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The Benefits of Yoga for Adults with Rheumatoid Arthritis

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The Benefits of Yoga for Adults with Rheumatoid Arthritis

by

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DISSERTATION

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Dedication

I dedicate this body of work to my husband, Dr. Ryan Greysen, and my mother, Mary Christensen, without whom, this never would have been possible.

Acknowledgments

Looking back over the last four year at UCSF, I am amazed at the dedication of my family, friends and faculty who provided incredible support throughout my program. I faced several challenges during my program, and was encouraged and cheered on through it all.

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I am grateful for the invaluable friendships I have made throughout my doctoral program. I want to thank my doctoral colleagues who listened to my ideas and gently nudged me in helpful directions. Thank you to my many friends at UCSF and elsewhere who supported me through my struggles and celebrated my successes with me. I am

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The Benefits of Yoga for Adults with Rheumatoid Arthritis

Heather M. Greysen, RN, NP, PhD(c)

Abstract

Introduction. Rheumatoid arthritis (RA) is a chronic inflammatory condition associated with debilitating symptoms. Physical activity has been studied as a means of improving physical function and symptoms in adults with RA for over thirty years, however, rates of physical activity in RA patients remains below that of patients with other chronic diseases. Yoga has been gaining popularity nationally and may be an acceptable form of physical activity in this population. The primary aim of this dissertation was to describe the physical activity of yoga and its role in symptom management and physical function for adults with RA. A review of the literature, a quantitative study, and a qualitative study were performed to meet this dissertation aim.

Methods. In the first study a review of the literature was performed to survey the literature on physical activity interventions in adults with RA to determine which exercises were effective for improving physical function and symptoms in adults with RA. In the second study cross-sectional analysis of secondary data from 369 adults with RA was performed. This quantitative study investigated whether participation in yoga was associated with less RA symptomatology and better physical function scores in adults with RA compared to adults with RA who did not participate in yoga. The third study is a qualitative analysis exploring self-selected community yoga practice in adults with RA. This qualitative study used open-ended interview questions to explore benefits, barriers and facilitators of yoga practice.

Findings. The literature demonstrated that physical activities with an aerobic and strengthening component, like yoga, are effective for improvement in physical function and relief of pain, depression and fatigue. In the cross-sectional quantitative study yoga participation was associated with less pain and better physical function.
The qualitative exploration highlighted the dynamic nature of yoga as an appropriate physical activity for the dynamic needs of adults with RA. The yoga participants reported benefits of RA symptom relief and increased coping abilities.

Summary. Yoga is a dynamic exercise that is beneficial for symptom and physical function improvement. Investigations into practice components may improve yoga practice recommendations for adults with RA.

Table of Contents

List of Tables

List of Figures

Chapter 1

Introduction

Background

Rheumatoid arthritis (RA) is a chronic inflammatory autoimmune disease, characterized by pain, stiffness, swelling and loss of joint function. RA can affect any joint, but preferentially affects the small joints of the hands and feet. This painful chronic condition is often accompanied by reduced quality of life, impaired ability to work and depression due to loss of function.[1] RA is a fairly prevalent chronic disease that affects at least two million adults in the United States (approximately 1% of the population); 75% are women. The onset of RA can occur at any time but usually presents starting anywhere after the fourth decade in women (around age 35) and in the fifth decade (around age 45) in men. Prevalence of RA increases with age in both men and women.[2]

Treatment Options

RA is typically treated with a multi-tiered approach. Patients are usually given medication, a prescription for exercise, and other therapies depending on severity of disease.[3] Medications typically include analgesics for pain control, Disease Modifying Anti-Rheumatic Drugs (DMARDs) to prevent disease progression, Non-Steroidal Anti-Inflammatory Drugs (NSAIDs) to decrease inflammation, Biologics to prevent and in some cases reverse disease progression, and corticosteroids in the case of acute severe inflammation. Range-Of-Motion (ROM), strengthening and aerobic exercises are recommended for people with RA to increase flexibility, muscle strength and endurance and to reduce joint pain and stiffness. Other recommendations include heat and cold therapy to manage inflammation and assistive devices to help with activities of daily living.

These traditional treatments for RA are beneficial for most patients; however, they are not without side effects. In addition, not all people who suffer from RA respond

well to traditional treatment. Many of the medications given for treatment have adverse effects such as mood alteration and organ damage. RA patients are not generally given individually tailored exercise prescriptions, putting them at potential risk for further joint stress and musculoskeletal damage.[4] Moreover, chronic conditions like RA are often accompanied by stress and depression, yet stress-management techniques are rarely incorporated into traditional treatment plans.

Nonpharmacologic Options

Nonpharmacologic treatments can be helpful for people with RA.[5] The American College of Rheumatology states that stretching, strengthening and conditioning exercises preserve physical function.[6] Therapeutic mind-body exercises, such as yoga, are reported to improve health-related quality of life outcomes, including physical function and depressive symptoms, pain, and fatigue, and sleep for people with RA.[5] Yoga offers RA patients a way to improve their physical and mental health by incorporating meditative breathing with physical exercise.[7] Yoga is an ancient practice that is gaining popularity in western countries as an intervention for conditions that cause pain.[8] Yoga emphasizes stretching, strengthening and conditioning as well as incorporating meditation to reduce chronic pain-related sequelae.

The physical practice of yoga is a sequence of poses that incorporates deep breathing and concentration. A guided yoga program specifically designed for people with arthritis has been suggested as a therapy for improvement in physical and mental function for people with RA.[9] Yoga improves flexibility by moving joints through the full range of motion, increases strength by holding muscles in isometric contraction, promotes balance with standing poses by stabilizing muscles, improves stress

management by using deep focused breathing, encourages mental engagement and uses meditative concentration.[10] A number of randomized controlled trials of yoga have shown improvements in patients with chronic musculoskeletal and joint issues, such as low back pain.[11-21]

Yoga for RA Symptom Management

Few studies evaluate the use of yoga to improve symptoms of RA.[10,22-26] These studies investigating use of a yoga intervention for treatment of RA have promising results, where participants reported benefits of reduced pain, disability, fatigue and depressive symptoms, as well as improved mood, general health and grip strength.[22-24,26,27] However, only two of these studies compare yoga participants to RA controls in an adult population representative of those most commonly affected by RA (adults over 35); two of the studies focuses solely on young adults. Moreover, no studies have been published using validated instruments to evaluate the use of yoga in adults with RA and its potential benefits related to increased physical function and ability to work. Thus, research is needed to investigate therapeutic mind/body strategies to decrease symptoms of pain, fatigue and depression in adults with RA and to gain an understanding of how decreasing these symptoms can improve physical function and work status.

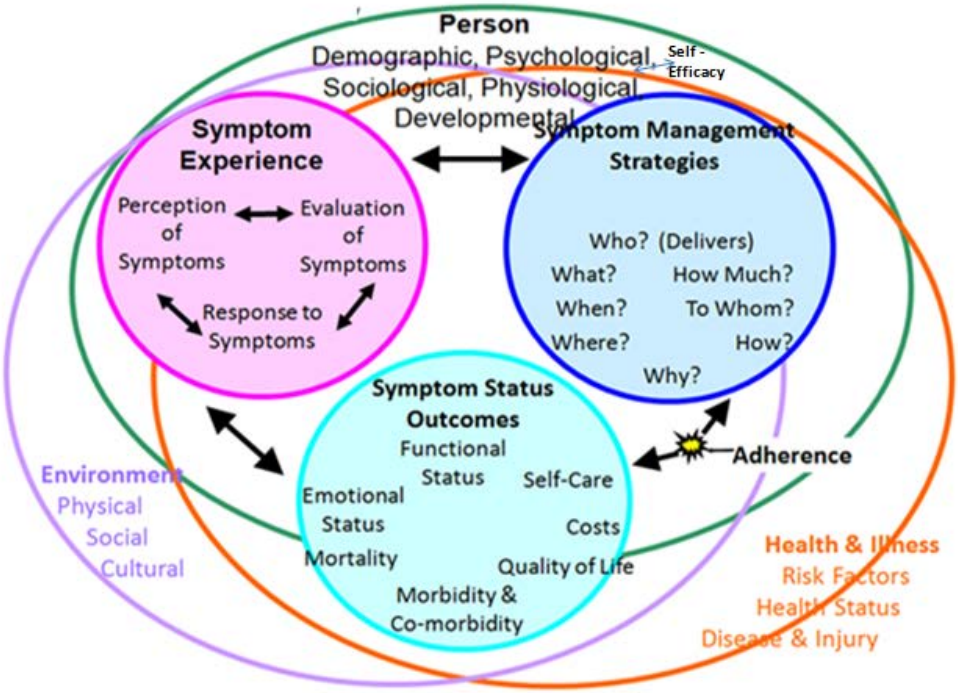
Since the symptom burden of a chronic disease like RA can be high, studying the RA symptom experiences of adults deserves further investigation using a well-established theoretical structure. Nurse researchers often use theory to guide research design and methods. A theoretical framework can assist researchers in organizing potential variables

around a shared framework of understanding. Theories can also help nurse researchers articulate how research findings can contribute evidence for clinical practice.[28,29]

Theoretical Framework

An important theoretical framework that can inform thinking about yoga as a mind-body therapy to improve symptoms of RA is the middle range theory of Symptom Management (Figure 1).[30] The Symptom Management Theory (SMT) was first described as a model by faculty at the University of California San Francisco (UCSF) in 1994. Since its introduction it has been revised as a middle-range theory.[30,31] The Symptom Management Theory (SMT) gave nurse researchers a way to address the subjective experience, or symptom, of an individual's illness. A symptom is a patient-reported subjective experience. A symptom reflects changes in biological, psychological and social functioning and is often precipitated by an illness or injury. In addition, symptoms can be caused by a medication or medical treatment. Individuals often make an effort to resolve a bothersome symptom and minimize the distress that it may cause. However, a persistent symptom or cluster of symptoms, unresolved by self-care management, often prompt individuals to seek professional medical care.[30]

Figure 1. Adapted 2008 Symptom Management Theory[30]



The SMT[30] describes three main concepts/domains that can be incorporated in symptom management: patient symptom experience, symptom management strategies, and symptom status outcomes. In addition, there are multiple sub-concepts within each concept. These three concepts and their sub-concepts are seen as interacting spheres, located within the three domains of nursing science: person, environment, and health/illness.[30]

The concept of "Symptom Experience" in the SMT[30] is described as the simultaneous perception of, evaluation of and response to a symptom. This experience is a change from the way the individual usually feels. This change in symptom experience can result from a change in any nursing domain. The symptom can be assessed by its frequency, its severity, and by the amount of distress associated with it.

The concept of "Symptom Management Strategies" in the SMT[30] is used to describe an individual's efforts to avert, delay, or minimize the symptom experience. Utilization of a strategy requires consideration of several important factors: Who? What? When (timing)? Where? Why? How much (dose)? To Whom? How? And Who delivers it? For example, in order to identify and develop a focused physical activity strategy for management of depression in adults with RA, a researcher or clinician may consider 1) the RA population mostly likely to accept and benefit from the physical activity (the who), 2) the nature of the physical activity based on the available data for the benefit in depression (the what), 3) the time of day that a physical activity should be performed in this population (when), 4) the location that the physical activity will be performed (where), 5) the frequency and duration of the physical activity (the dose), 6) which class of RA disease severity patients can participate in the physical activity (to whom), 7) how the physical activity can be modified to accommodate this patient population (how), and 8) if the physical activity requires a certified instructor (who delivers).

