance, coordination, muscular strength and endurance, and cardiorespiratory endurance. Further, AFEP aims to educate participants on the importance of exercise and how to perform exercises safely while instilling confidence in an environment that is inclusive, enjoyable, and safe to exercise while alleviating the symptoms of arthritis.

Similar to AFEP, AFAP is a community-based program designed to reduce arthritis-related symptoms and increase muscle strength and endurance, flexibility, functional status, and self-confidence while reducing fatigue and pain. The AFAP utilizes the unique properties of water to enhance the experience and outcomes of exercise for those with arthritis. Aquatic exercise has been noted as one of the most beneficial forms of exercise for treatment of arthritis (Dong et al., 2018). The unique properties of water can help control and reduce arthritis-related symptoms while promoting muscular strength and endurance as well as overall function (Johnson et al., 2019). For example, hydrostatic pressure redistributes excess fluid to remedy edema and water's enhanced heat conduction can aid in the control of inflammation, muscle spasm, and muscle tension (Kinnaird & Becker, 2008). The viscous property of water provides both support and resistance to improve balance while increasing muscle activity; buoyancy creates an offloading effect that provides ease with movement, reductions in pain, and increased physical activity levels (Becker, 2009). Specific programming capitalizing on the advantages of the aquatic environment, designed to focus on the needs of those with arthritis and arthritis-related diseases, including the Arthritis Foundation Aquatic Program (AFAP), are promoted by the Center for Disease Control (CDC) and the Arthritis Foundation (Center for Disease Control and Prevention, 2021).

While previous research has examined the effects of participating in AFEP and AFAP among individuals with arthritis, the scope and impact of these programs has not been thoroughly reviewed. Therefore, the aim of this paper was to systematically review peer-reviewed literature to qualitatively report the effects and impact of participation in AFEP and AFAP among individuals with arthritis. Our objective was to provide a descriptive summary of the outcomes assessed when participating in these programs to establish areas of existing evidence and identify gaps related to the efficacy of AFEP and AFAP in arthritis management that should be addressed in future studies.

Methods

Two independent scoping reviews were conducted following established scoping review methodology (Peters et al., 2015) to describe the existing literature on the effects of participating in 1) AFEP and 2) AFAP among individuals with arthritis. Independent literature searches were conducted between February 2021 and March 2021 for articles related to 1) AFEP and 2) AFAP. Databases included PubMed and Google Scholar; English language, but not date, restrictions were used. Literature identified through the search was screened for duplicates and relevance. Full text articles were reviewed for inclusion eligibility and the final body of literature was determined. A descriptive charting of the results was conducted and refined.

AFEP

On February 15th, 2021 a search on Pubmed was conducted using the search terms ("Arthritis foundation" AND exercise) from which 485 articles were identified. On February 27, 2021 a search on Google Scholar was conducted using the search terms ((AFEP OR arthritis) AND exercise) from which 46 articles were identified. On March 9, 2021 a search on Google Scholar was conducted using the search terms (YMCA arthritis foundation) and excluded (aquatic OR water OR hydro OR aqua OR aquatics) from which 928 articles were identified. On March 17, 2021 a search on Google Scholar was conducted using the search terms (Arthritis foundation exercise program) from which 119 articles were identified. In total, 1,578 articles were identified (Figure 1). Articles were extracted into an excel spreadsheet, checked for duplicates, and screened independently by duplicate reviewers for eligibility. Articles were excluded if they didn't specifically use the Arthritis Foundation Exercise Program as an experimental group in the research study. Titles, abstracts, and full text portions were reviewed to determine final articles for analysis. Data from relevant peer-reviewed literature was extracted including: study design, objective, measurements, and results. Significant and non-significant (NS) findings were reported.

AFAP

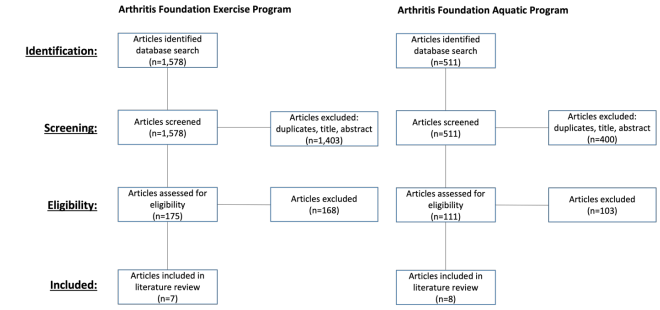
On February 18th, 2021 a search on PubMed for "("arthritis foundation" AND "aquatics")" found no results while a search on Google Scholar identified 511 titles. On March 14th, a search on PubMed and Google Scholar for ("arthritis foundation YMCA aquatic exercise program") did not provide any new articles. Articles were extracted into an excel spreadsheet, checked for duplicates, and screened for eligibility by two independent reviewers. Titles, abstracts, and fill text portions were reviewed by duplicate reviewers to determine final articles for analysis.