The concept of "Symptom Status Outcomes" in the SMT[30] is used to assess the effect of an implemented symptom management strategy. The measureable outcomes include: Functional Status, Emotional Status, Mortality, Self-Care, Costs, Quality of Life, Morbidity and Comorbidity. Symptom management strategies are seen as effective if they reduce the frequency or severity of a symptom, or if the strategy relieves the distress associated with the symptom.

The three main domains of nursing (person, environment, health and illness) are incorporated into the SMT.[30] Sub-domains for each of these nursing domains are also discussed. The person domain factors include: demographic, psychological, sociological,

physiological and developmental aspects. These person variables are inextricably linked to the way a person experiences and manages a symptom.[32] The environment domain is considered to be the setting in which the symptoms occur and includes the sub-domains of physical, social and cultural contextual influences. The health and illness domain encompasses health risk factors, health status, and disease. In this case, the health and illness domain is RA diagnosis, medical and pharmacological treatment, and duration. These variables can directly or indirectly affect a person's symptom experience, management and outcomes.[30,32]

The relationships among concepts in SMT[30] are bidirectional; each concept can influence and be influenced by another concept. In addition, nursing domains of person, environment and health/illness may contribute to any concept. The SMT's[30] personal factors sub-domain provide a strong framework for addressing how personal factors, such as demographic and psychological variables, are associated with yoga use among adults with RA. Investigating the association of demographic variables (such as income, gender, work status, and education level) on yoga use may provide insight into why a person might use yoga as a management strategy for symptoms of RA. These variables may impact a person's willingness or ability to participate in yoga since most yoga classes require a fee to participate. People of lower socio-economic status may not be able to afford the time or money to participate in a yoga class. Psychological personal factors likely play an important role in yoga use in adults with RA. Data from research studies have shown that yoga use can impact psychological factors such as social support, anxiety, or depression in adults with RA.[22,23]

Dissertation Aims

The goal of this dissertation was to describe the physical activity of yoga and its role in symptom management and physical function for adults with RA. The dissertation was written using American Medical Association (AMA) formatting[33] and is divided into five chapters.

Chapter 1 provides an introduction to the dissertation, presents a brief background, and outlines the theoretical framework.

Chapter 2 is a comprehensive review of the current research related to symptom and physical function improvement using physical activity interventions in adults with RA.

Chapter 3 presents findings of a cross-sectional research study that investigated whether participation in yoga was associated with less RA symptomatology and better physical function scores in adults with RA compared to adults with RA who do not do yoga. Demographic characteristics in addition to physical function scores and the primary symptoms of pain, depression, and fatigue were evaluated.

Chapter 4 presents findings from a mixed methods study exploring yoga participation in adults with RA. The research findings highlight the benefits, barriers, and facilitators for yoga practice in adults with RA.

Chapter 5 summarizes the findings of the research studies. The chapter also presents clinical implications and recommendations for future research.

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Chapter 2

Physical Activity in Adults with Rheumatoid Arthritis:

A Review of the Literature

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ABSTRACT

Objective. Physical activity is commonly used to improve physical function and symptoms in adults with rheumatoid arthritis (RA); however there is little consensus on which physical activity is best for this population. The objective of this review of the literature was to explore different physical activity's effectiveness for decreasing symptoms of pain, depression and fatigue, and for increasing physical function in adults with rheumatoid arthritis (RA).

Methods. A systematic search of the PubMed database was performed. Only physical activity intervention studies of adults with RA that measured a change in physical function, and at least one symptom outcome using validated scales were included. Study quality was rated using a modified Delphi score. Demographic data of participants and significant outcome changes resulting from the physical activity was extracted. Study quality and data regarding change in outcome score as a result of the physical activity intervention was used to evaluate effectiveness of physical activity.

Results. Twenty-three papers relating to 26 different physical activity interventions met the inclusion criteria. The mean methodological quality score was 7.5/10. Physical activity interventions included: aerobics, dynamic exercise, strengthening, tai chi, yoga and interventions using aerobic training solely or in combination with range of motion, strengthening, or both. Patients varied in age (range 28-61 years), disease duration (1-20 years), and disease severity. Physical activity dose (the frequency and duration of exercise) was similar in most studies, however the intensity varied. Pain improved with aerobics, strength/Range of Motion, strength/aerobics and yoga. Fatigue improved with Tai Chi and yoga. Depression

improved with aerobics, dynamic exercise, Tai Chi and yoga. Physical function improved with participation in all of the physical activities with varying levels of evidence. Only one physical activity intervention study, high intensity dynamic exercise, reported worsening of RA disease status after participation.

Conclusion. Physical activities with aerobic and strengthening components have the strongest evidence for improving multiple symptoms and physical function in adults with RA. The near absence of increased disease status resulting from physical activity provides evidence that physical activity is safe in adults with RA. Future research is indicated to directly compare interventions of aerobics alone, to strengthening alone and combination exercises programs, including yoga.

Key words: Rheumatoid arthritis, physical function, symptoms, physical activity, yoga, tai chi

INTRODUCTION

Rheumatoid arthritis (RA) is a chronic inflammatory autoimmune disease characterized by pain, stiffness, swelling and loss of joint function. RA can affect any joint, but preferentially affects the small joints of the hands and feet. This painful chronic condition is often accompanied by reduced quality of life, impaired ability to work and depression due to loss of function.[1] RA is a fairly prevalent chronic disease that affects two million adults in the United States (approximately 1% of the population); 75% of these are women. The onset of RA can occur at any time but usually presents in the fourth and sixth decade.[2] Steinbrocker published a functional capacity classification criteria for RA in 1949.[3] RA functional capacity classification ranges from I-IV. RA functional capacity class I, referred to as "RA Class I," is the highest functional ability while RA Class IV is the lowest, indicating incapacitation (Table 1).[3]

Table 1. Steinbrocker RA Functional Capacity Classification

Class	
I	Complete Ability to carry on all usual duties without handicaps
II	Adequate for normal activities Despite handicap of discomfort or limited motion at one or more joints
III	Limited Only to little or none of duties of usual occupation or self care
IV	Incapacitated, largely or wholly Bedridden or confined to wheelchair; little or no self care

Rheumatoid arthritis is typically treated with a multi-tiered approach. Patients are usually given medication, a prescription for exercise and sometimes other therapies depending on the severity of their disease. These traditional treatments for RA are beneficial for most patients; however, they are not without side effects. Many of the RA medications have adverse effects such as mood alteration and organ damage.[4] Often, the

suggested exercises are not tailored to suit individual needs, possibly leading to further joint stress and musculoskeletal damage.[5]

The purpose of this paper is to review the literature to determine which physical activity has the best evidence for decreasing pain, depression and fatigue, and for increasing physical function in adults with RA. The Symptom Management Theory (SMT)[6] was used to guide the framework for this review. A symptom is a patient reported experience that reflects changes in biological, psychological and social functioning and is often precipitated by an illness such as RA. The concept of "Symptom Management Strategies" in the SMT[6] is used to describe an individual's efforts to avert, delay, or minimize the symptom experience. One of the commonly-studied outcomes of a symptom management strategy is improvement in physical function. Physical function is defined as the ability to carry out various activities of daily life, ranging from self-care to more vigorous activities such as running.[7] Physical function encompasses a spectrum of abilities that range from disability to normal function to fitness.[8] Physical activity has been shown to be an effective symptom management strategy in adults with chronic disease.[9,10]

In the last two decades, there has been an increased focus on the use of tailored physical activity programs for RA patients to combat their decline in physical function. There have been a number of physical activity studies in RA patients that have primarily focused solely on one type of physical activity.[11-16] Other review studies have evaluated physiological outcomes such as aerobic capacity, cardiovascular muscle strength, disease activity and joint damage.[17,18] There are no systematic reviews focused on symptom and

physical function outcome changes in RA patients that compare types of physical activity.

METHODS

Search Strategy

A systematic search of the PubMed database was performed with the assistance of a medical librarian to identify publications regarding RA and physical activity. PubMed was searched using the Medical Subject Headings (MeSH), title and major search terms: "arthritis, rheumatoid" in combination with "physical activit*" or "exercis*" or "recreation" or "walk" or "jog*" or "sport*" or "bicycle*" or "yoga" or "motor activity" and "depression" or "fatigue" or "pain." In addition, references in review articles were scanned for potential articles to include. The search was limited to English language and adult studies. Next, the titles, abstracts, and full texts of articles were reviewed and considered for study inclusion based on the selection criteria outlined below.

Study Selection Criteria

A modified "PICO" format served as a method for organizing and focusing study selection criteria.[19] PICO stands for Patient problem, Intervention, Comparison, and Outcome. PICO was developed to enhance the practice of Evidenced Based Medicine (EBM)[20] and provide a method to focus clinical questions.[19] Studies were selected for this review based on their sample and comparison populations, nature of the intervention, measurements, and outcomes assessed. The outcome measurement instrument was added to the PICO framework as additional criteria for study selection.

Many intervention study designs were scanned and evaluated in order to include a wide variety of physical activities. Study designs included in this review were:

randomized controlled trials (RCT), quasi-experimental studies (non-randomized controlled clinical trials (CCT)), and pre and post intervention analyses (pre/post). Excluded study designs were: descriptive, observational, study protocols, case series or reports, clinical practice guidelines, literature reviews and meta-analyses.

The population of interest for this review was adults over age 18 with a clinical diagnosis of RA. Study populations were excluded if other joint or rheumatic diseases were mixed with the results of the RA population (i.e. osteoarthritis, systemic lupus erythematosus). The comparison population used was matched non-intervention RA patients or pre/post comparisons. All non-RA comparison populations were excluded.

Studies were included in the review if they measured at least one symptom of interest (pain, fatigue, depression) and physical function. Studies that did not include one symptom and one physical function measure were excluded. Excluded study examples include studies that measured physiologic outcomes such as: cardiovascular disease markers, bone loss, grip strength, neuropeptides, or energy expenditure. Studies were selected for inclusion if a validated instrument was used to measure the outcomes of interest. Studies that used non-validated measures of symptoms or physical function were excluded.

Interventions included whole-body exercise or physical activity programs as defined by the authors. Intervention programs that were education only, perception or predictions about physical activity, usual physical activity behavior, self-efficacy measures, or single joint exercises were excluded.

Assessment of Study Quality

Each study was assessed for methodological quality using a modified Delphi criteria list[21] similar to one used in several other reviews found in the physical activity literature in RA patients.[13,17,22] The original Delphi list was modified to adjust for criteria considered as relevant for the purposes of this review. The original criteria of 'patient blinded' and 'care provider blinded' were removed as they were deemed not appropriate for exercise interventions where the participant cannot be blinded to the intervention and primary care providers need not be blinded. The final quality criteria list (Table 3) was comprised of: 1) adequate randomization procedure, 2) groups similar at baseline, 3) eligibility criteria specified, 4) sufficient description of the intervention, 5) blinding of the outcome assessor, 6) co-interventions avoided or similar between groups (confounding factors such as pre-existing or concomitant exercise routines, group medication differences or changes), 7) description and presentation of outcome measures, 8) retention rate described and acceptable, 9) compliance rate described and acceptable, and 10) intention-to-treat analysis employed. Each criterion was scored yes, no, unclear, or not applicable (NA). A value of 1 was given to a yes criterion, a value of 0 was given to a no or unclear criterion. If a criterion was not applicable (NA) to a study, that criterion was excluded from the quality score calculated. An example of a criterion that would be considered not applicable would be the criteria of "adequate randomization" or "groups similar at baseline" in a quasi-experimental study which does not have a comparison group. The sum of the criterion categories was divided by the number of criteria that apply to the study, resulting in scores that range from 0-100%, where 0 would be the worst quality score and 100% would be the best. For the purposes of this review,

‘acceptable retention and compliance rates’ for the intervention group were set at 70%. Studies receiving a quality score of 70% or above were deemed high quality, scores between 61 and 69% were moderate quality, and studies with a score of 60% or less were deemed poor quality.