Specific inclusion criteria were any articles that mentioned the AFAP program. Articles were excluded if they were theses, literature reviews, or if they did not use the AFAP program as their intervention method in their study. Data from relevant peer-reviewed articles was extracted including objective, measurements, study design, and results. Significant and non-significant (NS) findings were reported.

Results

Figure 1

Flow diagram of research studies of the Arthritis Foundation Exercise Program (AFEP) and Arthritis Foundation Aquatics Program (AFAP)



AFEP

Of the 1,578 articles identified, 1,570 were removed for incomplete inclusion criteria. The remaining 8 articles were found to meet all inclusion criteria, specifically, use of AFEP; however, one was excluded (Mays et al., 2021) because data was pooled from 4 different community-based exercise programs and the outcomes specific to participation in AFEP could not be determined (Figure 1). The included studies had participants ranging from age 18 to 91 years old and included osteoarthritis, rheumatoid arthritis, and self-reported arthritis (Table 1). The articles included in this review were comprised of various intervention strategies which range from 8 – 10 weeks with 45 – 75 minute classes (Table 1).

Participating in AFEP elicited increased upper and lower body strength (Callahan et al., 2008), decreased blood pressure (Zgibor et al., 2017) and risk of falls (Schlenk et al., 2016), and reduced the number of poor mental health days (Freburger et al., 2010) as well as limited activity days (Freburger et al., 2010). Participants of AFEP with hypertension at baseline had controlled hypertension at 6 months and improved control of diabetes (Zgibor et al., 2017). Sleep quality was measured in two studies (Freburger et al., 2010; McManus et al., 2015) and found fewer sleep disturbances (McManus et al., 2015), decreased likelihood of waking up in the middle of the night, and diminished likelihood of waking up tired (Freburger et al., 2010). Two studies reported positive participant feedback, noting participants were satisfied with the exercise program, rated the instructors as excellent or very good, and would recommend it to a friend (Schlenk et al., 2016; Roncone, 2013).

AFEP did not modify balance, mobility, endurance, depressive symptoms or perceived helplessness (Callahan et al., 2008). Across studies, there were equivocal results for arthritis related pain (Callahan et al., 2008; McManus et al., 2015; McManus, 2013; Schlenk et al., 2016; Zgibor et al., 2017), stiffness (Callahan et al., 2008; Schlenk et al., 2016; Zgibor et al., 2017), and function (Callahan et al., 2008; Zgibor et al., 2017) as well as self-efficacy (Callahan et al., 2008; McManus, 2013; Roncone, 2013) and physical activity (Callahan et al., 2008; Freburger et al., 2010; Schlenk et al., 2016) with some studies showing improvements or declines, and others showing no significant effects.

Two studies examined the efficacy of participating in the Arthritis Foundation Exercise Program with or without including "10 Keys to Healthy Aging" (10 KHA) program (an educational program promoting actions and choices individuals can make to achieve a healthier lifestyle) (Schlenk et al., 2016; Zgibor et al., 2017). Those that completed AFEP +10 KHA showed decreased risk of falls (Schlenk et al., 2016) and systolic blood pressure (Zgibor et al., 2017). One study found improved arthritis related pain and function (Zgibor et al., 2017) while another found no significant effect on pain or stiffness (Schlenk et al., 2016). Participants with hypertension at baseline had controlled hypertension and showed improved control of their diabetes (Zgibor et al., 2017), but no significant effects on fasting blood glucose (Schlenk et al., 2016). However, there were no differences between completing the AFEP alone and completing the AFEP +10 KHA (Zgibor et al., 2017).

Table 1. Review of Studies for AFEP

Author	Study Design	Participants	Intervention	Measures	Results
Schlenk, et al. 2016	Pre-post pilot/feasibility study	N= 53, average age = 75.5 y (10.9 SD) self-reported osteoarthritis with no medical contraindications 73% arthritis diagnosis	AFEP + 10 KHA 10 wk w/ 1-2 75 min classes/wk.	Attendance, adherence, satisfaction Preventive measures – smoking status, cancer screening, immunizations, physical activity, musculoskeletal health, social contact, and combating depression WOMAC; Fasting blood glucose; Fasting LDL cholesterol	75% attended >50% of sessions; 53% adherence at 6 mo, 54% adherence at 12 mo; 97% highly rated satisfaction; NS preventive measures; ↓ risk of falls; ↓ physical activity; NS pain and stiffness (WOMAC); NS fasting blood glucose; NS LDL
Zgibor, et al. 2017	Cluster-randomized trial comparing AFEP vs. AFEP + 10 KHA	N=462, 73 y with self-reported osteoarthritis, no medical contraindications	AFEP vs. AFEP + 10 KHA	Height; Weight; Blood pressure; Fasting glucose; SPPB; WOMAC	NS between groups all measures Within group, pre-post: AFEP: improved physical function (SPPB), Arthritis related pain, stiffness, and function (WOMAC), SBP, controlled HT, controlled diabetes; AFEP +10 KHA: improved Arthritis related pain and function (WOMAC), SBP, controlled HT, controlled diabetes
McManus, Vlieland and Cox 2014	Convenience sample comparison study AFEP vs. Control	AFEP n=19 ,76-91 y Control n=20, 55-98 y with rheumatoid arthritis	AFEP classes 2x/wk vs. no intervention Control 8 wk.	Rheumatoid Arthritis Pain Scale (RAPS) Pittsburgh Sleep Quality Index (PSQI)	↓ Pain (RAPS) AFEP vs. Control ↑ Sleep (PSQI) AFEP vs. Control
Callahan, et al. 2008	Randomized Controlled Trial PACE vs. Control with delayed intervention	N=346, average age 70 y with self-reported arthritis	PACE classes 2x/wk vs. no intervention Control 8 wk.	Pain, Stiffness, Fatigue; Health Assessment Questionnaire disability scale; 10-pound lifts; Timed chair stands; Timed 360-degree turn; Gait speed test; 6-minute walk test ; Physical Activity Scale for the Elderly (PASE); Rheumatoid Arthritis Self-efficacy (RASE); Self-efficacy for Physical Activity (SEPA); Center for Epidemiological Studies Depression Scale (CES-D); Helplessness Subscale of the Rheumatology Attitudes Index (RAI)	↓ Pain, Fatigue AFEP vs. Control; Improved Arthritis Self-Efficacy (RASE) AFEP vs. Control; ↑ Lower Body Strength (Timed chair stands) AFEP vs. Control; ↑ Upper Body Strength (10 pound lifts) AFEP vs. Control; NS Stiffness, Self-reported function (HAQ), Standing Balance (timed 360 turn), Functional mobility (walking speed, normal and fast), Aerobic endurance (6 min walk test), Physical Activity Level (PASE), Physical activity self-efficacy (SEPA), Depressive symptoms (CES-D), Perceived Helplessness (RAI)
McManus K. 2014	Convenience sample control trial	AFEP n=13 Control n=14 All 55-81 y with rheumatoid arthritis	AFEP classes vs. no intervention Control 8 wk.	Arthritis Self-efficacy Scale (ASES-8) Rheumatoid Arthritis Pain Scale (RAPS)	NS Self-efficacy ↓ Pain (RAPS) AFEP vs. Control
Freburger, et al.2010	Randomized Controlled Trial vs. Control with delayed intervention	N=346, age 18+ with self-reported arthritis.	PACE classes 2x/wk vs. no intervention Control 8 wk.	4-item Self-reported Sleep quality 5 items from Health Related Quality of Life Scale (HRQoL)	NS Trouble falling asleep (self-reported sleep quality); ↓ Waking up at night (self-reported sleep quality); NS Trouble staying asleep (self-reported sleep quality); ↓ likelihood of waking up tired (self-reported sleep quality); NS Overall health (HRQoL); NS Physical health (HRQoL); ↓ Poor mental health days (HRQoL); ↓ Limited activity days (HRQoL)

***** Abreviations: KHA, Keys of Healthy Aging; WOMAC, Western Ontario and McMaster Universities Osteoarthritis Index; SPPB, Short Physical Performance Battery; SBP, Systolic Blood Pressure; RAPS, Rheumatoid Arthritis Pain Scale; PSQI, Pittsburgh Sleep Quality Index; PACE, People with Arthritis Can Exercise; PASE, Physical Activity Scale for the Elderly; RASE, Rheumatoid Arthritis Self-efficacy; SEPA, Self-efficacy for Physical Activity; CES-D, Center for Epidemiological Studies Depression Scale; RAI, Helplessness Subscale of the Rheumatology Attitudes Index; ASES-8, Arthritis Self-efficacy Scale; HRQoL, Health-Related Quality of Life Scale.