Assessment of Study Characteristics

The following variables were coded for each study: country of study, study design, RA disease severity class, number of participants, mean age, percent of female participants, symptom or disease duration, ethnicity, education, work status, description of intervention and control programs, and descriptions of the outcomes (Table 4 & 5 in the Appendix).

Assessment of Outcomes of Interest and Acceptable Measures

For the purposes of this review, symptom outcomes of interest are pain, depression and fatigue; and the salient quality of life outcomes of interest are physical function and ability to work. Outcome measures selected were those which have confirmed reliability, validity and sensitivity to change as described and generally accepted in the literature.

RESULTS

Selection of Included Studies

Figure 1 illustrates the results of the literature search. The initial search identified 246 studies. After a review of the titles, 42 articles were retained. Abstracts were reviewed for these 42 articles with application of the study selection criteria. After the abstract review, 35 studies were retrieved for a full text review. These 35 studies were reviewed and additional exclusions were made. Excluded studies and reasons for exclusion after the full text review are outlined in Table 2. The final sample includes 23 articles for this review and synthesis of literature.

Figure 1. Pub Med Search Results

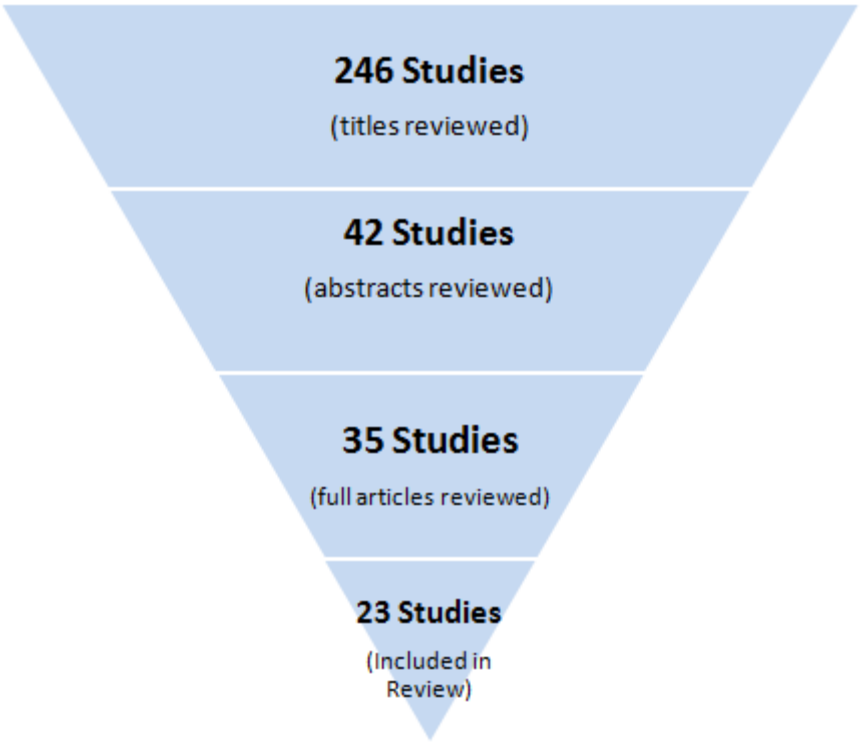


Table 2. Articles Excluded After Full Text Review Performed

	Author	Year	Journal	Type of Exercise	Reason for Exclusion
1	Baillet	2009	Rheumatology	Aerobic, Strength, ROM	No Symptoms
2	Daltroy LH	1995	Br J Rheumatol	Aerobic - land	RA & Lupus Results Mixed
3	Haaz S	2015	J Rheumatol	Yoga	RA & OA Results Mixed
4	Harkcom	1985	Arthritis Rheum	Aerobic - land	No Symptoms on valid scale
5	Minor MA	1989	Arthritis Rheum	Aerobic - aqua vs. land	RA & OA Results Mixed
6	Minor MA	1995	Arthritis Care Res	Aerobic - aqua & ROM	No Symptoms
7	Neuberger	1997	Research in Nurs & Health	Aerobic - land	No Physical Function
8	Neuberger	2007	Arthritis Rheum	Aerobic - land	No Physical Function
9	Singh VK	2011	Indian J Physiol Pharma	Yoga	No Physical Function
10	van den Berg MH	2006	Arthritis Rheum	Aerobic, Strength, ROM	No Symptoms
11	van den Ende CH	2000	Ann Rheum Dis	Aerobic, Strength, ROM	Hospitalized Patients
12	Westby MD	2000	J Rheumatol	Aerobic, Strength, ROM	No Symptoms

Legend: RA=Rheumatoid Arthritis, FU = Follow-up, OA = Osteoarthritis, ROM = Range of Motion

Methodological Quality

Methodological quality varied greatly between the studies with a mean methodological quality score of 76%. Almost half (10/23) of the studies were not randomized or had inadequate randomization.[23-32] Seven of the eighteen studies with a control group had comparable groups at baseline.[23,26,27,33-40] Surprisingly, one study did not specify eligibility criteria.[31] All authors adequately described their intervention. Blinding of the outcome assessor was either unclear or not performed in almost half (12/23) of the studies.[23-25,28-31,40-42] The majority of studies assessed for co-interventions (such as medication regimens and other physical activity participation), only eight did not.[28,29,31,35,39,40,42,43]

Nearly all studies provided adequate description of the outcome measures, only two did not.[23,28] All investigators discussed the drop-out or retention rate. Compliance with exercise program was not described in seven studies.[29,30,40,43-46] Retention or compliance rate were not adequate in the intervention group in four studies.[25,31,35,37] Only six studies performed intention-to-treat analyses.[23,31,34,38,44,47] Most studies (17/23) had a final quality score of over 70% and were deemed high quality studies.[23,25,27,32-34,37-47] Four

studies had a quality score of 60% or less and were deemed poor quality.[28-30,35] A list of the studies and their quality scores is provided in Table 3 in the appendix.

Characteristics of Study Participants

Table 4 summarizes the characteristics of study participants. Interestingly, studies were conducted worldwide ranging from Asia, Europe and the Middle East suggesting that RA is a global problem. Studies were published between 1990 and 2014.

Almost half (10/23) of the studies specified the RA disease severity class of the participants.[24,27-29,33-35,37,44,47] The majority of studies tested physical activity in patients with RA class III, but three limited their participants to RA class I-II only.[27,35,44] The number of participants varied from 5 to 150, with a mean of 30. The majority of participants in the physical activity programs were female (75%). Mean age of participants in these studies was 53 years (range 28-61 years). Ages reported as medians in individual studies were treated as means for the purposes of summarizing the results.

The mean disease duration was 6.5 years (ranging from less than 1 year to almost 20 years). Age and disease duration were comparable across most studies except for: two studies that focused on young adults,[25,46] three studies that had shorter disease durations (<2years),[38,41] and nine studies that included participants with disease durations of 10 years or more.[24,26,28,34,35,39,40,44,46] Only seven studies included information about race.[23,25,26,29,37,44,46] Education level of participants was rarely noted (5/23).[26,29,32,42,46] Since reporting of education levels varied widely across the studies, education was categorized as either: less than high school (<HS), having a high school education with or without some college, but no college degree (≥HS, no college degree), or having a

college degree (BS/MS/PhD). Thirty six percent of those surveyed in the studies had a college degree.

Very few studies (5/23) included the work status of the participants.[33,37,38,42,47] Since so few studies noted work status and the majority of workers in those studies worked full or part-time, work was collapsed into two categories: Working (Full or Part-time) or Not Working (Retired, Disabled, Unemployed). Only two studies made a distinct separation between retired and disabled or sick workers in the not working category.[38] About one third of all participants surveyed reported that they worked (36%).

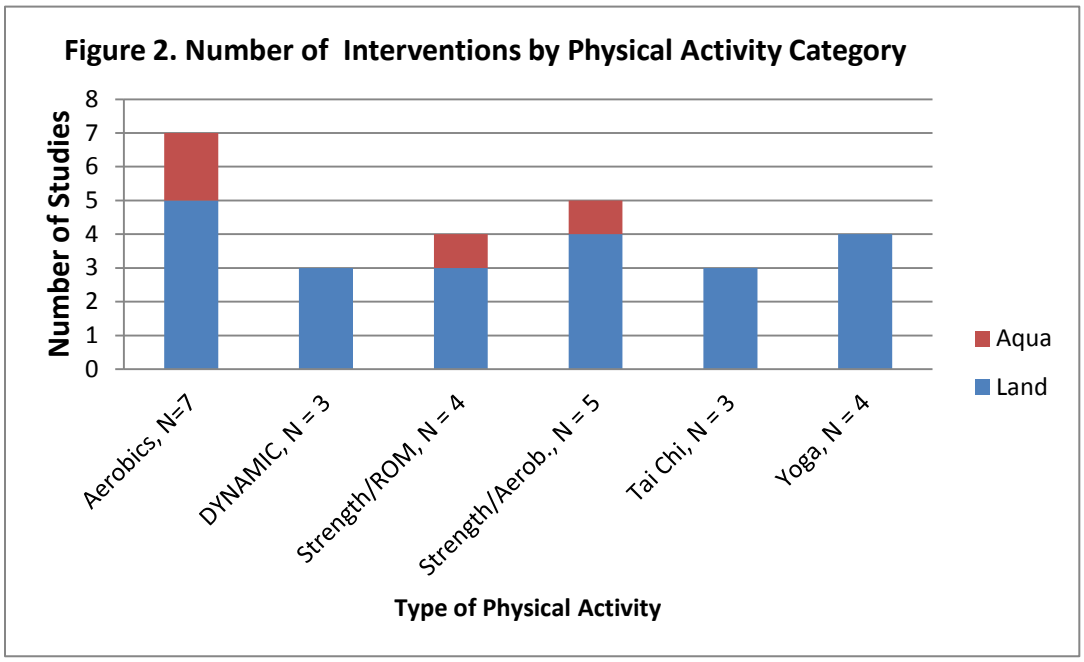
Characteristics of Studies

A comparison of study characteristics is outlined in Table 5 in the Appendix. This review included three types of trials: RCTs, Quasi-experimental controlled clinical trials (CCT), and Quasi-experimental single group pre-intervention status comparison to post-intervention outcome status (pre/post). The majority of the studies (17/23) were RCTs,[30,33-35,37-44,46,47] three studies were CCTs,[23,24,27] and six were pre/post quasi-experimental studies.[25,26,28,29,31,32] Although the exercise intervention programs were diverse, most of the studies had some aerobic component (15/23) such as aqua aerobics,[33,37,41] cycling,[39] running,[30] and dance aerobics.[27-29] Three of these aerobic studies were termed Dynamic Exercise Programs (DYNAMIC) where there is a combination of high intensity aerobics, strengthening and endurance training.[31,43,47] Several of the interventions had acronyms: a dance aerobics program that included an educational component was called "EDUSIZE,"[27-29] there were two different DYNAMIC interventions called "RAPIT"[31,47] and "FIT,"[43] and one program which had strength training plus an educational component was called "EXTRA."[38] Five studies had a

combination of aerobics and strengthening.[35,39-42] Three studies had strengthening and/or range of motion exercises as their intervention.[30,34,38] There were four yoga studies[23-25,46] and three Tai Chi studies.[26,32,44]

In one study the Tai Chi physical activity program was given to both the intervention and the control group but the intervention group also had acupressure treatments to the ear.[26] The two groups had similar baseline characteristics and the study showed no difference in outcomes between the groups with and without ear acupressure. Given the similarity of these two groups the results for both groups were combined and treated as one pre/post Tai Chi intervention group. Three studies had two intervention groups.[30,34,37] Since the two interventions in each study are very different and potentially valuable, each intervention will be treated as a separate study. Therefore, there are a total of 26 interventions from the 23 published studies presented in this paper.

The dose of exercise between the studies varied greatly. The duration of interventions varied from 6 weeks to 2 years. The frequency of exercise varied from one to seven days of exercise per week. And the length of each exercise session varied from 30-90 minutes. Figure 2 below is a graphical representation of the number of studies categorized by physical activity.



Outcome Measures

The outcomes of interest were measured using many validated scales. Pain was measured using: Visual Analog Scales (VAS), the Short Form-36 (SF-36) and the Arthritis Impact Measurement Scale (AIMS). Fatigue was measured using the: SF-36, VAS, the Profile of Mood States (POMS) and the Functional Assessment of Chronic Illness Therapy- Fatigue subscale (FACIT). Depression was measured using the: Beck Depression Inventory (BDI), Hospital Anxiety and Depression Scale (HADS), Brief Symptom Inventory (BSI-18), Dutch version of the AIMS2 (D-AIMS2), AIMS2, Center for Epidemiologic Studies Depression Scale (CED-S), POMS, and the SF-36. Physical function was measured using the: Health Assessment Questionnaire (HAQ), AIMS/AIMS2/D-AIMS2, Rheumatoid Arthritis Quality of Life questionnaire (RaQOL) and the Western Ontario and McMaster Osteoarthritis Index (WOMAC). Several investigators used multiple instruments to assess a particular concept. If multiple

instruments were used to measure one outcome concept, for example, if the HAQ and the SF-36 were both used to measure physical function, the physical activity was considered to be effective in improving that outcome if there was a significant finding using either of the measurement instruments.

All of the studies included some measure of physical function. None of the studies measured work status as an outcome variable. Each study included at least one of the RA symptoms of interest. Most (23/26) measured pain, only three studies did not include a measure of pain,[31,43,47] interestingly, they were the three DYNAMIC studies. Only eight of the twenty six interventions measured fatigue.[23,26,27,29,37,38,40,44] Most (15/26) of the studies measured depression, only eight did not.[30,34,35,38-42]

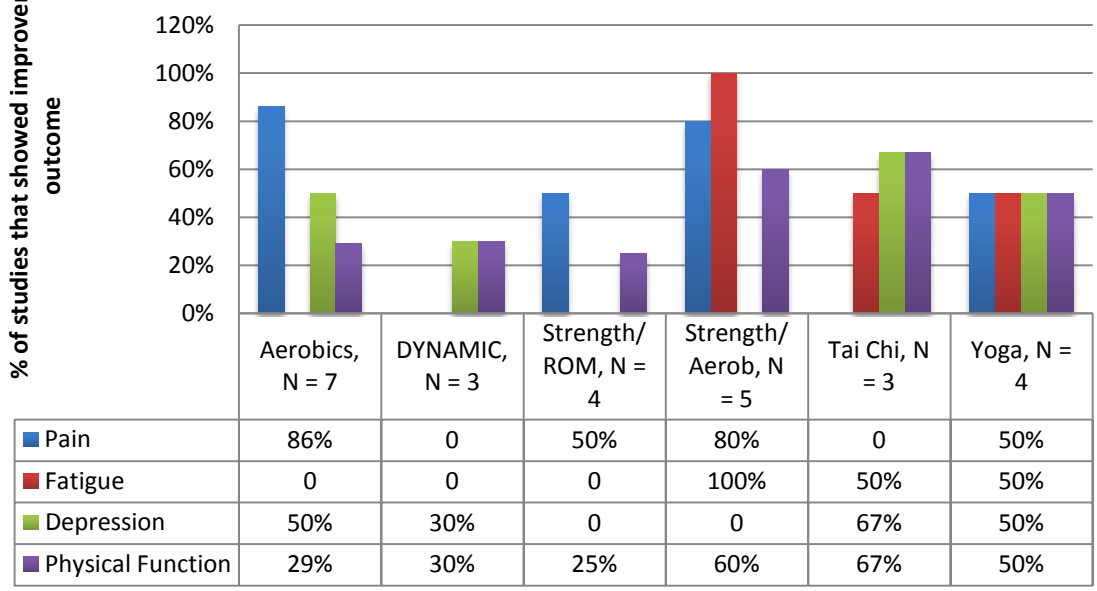
In addition, all of the studies included additional variables that were not considered primary outcomes for this literature review. Such variables include: Arthritis Self-Efficacy Scale (ASES), aerobic capacity, and several variables that measure disease activity: Disease Activity Score based on 28 variables (DAS-28), Disease Activity Score with 4 variables (DAS4), tender and swollen joint counts, Erythrocyte Sedimentation Rate (ESR), and C - reactive protein (CRP).

Study Results by Physical Activity Intervention Category

For each outcome measure, baseline and post intervention comparison results were extracted. Due to the variety of instruments used to assess outcome measures, the varied analyses methods used, and the differences in presentation of results, the study results are presented as being a significant or non-significant change within the treatment group from pre-intervention score to post-intervention (immediately after competition of the intervention) or as being a significant or non-significant change between the treatment

group post-intervention and the control group post-intervention. The outcome results of the comparisons are presented as either: non-significant (NS), significant at an alpha of 0.05 (*), significant at an alpha of 0.01 (**), or as not having been assessed (~). No follow-up scores were assessed since few studies measured follow-up outcomes and those that did had varying lengths of time to follow-up. The significant findings for each type of activity are presented in Table 6 in the appendix. Figure 3 below is a graphical representation of the number of studies that had a significant impact for the outcomes of interest categorized by physical activity.

Figure 3. Percentage of Studies that Showed Significant Improvements in Outcomes by Physical Activity



	Aerobics, N = 7	DYNAMIC, N = 3	Strength/ ROM, N = 4	Strength/ Aerob, N = 5	Tai Chi, N = 3	Yoga, N = 4
Pain	86%	0	50%	80%	0	50%
Fatigue	0	0	0	100%	50%	50%
Depression	50%	30%	0	0	67%	50%
Physical Function	29%	30%	25%	60%	67%	50%

Aerobics intervention studies. There were seven studies used either aqua or land-based aerobics as a primary intervention.[27-30,33,37,40,42] Most (6/7 or 86%) of the aerobics studies showed a statistically significant improvement in pain. Neither of the two

aerobics studies that evaluated fatigue showed any significant improvement in fatigue.[27,29] Three of the six aerobics studies (50%) that evaluated depression showed a statistically significant improvement; interestingly all three of the aerobic studies that found improvement in depression were the dance-based aerobic programs.[27-29] All of the aerobics studies looked at physical function, however only two of these seven studies (29%) showed any improvement in physical function. One of these studies used aqua-aerobics[33] and the other used a running intervention.[30]

Dynamic exercise program (DYNAMIC) intervention studies. Three studies used a DYNAMIC (high-intensity aerobics, sports, and strength training) as a primary intervention.[31,43,47] None of the DYNAMIC studies measured pain or fatigue. All three of the DYNAMIC studies measured depression and physical function, however, only one DYNAMIC study showed a statistically significant improvement in these two outcomes.[47]

Strength/ROM intervention studies. Four studies used a strength and or ROM training program as their primary intervention.[30,34,38] Three of the four studies included range of motion (ROM) exercises.[34,38] Only one of the four strength interventions was a strength training program without another component.[30] Two of the four (50%) strength programs showed a statistically significant improvement in pain.[30,38] Only one of the four studies measured fatigue and there was no demonstrated improvement in fatigue.[38] None of the strength programs measured depression. One of the four strength programs showed a statistically significant improvement in physical function.[30]

Strength/Aerobic combination intervention studies. Five studies used a strength training and aerobics combination program as their primary intervention.[35,39-42] Four of

the five (80%) strength/aerobics combination programs showed a statistically significant improvement in pain.[39-42] Only one of the five studies measured fatigue and there was a significant improvement in fatigue.[40] None of these strength/aerobics combination programs measured depression. Three of the five strength/aerobics programs showed a statistically significant improvement in physical function.[40-42]

Tai Chi intervention studies. Three of the twenty-six intervention studies used Tai Chi interventions; all three measured the four outcomes of interest.[26,32,44] None of the three studies showed an improvement in pain. One of the two Tai Chi studies that measured fatigue showed a statistically significant improvement.[26] Two of the three Tai Chi studies showed a statistically significant improvement in depression and physical function.[26,44]

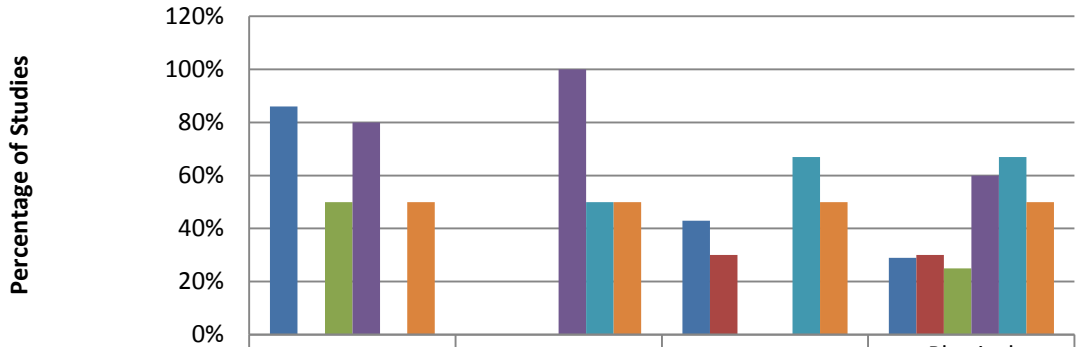
Yoga intervention studies. Four of the twenty-six intervention studies used yoga as their physical activity intervention.[23-25,46] Two of the four studies demonstrated a statistically significant improvement in pain.[24,25] One of the two studies that measured fatigue demonstrated a statistically significant improvement.[46] Two of the four studies demonstrated a statistically significant improvement in depression.[24,25] Two of the four studies demonstrated a statistically significant improvement in physical function.[23,24]

Study Results by Symptoms and Physical Function Outcomes

Outcome improvements are demonstrated by a statistically significant difference found either within the intervention groups or between the post-intervention treatment group and the post-intervention control group. The total percentage of studies that showed a statistically significant improvement in the outcome of interest is shown after each physical activity.