AFAP

Of the 511 articles identified, 503 were removed for incomplete inclusion criteria. The remaining 8 articles were found to meet all inclusion criteria, specifically, use of AFAP (Figure 1). The included studies had participants ranging from age 4 to 91 years of age and included osteoarthritis (OA), rheumatoid (RA), juvenile rheumatoid arthritis (JRA), self-reported arthritis, and systemic lupus erythematosus (SLE) (Table 2). The articles included in this review were comprised of various intervention strategies, however, all classes included a warm-up, a main segment including flexibility, strengthening and some aerobic exercises, and a cool-down. The class sessions were 45- 60 minutes in duration while the intervention length ranged from 6 weeks to 4 months (Table 2).

Participating in AFAP increased hand-eye coordination and flexibility (Suomi & Koceja, 2000). Improvements in the knee injury and osteoarthritis outcome score (KOOS) was also noted to show significant reductions in knee swelling, noise, hang up, and straightening (Yázigi et al., 2019). Additionally, a high rate of exercise compliance was noted for AFAP participation (Suomi & Collier, 2003; Suomi & Koceja, 2000) with increased attendance for those with high goal specificity, task self-efficacy, and scheduling self-efficacy (Gyurcsik et al., 2003) with an increase in self-efficacy for performing water exercise without aggravating symptoms (Wong & Scudds, 2009). Participation improved ability to complete ADLs, including increased grip strength and donning clothes with greater ease (Suomi & Koceja, 2000).

AFAP did not improve disability (Cadmus et al., 2010; Wong & Scudds, 2009), physical activity (Fisher et al., 2004), or depression (Cadmus et al., 2010). No significant change was found in the speed of quadriceps contraction (Fisher et al., 2004), VO_2 (Fisher et al., 2004), HR (Fisher et al., 2004), BP (Fisher et al., 2004), gait (Bacon et al., 1991) or BMI (Cadmus et al., 2010). Goal difficulty was shown to negatively correlate

with aquatic exercise attendance while it, along with goal specificity, task self-efficacy and scheduling self-efficacy, were non-significant predictors for attendance (Gyurcsik et al., 2003).

Across studies, there were equivocal results for arthritis related pain (Fisher et al., 2004; Cadmus et al., 2010; Suomi & Koceja, 2000; Wong & Scudds, 2009; Yázigi et al., 2019), functional status (Bacon et al., 1991; Fisher et al., 2004; Suomi & Koceja, 2000; Wong & Scudds, 2009), quality of life (Cadmus et al., 2010; Wong & Scudds, 2009), balance (Bacon et al., 1991; Suomi & Collier, 2003), muscular strength (Fisher et al., 2004; Suomi & Koceja, 2000), walking (Bacon et al., 1991; Fisher et al., 2004; Suomi & Koceja, 2000; Yázigi et al., 2019), stair climbing/navigation of stairs (Bacon et al., 1991; Yázigi et al., 2019), range of motion (Bacon et al., 1991; Suomi & Koceja, 2000; Yázigi et al., 2019), and various self-efficacy outcomes (Cadmus et al., 2010; Gyurcsik et al., 2003; Wong & Scudds, 2009) with some studies showing improvements and others showing no significant effects.