Pain was significantly improved by participation in aerobics (86%), strength training (57%), and yoga (50%). Fatigue was significantly improved by participation in Tai Chi (50%) and yoga (50%). Depression was significantly improved by participation in aerobics (50%), DYNAMIC (33%), Tai Chi (67%) and yoga (50%). Physical function was significantly improved by participation in all of the physical activities studied: aerobics (29%), DYNAMIC (33%), strength training (29%), Tai Chi (67%), and yoga (50%). Figure 4 below is a graphical representation of the percent of studies that had a significant impact in the outcomes of interest categorized by outcomes.

Figure 4. Percentage of Physical Activity Interventions that Showed Significant Improvements by Outcomes



	Pain	Fatigue	Depression	Physical Function
Aerobics	86%	0	43%	29%
DYNAMICS	0	0	30%	30%
Strength/ROM	50%	0	0	25%
Strength/Aerobics	80%	100%	0	60%
Tai Chi	0	50%	67%	67%
Yoga	50%	50%	50%	50%

DISCUSSION

Pain was significantly improved by participation in aerobics, strength/ROM, strength/aerobics and yoga. Fatigue was significantly improved by participation in Tai Chi and yoga in half of the studies. Depression was significantly improved by participation in aerobics, DYNAMIC, Tai Chi and yoga. Physical function was significantly improved by participation in all of the physical activities with varying levels of evidence: aerobics, DYNAMIC, and strength training in less than half of the studies and Tai Chi and yoga in half or more of the studies. In all of these physical activity intervention studies, only one study[47] reported worsening of RA disease status after participation in the activity, which provides evidence that physical activity is safe in adults with RA.

The wide range of papers investigating physical activity in adults with RA in this study represent a small section of the over thirty years of exploration into this topic. The study of physical activity in RA began in the late 1980's with papers investigating efficacy and therapeutic value of exercise in rheumatoid arthritis and continues today.[48-50] There is a large body of research dedicated to this topic, and it is unfortunate that not all seminal physical activity papers could be covered with this paper. In order to add new insight into the discussion about the broad topic of physical activity in adults with RA, the SMT[6] was used to frame the objective and inclusion criteria for this paper, which is focused solely on physical function and symptom outcomes of physical activity interventions in RA patients.

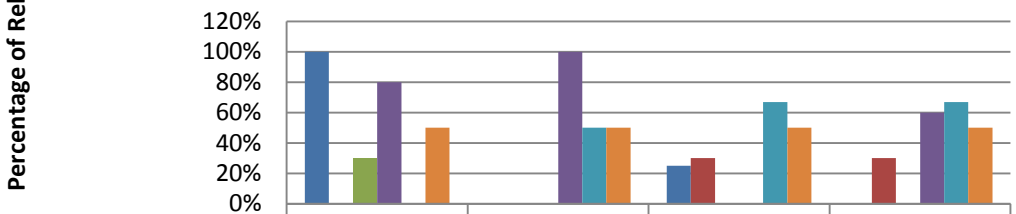
Study Quality and Reliability

The overall quality of most studies was high. The majority of investigators applied enough methodological rigor to achieve a moderate quality score of over 60% on the modified Delphi List. When studies are designed with high methodological rigor, the results can more easily be trusted than studies that did not apply such rigor. Therefore, the results from the studies with high and medium rigor will be discussed separately here.

An improvement in an outcome must be demonstrated in multiple studies in order to be reliable. For the purpose of this review, the criterion for reliable improvement is a finding of statistically significant improvement in at least half of the studies that assessed the concept. Pain was reliably improved in quality intervention studies using aerobics, strength/aerobics combination programs, and yoga. Fatigue and physical function were reliably improved in strength/aerobics combination programs, yoga and Tai Chi. Depression was reliably improved in Tai Chi & Yoga, however, it was not measured in strength/ROM nor the Strength/Aerobics combination programs.

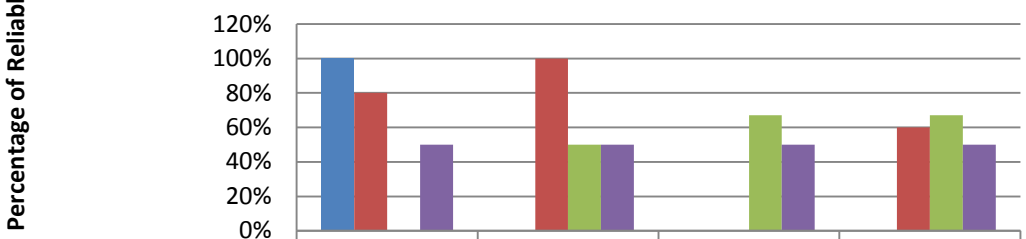
After removing the poor quality and less reliable studies, the evidence for reliably demonstrating the benefit of the various physical activities looks different (Figure 5). This analysis suggests that physical activities that have components of both aerobics and strengthening have the strongest evidence for reliably improving multiple symptoms and physical function in patients with RA.

Figure 5. Percentage of High Quality Physical Activity Studies that Showed Significant Improvements by Outcomes



	Pain	Fatigue	Depression	Physical Function
Aerobics, n = 4	100%	0	25%	0%
DYNAMIC, n=3	0	0	30%	30%
Strength/ROM, n=3	30%	0	0	0
Strength/Aerobics, n=5	80%	100%	0	60%
Tai Chi, n=3	0	50%	67%	67%
Yoga, n=4	50%	50%	50%	50%

Figure 6. Percentage of High Quality Physical Activity Studies that Showed Significant and Reliable Improvements by Outcomes



	Pain	Fatigue	Depression	Physical Function
Aerobics, n = 4	100%	0%	0%	0%
Strength/Aerobics, n=5	80%	100%	0	60%
Tai Chi, n=3	0%	50%	67%	67%
Yoga, n=4	50%	50%	50%	50%

Study Participants

Missing demographic data can affect generalizability of results, especially because of the very diverse populations represented. Many investigators did not include ethnicity, education or work status information. Ethnicity can greatly impact results of physical activity studies because of cultural beliefs about exercise and its benefits. In addition, the effect of work status could present a confounding factor. People who work may be less able to participate in physical activity interventions due to time constraints; however, they may also have a high baseline fitness level because of their daily work activities. Without knowing the work status of the participants we do not know if the sample is potentially biased by including primarily disabled people, which would greatly affect the result because they may have higher disease severity (a variable that very few studies captured). Participant age may have played a role in biasing the analysis of the effectiveness of a physical activity. Younger physical activity participants, even with similar disease durations, may have an improved response to physical activity than older participants simply because their body has not been exposed to the degenerative effects of aging.

There are other important behavioral and disease related confounding factors, such are participation in outside physical activities, disease severity and RA medical treatment protocols. Measurement of and controlling for participation in other physical activities at baseline and throughout the intervention would help mitigate outside physical activity as a confounding factor. Participation in additional physical activities during a physical activity intervention would confound the results and make conclusive associations difficult to assess. A stable medication regimen was an inclusion criterion

for many studies. In addition, most studies excluded patients with severe co-morbidities and disabilities. Therefore, the majority of study participants had only mild disease and minor physical function limitations. Physical functioning scores may be less likely to change from baseline if baseline scores are relatively low to begin with.

Characteristics of Studies

Studies that provide lower level evidence, such as the pre/post quasi-experimental studies, were included in this review to include studies that use alternative exercises like yoga and Tai Chi. Studies conducted using these methods are not generally RCTs or CCTs due to the difficulty recruiting enough participants in these types of studies.

Three of the studies that included a control group found important significant differences between the treatment and control groups at baseline. Two of these studies have differences in their treatment and control groups that can influence the interpretation and the value of their results.[40,46,47] De Jong's[47] Dynamic intervention demonstrated improvements in the treatment group compared to the controls. However, the control group in de Jong's study had significantly longer disease durations than did the treatment group, meaning that the control group was likely more chronically ill. This difference in the group characteristics would favor the treatment group showing improvement in symptoms and physical function. De Jong did not provide an analysis of pre and post intervention scores for the outcomes. In addition, de Jong is the only one of the three DYNAMIC intervention studies to find any significant results in improvement due to DYNAMIC. The unbalanced comparisons between the control and treatment groups and the lack of outcome improvements in other DYNAMIC studies makes the findings of de Jong's DYNAMIC study appear less reliable. In the Evans and colleagues yoga study, the

intervention group has significantly longer disease duration.[46] Evans reported only comparisons between the control and intervention group, which had non-significant results for the outcomes of pain, depression and physical function. The controls, having shorter disease durations, were likely healthier than the yoga intervention group, thus making it more difficult to show improvements in the yoga group when comparing it to the healthier control group. If Evans and colleagues[46] had balanced intervention and control groups or compared the pre and post intervention scores, the yoga intervention may have had more significant results. However, as mentioned previously, age may bias study results, and since in both of the Evans yoga studies[25,46] the participant mean age was under 30 years, the intervention of yoga may have appeared more effective simply since the group studied was younger and more responsive to improvement. Future studies may wish to set tighter age limits on study inclusion criteria to better evaluate physical activity results without the confounder of age.

A common finding, which was not explored in this review, was that physical activity is safe for people with Rheumatoid Arthritis. Only one of the studies showed an increase in disease activity after performing the intervention exercises.[47] After 24 months of the DYNAMIC intervention de Jong et al.(2003) found significantly more joint damage on the x-rays of the DYNAMIC participants compared to the controls.[47] The DYNAMIC type exercises are characterized as high-intensity and include multiple different types of intense sports activities, which may have contributed to the joint damage. However, the very rare finding of a negative outcome as a result of physical activity is encouraging, since many adults with RA are hesitant to participate in physical activities due to fear of increased disease activity.

Future Studies

Several topics for future research are apparent from the review of this literature. Since the results suggest that the programs that had an aerobic and strengthening component are most effective for improvement of symptoms and physical function, future studies should directly compare interventions of aerobics alone, to strengthening alone and combination exercises programs like yoga. Additionally, it would be interesting to compare different exercises based on three tiers of dose (high, medium & low) since the dose of physical activity likely impacts the effectiveness of the intervention. Another gap in knowledge exists about changes in work status as an outcome of physical activities. However, testing a short-term physical activity program may not lead to sufficient physical function improvement to motivate individuals to find employment. Therefore employment outcomes would be better measured in a trial of longer duration as one of the long-term outcome benefits for a younger population with RA.

Conclusion

In summary, the evidence from this review demonstrates that physical activities with aerobic and strengthening components have the strongest evidence for improving multiple symptoms and physical function in adults with RA. Other physical activities also showed evidence for improving symptoms and physical function; however, studies investigating these physical activities do not have as strong or reliable evidence. Physical activities that had evidence for showing improvements in pain were aerobics, strength training, and yoga. Effective physical activities for improving fatigue were Tai Chi and yoga. Effective physical activities for improving depression were yoga, Tai Chi,

DYNAMIC, and dance aerobics. Effective physical activities for improving physical function were yoga, Tai Chi, strength training, DYNAMIC, running and aqua aerobics. However, the evidence for the contributions of a DYNAMIC intervention program is suspect. Conversely, the evidence for the benefit of yoga may have been understated. Tailored physical activity programs are essential for patients to combat their decline in physical function and numerous uncomfortable RA symptoms. This literature review suggests that yoga, tai chi and other aerobic/strengthening programs can be beneficial for improving disease-related symptoms and physical function.

APPENDIX

Table 3. Methodological Quality of Studies Included in the Review (alphabetical, by first author)

-	Study Author	Random	Groups Similar	Eligib. criteria	Inter. Descrip.	Blinding	Co-Inter.	Outcome measures	RR	CR	ITT	Final Quality Rating 0-100%
1	**Badsha, 2009**	NA	1	1	1	0	1	0	1	1	1	78%
2	**Bilberg, 2005**	1	1	1	1	1	1	1	1	1	0	90%
3	**Bosch, 2009**	NA	0	1	1	0	1	1	1	1	0	67%
4	**Breedland, 2011**	1	1	1	1	1	0	1	1	0	0	70%
5	**de Jong, 2003**	1	0	1	1	1	1	1	1	1	1	90%
6	**Durcan, 2014**	1	0	1	1	NA	NA	1	1	NA	NA	83%
7	**Evans, 2010**	NA	NA	1	1	0	1	1	1	1	0	75%
8	**Evans, 2013**	1	0	1	1	1	1	1	1	0	0	70%
9	**Eversden, 2007**	1	1	1	1	1	1	1	1	1	1	100%
10	**Flint-Wagner, 2009**	1	0	1	1	0	0	1	1	1	0	60%
11	**Hakkinen, 2001**	1	1	1	1	0	1	1	1	1	0	80%
12	**Hsieh, 2009**	1	1	1	1	1	1	1	1	1	0	90%
13	**Jahanbin, 2014**	1	1	1	1	0	0	1	1	1	NA	78%
14	**Lee, 2012**	NA	1	1	1	1	1	1	1	0	0	78%
15	**Manning, 2014**	1	1	1	1	1	1	1	1	1	1	100%
16	**Noreau, 1995**	NA	1	1	1	0	1	1	1	1	0	78%
17	**Noreau, 1997**	NA	NA	1	1	0	0	0	1	1	0	50%
18	**Perlman, 1990**	NA	NA	1	1	0	0	1	1	0	0	50%
19	**Rahnama, 2012**	0	0	1	1	0	1	1	1	0	0	50%
20	**Strasser, 2011**	1	1	1	1	1	0	1	1	1	0	80%
21	**Uhlig, 2010**	NA	NA	1	1	1	1	1	1	1	0	78%
22	**Van der Giesen, 2010**	NA	NA	0	1	0	0	1	1	1	1	63%
23	**Wang, 2008**	1	0	1	1	1	1	1	1	0	1	80%
MEAN												**76%**

Legend: 1=Yes, 0=No, NA=Not Applicable, RR = retention Rate, CR = Compliance Rate, Random. = Randomization Adequate, Eligib. = Eligibility, Inter. Descrip. = Intervention Description Sufficient, Co-Inter. = Co-Interventions Avoided ITT=Intention to Treat Analysis

Table 4. Characteristics of Participants in Studies - Treatment Participants Only

Article	**Badsha**	**Bilberg**	**Bosch**	**Breedland**	**de Jong**	**Durcan**	**Evans**	**Evans**	**Eversden**	**Flint-Wagner**	**Hakkinen**	**Hsieh**
Year	2009	2005	2009	2011	2003	2014	2010	2013	2007	2009	2001	2009
Country	Dubai	Sweden	USA	Netherlands	Netherlands	Ireland	USA	USA	UK	USA	Finland	Taiwan
Design	CCT	RCT	CCT	RCT	RCT	RCT	Pre/Post	RCT	RCT	RCT	RCT	RCT
Exercise	Yoga	Aerobic -Aqua	Yoga	Dynamic "FIT"	Dynamic "RAPIT"	Strength & Aerobics - Land	Yoga	Yoga	Strength & ROM - Aqua / Land	Strength & Aerobics - Land	Strength & Aerobics - Land or Aqua	Aerobic - Group aqua vs. solo aerobic
N (treatment only)	26	20	9	19	20	40	5	11	57	14	31	15
RA Functional Class[1]	~	I-III	I-III	~	I-III	~	~	~	I-III	I-II	~	II & III
Age, years (SD)	44.0 (10)	49	56.3 (7.6)*	45 (11.9)	54.0 (16)	61 (8.0)	28 (2.7)	29.9 (2.9)	55.2 (13.3)	52.2 (13)	49 (10)	54.1 (8.3)
Female, N (%)	~	~	9 (100)	12 (61)	119 (79)	30 (75)	4 (80)	11 (100)	39 (68)	~	18 (58)	15 (100)
Disease Duration, years (SD)	6.0 (7.8)	2.6	19.7 (6.8)	9.7 (14.0)	5.0 (7)*	16 (10.9)	~	15.8 (9.8)*	10	15.4 (10.8)	0.8 (0.8)	8.2 (9.8)
Race, N (%)												
White	6 (23)	~	~	~	~	~	3 (60)	6 (55)	~	~	~	0
Latino	0	~	~	~	~	~	2 (40)	5 (46)	~	~	~	0
Asian	20 (77)	~	~	~	~	~	0	0	~	~	~	15 (100)
African American	0	~	~	~	~	~	0	0	~	~	~	0
Education, N (%)												
< HS	~	~	~	~	~	~	~	2 (18)	~	~	~	~
≥ HS, no college degree	~	~	~	~	~	~	~	0	~	~	~	~
College Degree	~	~	~	~	~	~	~	9 (82)	~	~	~	~
Work Status	~											
Working	~	50%	~	~	31%*	~	~	~	~	~	~	23%
Not Working	~	20%	~	~	~	~	~	~	~	~	~	77%

Legend: N = number of participants, SD = standard deviation, HS= High School, ~ = Not Available (Information not Given), RCT= Randomized Control Trial, CCT = Controlled Clinical Trial, Pre/Post = only a treatment group, where pre-intervention assessments compared to post intervention assessments, [1] = Steinbrocker Classification of Functional Capacity in People with RA (1949), *indicates when the characteristics are not equally distributed between treatment and control group, *Bosch - the control group was older, *deJong - the conrol grp had sig longer disease duration, and had more working adults, *Evans, 2013 - Tx group has sig longer disease duration, Nota Bene: Characteristics are provided for reference of general population studied in different articles, not as a comparison between control and treatment groups

Table 4 (continued). Characteristics of Participants in Studies - Treatment Participants Only

Article	**Jahanbin**	**Lee**	**Manning**	**Noreau**	**Noreau**	**Perlman**	**Rahnama**	**Radnama**	**Strasser**	**Uhlig**	**van der Giesen**	**Wang**
Year	2014	2012	2014	1995	1997	1990	2012	2012	2011	2010	2010	2008
Country	Iran	Korea	UK	Canada	Canada	USA	Iran	Iran	Austria	Norway	Netherlands	USA
Design	RCT	Pre/Post	RCT	CCT	Pre/Post	Pre/Post	RCT	RCT	RCT	Pre/Post	Pre/Post	RCT
Exercise	Strength & Aerobics - Land	Tai Chi	Strength & ROM - Land "EXTRA"	Aerobic - Dance EDUSIZE	Aerobic - Dance EDUSIZE	Aerobic - Dance EDUSIZE	Aerobics - Land (running)	Strength - Land	Strength & Aerobics - Land	Tai Chi	Dynamic "RAPIT"	Tai Chi
N (treatment only)	32	21	52	19	10	53	12	12	20	13	150	10
RA Functional Class[1]	~	~	~	I & II	III	I-III	~	~	~	~	~	I & II
Age, years (SD)	48.6 (10.5)	61 (11.7)	53 (16)	49.3 (13)	54 (10)	57	59.4 (8.1)	57.0 (7.4)	59.3 (7.9)	57	51 (12)	48 (10)
Female, N (%)	32 (100)	20 (95.2)	44 (85)	12 (63)	10 (100)	41 (95)	0	0	19 (95)	11 (85)	121 (81)	8 (80)
Disease Duration, years (SD)	~	10 (5.9)	1.7 (1.5)	8.1 (8.2)	14 (9)	~	~	~	16.2 (6.5)	6	~	14 (6)
Race, N (%)												
White	~	20 (95)	~	~	~	33 (77)	~	~	~	~	~	8 (80)
Latino	~	0	~	~	~	~	~	~	~	~	~	~
Asian	~	1 (5)	~	~	~	~	~	~	~	~	~	~
African Amer.	~	0	~	~	~	6 (14)	~	~	~	~	~	~
Education, N (%)												
< HS	(50)	~	~	~	~	2 (5)	~	~	~	3 (23)	~	~
≥ HS, no college degree	~	~	~	~	~	23 (54)	~	~	~	10 (77)	~	~
College Degree	~	4 (29)	~	~	~	18 (42)	~	~	~	~	~	~
Work Status												
Working	~	~	21 (40%)	~	~	~	~	~	~	~	~	~
Not Working	72%	~	31 (60%)	~	~	~	~	~	~	~	~	~

Legend: N = number of participants, SD = standard deviation, HS= High School, ~ = Not Available (Information not Given), RCT= Randomized Control Trial, CCT = Controlled Clinical Trial, Pre/Post = only a treatment group, where pre-intervention assessments compared to post intervention assessments, [1] = Steinbrocker Classification of Functional Capacity in People with RA (1949), Nota Bene: Characteristics are provided for reference of general population studied in different articles, not as a comparison between control and treatment groups

Table 5. Characteristics of Studies

Article	Badsha	Bilberg	Bosch	Breedland	de Jong	Durcan	Evans	Evans	Eversden	Eversden	Flint-Wagner
Year	2009	2005	2009	2011	2003	2014	2010	2013	2007	2007	2009
Country	Dubai	Sweden	USA	Netherlands	Netherlands	Ireland	USA	USA	UK	UK	USA
Design	CCT	RCT	CCT	RCT	RCT	RCT	Pre/Post	RCT	RCT	RCT	RCT
Exercise	Yoga	Aerobic-Aqua	Yoga	Dynamic "FIT"	Dynamic "RAPIT"	Strength & Aerobics - Land	Yoga	Yoga	Strength & ROM - Aqua	Strength & ROM - Land	Strength & Aerobics - Land
N (treatment only)	26	20	9	19	20	40	5	11	57	58	14
Study Quality	78%	90%	67%	70%	90%	83%	75%	70%	100%	100%	60%
Program Description											
Group vs. Solo	Group	Group	Group	Group	Group	Solo	Group	Group	Group	Group	Group
Aerobic	~	X - aqua	~	X - land & aqua	X- land	X - land	~	~	~	~	X
Strength	X	X	X	X	X	X	X	X	X	X	X
ROM/Flexibility	X	X	X	~	~	X	X	X	X	X	~
Relaxation	X	X	X	~	~	~	X	X	~	~	~
Length (weeks)	8	12	10	8	24 (mo)	12	6	6	6	6	16
Frequency (days per week)	2	2	3	2	2	3	2	2	1	1	3
Duration (min)	60	45	75	90	75	30-60	90	90	30	30	75
RR%	100%	91%	82%	89%	97%	100%	63%	79%	77%	71%	63%
CR%	100%	78%	87%	~	74%	~	95%	~	93%	81%	82%
Type of Control	Wait	UC	Wait	Wait	UC	UC	~	Wait	Land - Exercises	Aqua - Exercises	UC

Legend: SD= Standard Deviation, CCT= Controlled Clinical Trial, RCT= Randomized Clinical Trial, ROM = Range of Motion, Freq.= frequency, RR= retention rate, CR= compliance rate, UC=Usual Care Control, Wait = Wait-list control, X - indicates that it was included, ~ indicates that it was not assessed