Table 2. Review of Studies for AFAP

Author	Study Design	Participants	Intervention	Measures	Results
Wong and Scudds 2009	Pre-test, within study design	N=31, 18-65 y with RA or SLE mean disease duration 5.97 y (SD 5.62)	4-wk AFAP + 8-wk maintenance	CHAQ questionnaire; Pain Visual Analog Scale (VAS); QOL – Chinese SF-36 ; Arthritis Self-efficacy Scale (ASES) – related to exercising regularly and self-management	NS Disability (CHAQ); ↓Pain (VAS) ; ↑ QOL in general health, physical functioning, role-physical, role-emotional, bodily pain, vitality; NS QOL in social functioning, mental health; ↑ self-efficacy (ASES) in performing water exercise without aggravating symptoms
Yazigi et. al. 2019	Single-blinded, randomized control trial	N=48, 40-65 y with BMI > 28 kG/M² and clinical and radiographic KOA	2x/wk, 60 min/session using the PICO protocol vs control 12 wk	Knee injury and osteoarthritis outcome score (KOOS) and it's 5 components; quality of life, knee pain, ADL, other disease-specific symptoms, and recreation function	↓ Pain (KOOS); ↓Swelling (KOOS); ↓knee noise (KOOS); ↓Hang Up (KOOS); ↑Straighten (KOOS); ↑Walking (KOOS) ; ↑Up/Down Stairs (KOOS)
Fisher et al. 2004	Convenience sample pre/post intervention	N=18 KOA	3x/wk, 45 min/class using AFAP 8 wk.	Jette functional status index (JFSI); Habitual physical activity questionnaire (HPA); RPE; Maximal voluntary isometric contraction strength of the quadriceps & hamstrings (MVIC); Sustained MVICs x 90 sec (muscular endurance); Speed of quadriceps contraction; Graded exercise test – cycle ergometer (VO_2, BP, HR)	NS JFSI; NS Walking time; NS pain, difficulty, dependence; NS HPA; NS maximal isometric strength of quadriceps; NS maximal isometric strength of hamstrings; NS sustained maximal isometric strength of quadriceps; NS sustained maximal isometric strength of hamstrings; NS Speed of quadriceps contraction NS VO_2, HR, BP
Cadmus et al. 2009	Randomized control trial AFAP vs Control	N=249 55-75 y with OA	2-5x/wk, 45-60 min AFAP classes vs control 20 wk	Perceived Quality of Life scale (PQOL); self- efficacy scale; VAS scale; Health Assessment Questionnaire (HAQ); Disability Index (DISINDEX) of HAQ (actvity limitation); Center for Epidemiological Studies Depression Scale (CES-D) ; BMI	↑Perceived QOL BMI moderates relationship between AFAP and PQOL NS self-efficacy scale, VAS, HAQ, DISINDEX, CES-D, BMI
Suomi & Collier 2000	Pre-post intervention study	N=32 69-79 y with diagnosed OA or RA	2x/wk x 45 min sessions using AFAP or PACE vs control 8 wk.	Exercise Compliance; Modified Functional Capacity Evaluation – difficulty in ADL and pain Functional Fitness Assessment for Adults over 60 – Flexibility, Coordination, Agility/Dynamic Balance, Strength & Endurance, Cardiorespiratory Endurance Nicholas Manual Muscle Tester (MMT) – hip & shoulder	Exercise Compliance rate high for both AFAP (79%) & PACE (90%) AFAP ↑ MMT in R/L shoulder & L hip; ↑ Flexibility; ↑ Hand-eye Coordination; ↑ R/L Arm Curl; ↓ Pain; ↓ ADL difficulty
Suomi & Koceja 2003	Pre-post intervention Study	N=24 45-70 y with diagnosed OA or RA	3x/wk x 45 min classes using AFAP vs control 6 wk.	Static two-legged stance with vision (S2V); Static two-legged stance without vision (S2WOV); Exercise Compliance	High Exercise Compliance (82%); ↑ balance with vision; ↑ balance without vision
Gyurcsik, Estabrooks, Feaster-Tampier 2003	Comparative analysis	N=216 32-91 y with arthritis	AFAP classes 2-5x/wk 8 wk.	Impact of Goal Difficulty, Goal Specificity, Task Self-Efficacy & Scheduling Self-Efficacy on Aquatic Exercise Attendance (AexA)	High Goal specificity, task self-efficacy, & scheduling self-efficacy yields ↑ AExA; Goal difficulty negatively correlated with AExA; Goal Difficulty, Goal Specificity,Task Self-Efficacy & Scheduling Self-Efficacy NS predictors for AExA.
Bacon, Nicholson, Binder, White 1991	Pre-post intervention Pilot Study	N=11 4-13 y with Juvenile RA (JRA)	AFAP classes 2x/wk x 45 min classes + 15 min free play 6 wk.	ROM; Gait; Balance; Lower Extremity Functional mobility (LEFM); Timed single-leg stance; Heel-to-toe walking; Timed 25 foot run; 100-foot walk; 13-step stair-climb; Timed change from supine to standing position; Gait velocity; Cadence; Stride length; HR	↑ bilateral internal and external hip rotation, R hip flexion with knee extension (ROM); NS plantar flexion; NS balance, Timed single-leg stance, Timed change from supine to standing position, Timed 25-foot run, 100-foot walk, 13-step stair-climb; NS gait velocity, cadence, stride length; improvements in HR, full recovery after 5 minutes of vigorous activity

***** Abreviations: SLE, Systemic lupus erythematosus; RA, rheumatoid arthritis; CBWEP, Community-based water exercise program; CHAQ, Chinese Health Assessment Questionnaire; VAS, visual analog scale; QOL, quality of life; JFSI, Jette functional status index; HPA, Habitual physical activity questionnaire; MVIC, Maximal voluntary isometric contraction; PQOL, Perceived Quality of Life scale; HAQ, Health Assessment Questionnaire; DISINDEX, Disability Index; CES-D, Center for Epidemiological Studies Depression Scale; MMT, Manual Muscle Tester; S2V, Static two-legged stance with vision ; S2WOV , Static two-legged stance without vision; AexA, Aquatic Exercise Attendance; JRA, Juvenile Rheumatoid Arthritis.

Table 3. AFAP and AFEP Outcome Measures

Outcome Measures	AFAP	AFEP	Both AFAP and AFEP
Pain (WOMAC, SPPB, RAPS, Modified Functional Capacity Evaluation)	↓Pain (VAS) ↓Pain (KOOS) NS pain ↓ Pain (Modified Functional Capacity Evaluation)	NS pain and stiffness (WOMAC) Within group, pre-post: AFEP: Arthritis related pain, stiffness, and function (WOMAC) ↓- Pain (RAPS) AFEP vs. Control ↓- Pain, Fatigue AFEP vs. Control ↓- Pain (RAPS) AFEP vs. Control	Decrease pain in both programs.
Flexibility/ROM (ROM, LEFM)	↑ Flexibility ↑ bilateral internal and external hip rotation, R hip flexion with knee extension (ROM) NS plantar flexion	NS Stiffness	Equivocal findings in flexibility/ROM between programs.
Functional Mobility (SPPB, Timed 360-degree turn, Gait speed test, KOOS, DISINDEX, HAQ, Heel-to-toe walking, Timed 25-foot run, 100-foot walk, 13-step stair-climb, Timed change from supine to standing position, Gait velocity, cadence, Stride length)	↑Walking (KOOS) ↑Up/Down Stairs (KOOS) NS Walking time NS Timed 25-foot run, 100-foot walk, 13-step stair-climb NS gait velocity, cadence, stride length ↓- ADL difficulty NS JFSI NS DISINDEX NS HAQ ↑ Hand-eye coordination	Within group, pre-post: AFEP: Improved physical function (SPPB) NS Self-reported function (HAQ), Functional mobility (walking speed, normal and fast)	Improvements in function illustrated in both programs
Muscular Strength & Endurance (10-pound lifts, Maximal voluntary isometric contraction strength of the quadriceps & hamstrings (MVIC), Sustained MVICs x 90 sec (muscular endurance), Speed of quadriceps contraction)	↑ R/L Arm Curl NS maximal isometric strength of quadriceps ↑ MMT in R/L shoulder & L hip NS maximal isometric strength of hamstrings NS sustained maximal isometric strength of quadriceps NS sustained maximal isometric strength of hamstrings NS Speed of quadriceps contraction	↑Lower Body Strength (Timed chair stands) AFEP vs. Control ↑Upper Body Strength (10 pound lifts) AFEP vs. Control	Some improvements in muscular strength and endurance in both programs.
Balance (S2V, S2WOV, Timed single-leg stance)	↑ balance with vision ↑ balance without vision NS balance, Timed single-leg stance, Timed change from supine to standing position	↓- risk of falls NS Standing Balance (timed 360 turn)	Equivocal findings in balance between programs.
Aerobic Capacity (6-minute walk test, VO_2, HR response)	NS VO_2 Improvements in HR, full recovery after 5 minutes of vigorous activity	NS Aerobic endurance (6min walk test) ↓- Fatigue AFEP vs. Control	Equivocal findings in aerobic capacity between programs.
Quality of Life (HRQoL, QOL – Chinese SF-36, PQOL)	↑ QOL in general health, physical functioning, role-physical, role-emotional, bodily pain, vitality NS QOL in social functioning, mental health BMI moderates relationship between AFAP and PQOL	NS Overall health (HRQoL) NS Physical health (HRQoL) ↓-Poor mental health days (HRQoL) ↓-Limited activity days (HRQoL)	Some improvement in QOL for both programs.
Self-efficacy (SEPA, Perceived self-efficacy, ASES, self- efficacy scale, Task Self-Efficacy & Scheduling Self-Efficacy)	↑ self-efficacy (ASES) in performing water exercise without aggravating symptoms NS self-efficacy scale Task Self-efficacy & Scheduling Self-Efficacy NS predictors for AExA	NS Physical activity self-efficacy (SEPA) ↑Perceived self-efficacy (60% reported)	Some associated improvements were found in both programs.

AFEP and AFAP

Discussion

The purpose of this work was to systematically review peer-reviewed literature to qualitatively report the effects and impact of participation in AFEP and AFAP among individuals with arthritis. Our objective was to provide a descriptive summary of the outcomes assessed when participating in these programs to establish areas of existing evidence and identify gaps in determining the efficacy of AFEP and AFAP in arthritis management that should be addressed in future studies.