Table 5.(Continued) Characteristics of Studies

Article	**Hakkinen**	**Hsieh**	**Hsieh**	**Jahanbin**	**Lee**	**Manning**	**Noreau**	**Noreau**	**Perlman**
Year	2001	2009	2009	2014	2012	2014	1995	1997	1990
Country	Finland	Taiwan	Taiwan	Iran	Korea	UK	Canada	Canada	USA
Design	RCT	RCT	RCT	RCT	Pre/Post	RCT	CCT	Pre/Post	Pre/Post
Exercise	Strength & Aerobics - Land or Aqua	Group Aerobic - Aqua	Solo Aerobic - Any	Strength & Aerobics - Land	Tai Chi	Strength & ROM - Land "EXTRA"	Aerobic - Dance EDUSIZE	Aerobic - Dance EDUSIZE	Aerobic - Dance EDUSIZE
N (treatment only)	31	15	15	32	21	52	19	10	53
Study Quality	80%	90%	90%	78%	78%	100%	78%	50%	50%
Program Description									
Group vs. Solo	Solo	Group	Solo	Group	Group	Group	Group	Group	Group
Aerobic	X - aqua or land	X - aqua	X - aqua or land	X - land	~	~	X -land	X -land	X -land
Strength	X	~	~	X	X	X	~	~	X
ROM/Flexibility	X	X	~	~	X	X	X	X	X
Relaxation	~	~	~	~	~	~	~	X	~
Length (weeks)	24 (mo)	8	8	8	12	12	12	8	16
Freq. (days per wk)	2	3	3	2	2	7	2	2	2
Duration (min)	45	60	60	45	60	~	50	50	60
RR%	90%	100%	100%	100%	87%	83%	100%	100%	81%
CR%	73%	100%	52%	100%	~	71%	83%	88%	88%
Type of Control	Solo - ROM	Solo-aerobic	Group-aerobic	UC	~	UC	UC	~	~

Legend: SD= Standard Deviation, CCT= Controlled Clinical Trial, RCT= Randomized Clinical Trial, ROM = Range of Motion, Freq.= frequency, RR= retention rate, CR= compliance rate, UC=Usual Care Control, Wait = Wait-list control, X - indicates that it was included, ~ indicates that it was not assessed

Table 5. (Continued) Characteristics of Studies

Article	Rahnama	Radnama	Strasser	Uhlig	van der Giesen	Wang
Year	2012	2012	2011	2010	2010	2008
Country	Iran	Iran	Austria	Norway	Netherlands	USA
Design	RCT	RCT	RCT	Pre/Post	Pre/Post	RCT
Exercise	Aerobics - Land	Strength - Land	Strength & Aerobics - Land	Tai Chi	Dynamic "RAPIT"	Tai Chi
N (treatment only)	12	12	20	13	150	10
Study Quality	50%	50%	80%	78%	63%	80%
Program Description						
Group vs. Solo	Group	Group	Group	Group	Group	Group
Aerobic	X	~	X	~	X- land	~
Strength	~	X	X	X	X	X
ROM/Flexibility	~	~	X	X	~	X
Relaxation	~	~	~	~	~	X
Length (weeks)	8	8	6 (mo)	12	12 (mo)	12
Frequency (days per week)	3	3	2	2	2	2
Duration (min)	45	45	30	60	75	60
RR%	75%	75%	75%	87%	54%	100%
CR%	100%	100%	75%	83%	55%	83%
Type of Control	UC	UC	Solo ROM	~	~	Group education & stretching

Legend: SD= Standard Deviation, CCT= Controlled Clinical Trial, RCT= Randomized Clinical Trial, ROM = Range of Motion, Freq.= frequency, RR= retention rate, CR= compliance rate, UC=Usual Care Control, Wait = Wait-list control, X - indicates that it was included, ~ indicates that it was not assessed

Table 6. Characteristics of Study Results by Exercise

	Aerobics							Strength			
Article	**Bilberg**	**Hsieh**	**Hsieh**	**Noreau**	**Noreau**	**Perlman**	**Rahnama**	**Radnama**	**Manning**	**Eversden**	**Eversden**
Year	2005	2009	2009	1995	1997	1990	2012	2012	2014	2007	2007
Design	RCT	RCT	RCT	CCT	Pre/Post	Pre/Post	RCT	RCT	RCT	RCT	RCT
Exercise	Aerobic-Aqua	Aerobic - Group Aqua vs. Solo Aerobic	Aerobic - Solo Aerobic vs. Group Aqua	Aerobic - Dance EDUSIZE	Aerobic - Dance EDUSIZE	Aerobic - Dance EDUSIZE	Aerobics - Land (running)	Strength - Land	Strength & ROM - Land "EXTRA"	Strength & ROM - Aqua	Strength & ROM - Land
N (treatment only)	20	15	15	19	10	53	12	12	52	57	58
Study Quality	90%	90%	90%	78%	50%	50%	50%	50%	100%	100%	100%
Pain	**SF-36**	**VAS**	**VAS**	**AIMS**	**AIMS**	**AIMS**	**VAS**	**VAS**	**VAS**	**VAS**	**VAS**
within	**	*	*	*	NS	**	~	~	**	NS	NS
between	NS	NS	NS	~	~	~	**	**	*	~	~
Fatigue	**~**	**~**	**~**	**POMS**	**~**	**POMS**	**~**	**~**	**VAS**	**~**	**~**
within	~	~	~	NS	~	NS	~	~	NS	~	~
between	~	~	~	~	~	~	~	~	NS	~	~
Depression	**SF-36**	**AIMS**	**AIMS**	**POMS**	**POMS**	**AIMS**	**~**	**~**	**~**	**~**	**~**
within	NS	NS	NS	**	*	**	~	~	~	~	~
between	NS	NS	NS	~	~	~	~	~	~	~	~
Physical Function	**HAQ**	**HAQ**	**HAQ**	**AIMS**	**AIMS**	**AIMS**	**WOMAC**	**WOMAC**	**RAQoL**	**HAQ**	**HAQ**
within	*	NS	NS	NS	NS	NS	~	~	NS	NS	NS
between	*	NS	NS	~	~	~	**	**	NS	~	~

Legend: ROM= Range of Motion, Within = comparisons are made within the treatment group pre & post intervention. Between = comparisons are made between the post-tx group and the post-control group, NS= comparison made, but it was not significant

* p-value < 0.05 (indicates a significant difference in the comparison of the groups' scores)

** p-value < 0.01 (indicates a significant difference in the comparison of the groups' scores)

~ indicates that it was not assessed

Table 6. (Continued) Characteristics of Study Results by Exercise

	Dynamic			**Combos - Strength & Aerobics**				
Article	**de Jong**	**Breedland**	**van der Giesen**	**Hakkinen**	**Durcan**	**Jahanbin**	**Strasser**	**Flint-Wagner**
Year	2003	2011	2010	2001	2014	2014	2011	2009
Design	RCT	RCT	Pre/Post	RCT	RCT	RCT	RCT	RCT
Exercise	Dynamic "RAPIT"	Dynamic "FIT"	Dynamic "RAPIT"	Strength & Aerobics - Land or Aqua	Strength & Aerobics - Land	Strength & Aerobics - Land	Strength & Aerobics - Land	Strength & Aerobics - Land
N (treatment only)	20	19	150	31	40	32	20	14
Study Quality	90%	70%	63%	80%	83%	78%	80%	60%
Pain	~	~	~	**VAS**	**VAS**	**VAS**	**VAS**	**VAS**
within	~	~	~	~	***	NS	*	~
between	~	~	~	*	*	**	~	NS
Fatigue	~	~	~	~	**FSS**	~	~	~
within	~	~	~	~	***	~	~	~
between	~	~	~	~	*	~	~	~
Depression	**HADS**	**D-AIMS2**	**HADS**	~	~	~	~	~
within	~	NS	~	~	~	~	~	~
between	**	NS	NS	~	~	~	~	~
Physical Function	**HAQ**	**D-AIMS2**	**HAQ**	**HAQ**	**HAQ**	**AIMS2-SF**	**HAQ**	**HAQ**
within	~	NS	~	~	***	***	NS	~
between	*	NS	NS	**	***	**	~	NS

Legend: ROM= Range of Motion, Within = comparisons are made within the treatment group pre & post intervention. Between = comparisons are made between the post-tx group and the post-control group, NS= comparison made, but it was not significant

* p-value < 0.05 (indicates a significant difference in the comparison of the groups' scores), ** p-value < 0.01 (indicates a significant difference in the comparison of the groups' scores), ~ indicates that it was not assessed

Table 6. (Continued) Characteristics of Study Results by Exercise

	Tai Chi			Yoga			
Article	**Wang**	**Uhlig**	**Lee**	**Badsha**	**Evans**	**Evans**	**Bosch**
Year	2008	2010	2012	2009	2010	2013	2009
Design	RCT	Pre/Post	Pre/Post	CCT	Pre/Post	RCT	CCT
Exercise	Tai Chi	Tai Chi	Tai Chi	Yoga	Yoga	Yoga	Yoga
N (treatment only)	10	13	21	26	5	11	9
Study Quality	80%	78%	78%	78%	75%	70%	67%
Pain	**VAS**	**VAS**	**VAS**	**VAS**	**VAS**	**SF-36**	**VAS**
within	NS	NS	NS	NS	*	~	*
between	NS	~	~	~	~	NS	NS
Fatigue	**VAS**	**~**	**VAS**	**SF-36**	**~**	**FACIT**	**~**
within	NS	~	**	NS	~	~	~
between	NS	~	~	~	~	*	~
Depression	**CES-D**	**SF-36**	**AIMS-2**	**SF-36**	**BSI**	**BSI**	**BDI**
within	NS	NS	**	NS	*	~	*
between	**	~	~	~	~	NS	*
Physical Function	**HAQ**	**HAQ**	**AIMS-2**	**HAQ**	**HAQ**	**HAQ**	**HAQ**
within	*	NS	**	**	NS	~	**
between	*	~	NS	~	~	NS	*

Legend: ROM= Range of Motion, Within = comparisons are made within the treatment group pre & post intervention. Between = comparisons are made between the post-tx group and the post-control group, NS= comparison made, but it was not significant

* p-value < 0.05 (indicates a significant difference in the comparison of the groups' scores), ** p-value < 0.01 (indicates a significant difference in the comparison of the groups' scores), ~ indicates that it was not assessed

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Chapter 3

Yoga Practice is Associated with Less Symptom Severity and Better Physical Function in Adults with Rheumatoid Adults

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ABSTRACT

Background. Therapeutic mind-body exercises such as yoga offer rheumatoid arthritis (RA) patients a symptom management strategy for improving their physical and mental health by incorporating meditative breath with exercise. Few studies have evaluated yoga practice as a strategy to manage symptoms of RA and improve physical function; moreover, none have examined the relationship between yoga practice and work status. The objective of this cross-sectional study was to investigate whether individuals who participate in yoga have less RA symptomatology, better physical function scores, and ability to work for adults with RA compared to adults with RA who do not participate in yoga.

Methods. Adults in Northern California with rheumatologist-diagnosed RA completed a telephone survey asking about their yoga use in the past year, disease status, symptoms, physical function, and work status. Primary outcomes were measured using validated scales: continuous numeric rating scale (NRS) of pain, Patient Reported Outcomes Measurement Information System (PROMIS) depression, PROMIS sleep disturbance, PROMIS physical function, and the Health Assessment Questionnaire (HAQ). Differences between the yoga and non-yoga participation groups were assessed with 2-sided t-tests or Pearson's chi-square tests. Multivariate linear regression analyses were conducted to identify significant associations between yoga participation and primary outcomes.