Overall findings suggest that Arthritis Foundtion programming can improve pain, function, quatlity of life, and muscular strength and endurance, but their impact on balance, flexiblility/ROM, and aerobic capacity are inconsistent. Both the land and aquatic Arthritis Foundation programs found equivocal results for key arthritis-related symptoms, including pain, stiffness, and impaired function. In part, the equivocal findings of the present scoping review are attributed to differences between subjects (e.g., type of arthritis, degree of onset) as well as interventions (e.g., length of intervention). For example, it is common in human exercise intervention research for the greatest improvements to be found in those with the poorest measures at baseline (e.g., those with the highest blood pressure at the start of an exercise program will exhibit the greatest reduction in blood pressure by the end of the program). Osteoarthritis is graded on a 0 (none)-4 (severe) scale; inclusion criteria for subjects with a 3-4 arthritis grade could be an important factor for determining the impact of an intervention when studying individuals with OA. Additionally, most outcomes were assessed in only 1-2 studies making it difficult to draw firm conclusions regarding the impact of these programs on specific outcomes. Therefore, to best determine the impact on arthritis-specific outcomes future research should control for subject characteristics (e.g., body weight, arthritis severity), include a variety of outcomes measures, and implement more controlled interventions (e.g., controlling for physical activity outside of the AFEP/AFAP program).

AF exercise improves muscular strength and flexibility, but the majority of studies investigated these outcomes on the lower extremity. Future studies should also include upper extremity outcomes, particularly the hands. Many individuals who suffer from arthritis systemically will have arthritis in the joints of their hands and digits, which can dramatically impair important ADLs. The AFAP and AFEP dedicate an entire section within their manuals to exercises focused on the hands and wrists. This is due to the prevalence of arthritis impacting the hand, as it is the most common site for OA and RA (Bobos et al., 2019). Additionally, joint protection is taught and reinforced throughout the AF programming. Both exercise and practicing joint protection are common treatments for individuals with arthritis impacting their hands (Bobos et al., 2019) thus it would be prudent to focus studies on this population. Since some types of arthritis are more likely to occur with aging (e.g., osteoarthritis) and production of muscle power rapidly deteriorates with age, muscular assessments should also include outcomes specific to power production. Age related muscle mass and function loss can typically be slowed with interventions that include exercise (Larsson et al., 2019). This holds significant importance in relation to power production as it has been directly associated with reducing falls and fall-related injuries (Larsson et al., 2019). The inability to produce muscular power results in a slowing of movement resulting in the failure to adequately react to a fall stimulus (Larsson et al., 2019).

Many forms of arthritis are associated with increased fall risk, attributed to typical symptoms of arthritis such as pain, stiffness, and impaired function, including compromised gait and balance (Doré et al., 2015; Guillamón et al., 2019; Stanmore et al., 2013). Reviews of both AFEP and AFAP found equivocal results for these key symptoms. Lower extremity weakness in addition to balance and gait deficits are reported to be the most important individual risk factors in relation to falls

(Guillamón et al., 2019; Moreland et al., 2004; Rubenstein, 2006). Moreover, limitations in strength, flexibility, balance and reaction time are considered to be the greatest modifiable fall risk factors (Guillamón et al., 2019; Myers et al., 1996). Both the AFEP and AFAP programs propose an emphasis on the aforementioned fall risk factors within the program design. Further, water exercise has been shown to diminish fear of falling while training for improved balance due to the reduced risk associated with movement errors (Guillamón et al., 2019; Sá & Palmeira, 2019; Simmons & Hansen, 1996). Future research using AFAP as an intervention for reducing fall risk and its associated risk factors should be considered.

Improvements in strength, power, reaction time, and flexibility should be assessed alongside injury, fall rate, and use of assistive devices as there is a direct, negative correlation between neuromuscular improvements and risk of injury, falls, and balance, especially among older individuals. Each of these physiological characteristics relating to basic and skill-related physical fitness, can be improved through application of appropriate training stimuli during AFAP and AFEP.

Another area that deserves further investigation is the impact of these programs on weight loss and maintenance. It has been well established that individuals with arthritis are at an increased risk of obesity which can aggravate symptoms and limit function (Magliano, 2008). Losing weight is one of the first lifestyle-recommendations physicians may make to individuals with arthritis related obesity (Egerton et al., 2018). Moreover, body composition changes reflecting an increase in body fat and reduced muscle mass, that have similarly been reported with advancing age and functional impairments, can also be positively impacted by exercise interventions (Larsson et al., 2019). Furthermore, arthritis commonly exacerbates muscle wasting, strength loss, and impairment in skeletal muscle function due to disuse or joint function (Liao et al., 2020). The increased caloric expenditure associated with exercise in addition to the positive functional outcomes associated with AFAP and AFEP, can contribute to weight loss as well as overall function. Losing weight through a combination of diet and exercise could help preserve muscle mass and bone health, while reducing the strain and impact to arthritis-affected joints and should be studied.

While both the AFEP and AFAP exercise programs are designed to maximize joint health during exercise, individuals that have self-limited physical activity due to arthritis related pain, including those that are overweight or obese, may find land-based exercise less comfortable than water-based trainingWhile both programs improved pain, there is some support in favor of aquatic exercise as a preferred environment for exercise for those with arthritis-related pain (Bartels et al., 2016; Kunduracilar et al., 2018). Findings suggest reductions in pain and improved physical performance of exercises when executing exercises while immersed (Bartels et al., 2016; Kunduracilar et al., 2018). Future research utilizing the AFAP program as an entry-level form of exercise to promote increased physical activity in individuals that have self-limited physical activity due to pain should be considered.

Though this review identified many outcome variables that have been investigated, albeit with few studies, many health-related outcomes have yet to be investigated. Perhaps most important is bone health. The negative consequences of arthritis to bone health and function are well established; however, exercise is among the primary modifiable risk factors capable of influencing bone health by preserving bone mass and strength and preventing the death of bone cells (Loprinzi et al., 2015; Santos et al., 2017; Weaver et al., 2016). Moreover, water exercise has been shown to have further effects on bone health due to the unique environmental stimuli, reduction in joint impact and risk of fracture due to trauma (Lv et al., 2021; Simas et al., 2017). Significant effects on bone metabolism, reductions of bone resorption and increases in bone formation have been noted (Lv et al., 2021). Future research investigating the impact of AFEP or AFAP could incorporate bone health assessments to determine the beneficial outcomes of exercise on bone. In line with bone health, examining the effects of an AF exercise program to the impact on inflammation, rate of joint change, or quality of synovial fluid could provide important mechanistic insights to any associated improvements in arthritis-related symptoms with Arthritis Foundation program participation.

Aside from health-related outcomes, the benefits of participating in an education-based, group exercise program have been understudied. Some research has investigated the impact to mental health, exercise adherence, enjoyment, and quality of life, but the results were equivocal and additional work should be implemented to further elucidate the impact of Arthritis Foundation programming on these favorable outcomes. Moving forward, outcomes specific to exercising with peers with similar symptoms could be investigated. For instance, mixed-methods research could evaluate the impact of AFEP and AFAP programs on exercise motivation, the impact of social engagement on exercise adherence, and improvements to social isolation. Further, both programs incorporate educational components, but few studies investigated the impact of this education on knowledge gains and behavior change. Incorporating these outcomes to future studies could evaluate the impact of this education programming and provide recommendations for improvement and increased use.

Conclusion

The Arthritis Foundation created a series of exercise programs for individuals with arthritis to facilitate the adoption of appropriate exercise for this population. This scoping review of peer-reviewed literature qualitatively reported the effects and impact of participation in AFEP and AFAP among individuals with arthritis. AFEP and AFAP programming found improvements overall, but there were equivocal results for many of the hallmark symptoms of arthritis, including pain, stiffness, and impaired function. Recommendations for future research are to control for subject characteristics, include a variety of outcomes measures, and implement more controlled interventions to best determine the impact on arthritis-specific outcomes. Additionally, we identified many gaps that should be addressed in future studies to determine the efficacy of AFEP and AFAP in arthritis management, including bone health, fall risk, weight loss, muscular power, and benefits of exercising in a group of peers with similar symptoms.

Contribution and practical implications

This scoping review of Arthritis Foundation programming (AFAP and AFEP) highlights several practical implications of participating in the Arthritis Foundation Exercise Program (AFEP) and the Arthritis Foundation Aquatic Exercise Program (AFAP). Findings from table 3 suggest that both AFAP and AFEP positively influence pain, functional mobility with some improvement ins in muscular strength and endurance, QOL and self-efficacy. There were equivocal findings for flexibility/ROM, balance and aerobic capacity. Practical implications of this information suggest that participating in AFEP can have several positive effects on physical and mental well-being, including improved strength, reduced blood pressure, decreased risk of falls, and better sleep quality. However, the program may not consistently impact certain areas such as arthritis-related symptoms, self-efficacy, or physical activity levels. The addition of the 10 KHA program does not appear to yield significant additional benefits. It is important to consider individual variations and further research to fully understand the effectiveness and potential limitations of AFEP in addressing the needs of individuals with arthritis. Further, these findings suggest that participating in AFAP can have positive effects on hand-eye coordination, flexibility, knee-related symptoms, and certain aspects of ADLs. However, the program may not consistently improve disability, physical activity levels, depressive symptoms, or several other outcomes associated with arthritis. The results vary across different

studies, with some showing improvements and others finding no significant effects. Further research is necessary to better understand the specific benefits and limitations of AFAP in addressing the needs of individuals with arthritis.

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