Results. A total of 398 adults with RA were included in the study; 88% were females and 66% were white. The mean (SD) age was 61.8 (12.6) years, and mean disease duration was 24.8 (12.3) years. In the overall sample, 42 (10.6%) people reported

participating in yoga in the past year. The yoga participation group was significantly younger ($p<0.001$) and had more education ($p=0.001$) compared to non-yoga participants. The yoga group had a significantly higher percentage of employed individuals ($p<0.05$) compared to non-yoga participants, controlling for age. Compared to the adults with RA who did not participate in yoga, the yoga participants had less pain, less disability and better physical function. Physical function remained significant ($p = 0.01$) after controlling for differences in age and education among the groups (Table 1).

Conclusion. These cross-sectional findings suggest that, in adults with RA, yoga participation is associated with better physical function. The study design limits the interpretation of the findings; it is unclear if yoga participants had better physical function preceding their yoga use. A randomized control trial using a yoga intervention is needed to determine the true extent of the effects of yoga on symptoms and physical functioning.

INTRODUCTION

Rheumatoid arthritis (RA) is a chronic inflammatory autoimmune disease, characterized by pain, stiffness, swelling and loss of joint function.[1] RA can affect any joint, but preferentially affects the small joints of the hands and feet. This painful chronic condition is often accompanied by disturbed sleep, fatigue, impaired ability to work and depression due to loss of function.[2] RA is a fairly prevalent chronic disease that affects at least two million adults in the United States (approximately 1% of the population); 75% are women. The onset of RA can occur at any time but usually presents starting anywhere after the fourth decade in women (around age 35) and in the fifth decade (around age 45) in men. Prevalence of RA increases with age in both men and women.[3]

Rheumatoid arthritis is typically treated with a multi-tiered approach. Patients are usually given medication, a prescription for exercise and sometimes other therapies depending on the severity of their disease.[4] Nonpharmacologic treatments, such as physical activity, can be helpful for people with RA.[5] The American College of Rheumatology states that stretching, strengthening and conditioning exercises preserve physical function.[6] Therapeutic mind-body exercises, such as yoga, are reported to improve health-related quality of life outcomes, including physical function, depressive symptoms, pain, fatigue, and sleep for people with RA.[5] The symptom management theory[7] asserts that when symptoms are bothersome enough, people will seek symptom management strategies. These strategies are seen as effective if they reduce the frequency or severity of a symptom, or if the strategy relieves the distress associated with the symptom. Yoga offers RA patients a symptom management strategy for improving their physical and mental health by incorporating meditative breathing with physical exercise.[8]

Although only a few studies have evaluated the use of yoga as a strategy to manage symptoms of RA, results are promising.[9-14] Yoga participants report reduced pain, disability, fatigue and depressive symptoms, as well as improved mood, general health and grip strength.[9-11,14,15] However, only two of these studies compare yoga participants to RA controls in an adult population representative of those most commonly affected by RA, those over 35 years of age. Two other studies focused solely on young adults. Moreover, no studies have been published evaluating yoga practice in adults with RA and its association with work status.

Thus, more research is needed to investigate yoga use as a strategy to decrease symptoms of pain, fatigue and depression in adults with RA and to gain an understanding of how decreasing these symptoms can improve physical function and work status. To address the gap in our understanding of the potential beneficial effects of yoga in RA, the objective of this cross-sectional study was to investigate whether participation in yoga is associated with less RA symptomatology, better physical function, and its association with work status in adults with RA compared to adults with RA who do not participate in yoga.

PARTICIPANTS AND METHODS

Subjects

Participants were a convenience sample of physician-diagnosed RA patients from outpatient Rheumatology clinics in Northern California who have participated in the UCSF RA Cohort telephone survey in previous years.[1,16] To be included in the study a patient must have been at least 18 years old, have a physician diagnosis of RA and have English fluency.

Study Protocol

Data from the validated quantitative instruments were gathered as a part of a larger RA cohort study conducted by the UCSF Arthritis Research Group. Potential participants in this large cohort study were identified by rheumatologists from outpatient Rheumatology clinics in Northern California. Participating clinics kept track of all patients with a physician-confirmed diagnosis of RA. Physicians in these clinics asked all RA patients if they were willing to be contacted by researchers from UCSF for participation in a research project. Contact information for all physician-diagnosed RA patients who agreed to be contacted was given to the UCSF Arthritis Research Group RA Cohort study staff. Data was collected via annual structured telephone interviews; data for the current analysis were collected in 2013-2014. Interviews included measures of pain, depression, fatigue, physical function, and employment status. This study was conducted with oversight from the UCSF institutional review board.

Measures

Yoga participation was based on the dichotomous response to a question asking whether they had participated in yoga in the past year. RA symptoms assessed included pain during the current day of the telephone survey, and depressive symptoms, fatigue, and sleep during the past week. Physical function and employment were also assessed for the past week.

Several of the outcomes of interest were measured using the National Institutes of Health (NIH) funded Patient Reported Outcomes Measurement Information System (PROMIS). PROMIS is a system of highly reliable, valid, flexible, standardized, precise, and responsive assessment items that measure patient–reported symptoms and quality of

life indicators across a range of chronic conditions. Psychometric properties for all PROMIS measures are available to the public on their website.[17] A unique aspect of the scores of the PROMIS measures is their anchoring to a mean score level in the healthy US general population, where a score of 50 on a PROMIS measure is the mean level for the US population, with one SD being 10 points.[18] The raw summary scores from PROMIS instruments are converted to t-scores in order to give a score that can be compared to the US population.

Pain. Pain was assessed using a single item continuous numeric rating scale (NRS) of today's pain on a scale of 0-100. This numeric version of the visual analog scale for pain is a unidimensional measure of pain intensity, with 0 representing no pain, and 100 representing the worst pain possible. The NRS has high test-retest reliability (r=0.96) in RA patients, and a high construct validity compared to the visual analog scale for pain (r=0.95) in patients with chronic pain.[19]

Depression. The PROMIS – Depression sub-scale within the PROMIS-29 Profile v1.0 questionnaire was used for this study. This subscale has 4 items focused on depressive symptom frequency in the past 7 days. Response options on a 5-point Likert scale range from "Never" to "Always" experiencing symptoms. A continuous raw summary score was obtained from the 4 items and converted to a t-score. Higher scores indicate more depressive symptoms. This scale has a high amount of internal consistency among our sample population; the Cronbach's alpha reliability statistic for this scale in our sample population was 0.89.

Fatigue. Fatigue was assessed using a single item categorical scale rating of the severity of fatigue experienced in the past two weeks. Response options ranged from 5 - "Severe Fatigue" to 0- "No Fatigue."

Sleep quality. Sleep quality was measured using the PROMIS Sleep Disturbance Short form 8b. This scale has 8 items focused on sleep disturbance frequency and severity symptoms in the past 7 days. Response options on a 5-point Likert scale range from "Never" to "Always" for frequency items, "Not at all" to "Very Much" for severity items. A continuous raw summary score was obtained from the 8 items and converted to a t-score. Higher scores indicate worse sleep quality. This scale has a high amount of internal consistency among our sample population; the Cronbach's alpha reliability statistic for this scale in our sample population was 0.92.

Physical function. Physical function was measured using both the Physical function sub-scale within the PROMIS-29 Profile v1.0 questionnaire and the Health Assessment Questionnaire (HAQ) -Disability Index. The Physical function sub-scale within the PROMIS-29 Profile v1.0 questionnaire has 4 items focused on level of difficulty in performing tasks in the past 7 days. Response options on a 5-point Likert scale range from "Unable to do" to "Without any difficulty." Higher scores indicate better function. A continuous raw summary score was obtained from the 4 items and converted to a t-score. This scale has a high amount of internal consistency among our sample population; the Cronbach's alpha reliability statistic for this scale in our sample population was 0.90.

The Health Assessment Questionnaire (HAQ) -Disability Index is a 41-item patient-reported functional disability index measures a patient's difficulty in performing

daily activities over the past week.[20,21] There are twenty 4-point Likert-scale questions that assess daily task difficulty, 13 yes/no questions that inquire about assistive devices and 8 yes/no questions that pertain to assistance with daily tasks. The stem of the Likert-scale items asks: "Over the past week, are you able to..." perform a particular task; answer choices ranges from 0 (no difficulty) to 3 (unable to do). Higher scores indicate worse function.[22] The assessment tool has well established reliability and validity.[21] The index has high internal consistency in the US population with Cronbach's alpha >0.90.[23] The Cronbach's alpha reliability statistic for this scale in our sample population was 0.95, demonstrating the reliability and internal consistency of this measure.

Employment status. Only adults of working age (under 65 years) were included in the employment variable (N=215). Employment status was evaluated based on a question asking the employment status of the participant over the past week. Answer choices included: working; had a job, but not working; looking for work; keeping house; going to school; unable to work; retired; or other. If a person selected working or had a job, but not working, they were asked, on average how many hours they had worked per week in the past year. The status of employed was assigned if a person acknowledged working any number of hours per week for pay within the past year. The status of unemployed was assigned if a person chose one of the categories: keeping house; going to school; unable to work; retired; or other.

Statistical Analysis

Means and standard deviations are given as descriptive statistics of continuous variables. Frequencies and percentages of the total group sample are given for categorical variables. Normality of data distribution was based on examination of the histogram and

the significance of the Kolmogorov-Smirnov test statistic. Differences between yoga and non-yoga groups were analyzed by Student's unpaired t-test or Chi-Square test where appropriate. Multiple linear regression analyses were used to estimate the unique contribution yoga participation had on differences between the yoga and non-yoga group on the continuous outcomes of interest, controlling for age and education. Missing variables were excluded listwise. Standard effect sizes for the between group differences were calculated using Cohen's d (95% CI) and interpreted as small (d = 0.2), medium (d=0.5), and large (d=0.8).[24,25] Data analysis was performed using the Statistical Package for Social Sciences (SPSS 22.0) for Windows, and significance for primary outcomes was accepted at p values < 0.05.

RESULTS

Over a period of 12 months, study staff attempted to contact 438 patients, 398 patients completed the surveys (89%). Of the 398 patients with completed surveys, 371 answered the question about yoga participation and 42 (10.6%) responded that they had participated in yoga in the past year. The yoga group was then compared to the 329 respondents who had not participated in yoga. Both groups, the yoga group and the non-yoga group, had similar demographic characteristics for sex, race and disease duration. There were only two men in the yoga group. As seen in Table 1, the yoga group was significantly younger ($p < 0.001$), had significantly more people with higher education ($p < 0.01$) compared to the non-yoga group. Age and education were therefore included as a potential confounder in all regression analyses. After excluding all participants over the age of 65, there were 215 people in the total sample, 31 in the yoga group and 184 in the

non-yoga group. There were a total of 94 employed adults under age 65. There were significantly more people employed in the yoga group (n=20, 64,5%) than in the non-yoga group (n=74, 40.2%), p= 0.012.

Table 1. Demographic and Clinical Characteristics of Rheumatoid Arthritis Sample

Variable	**Yoga Group (n=42)**	**Non-Yoga Group (n=329)**	**Statistic (p-value)**
Age, mean (SD) years	51.9 (13.7)	62.4 (11.9)***	t = -5.29 (<0.001)
Female (%)	40 (95.2%)	292 (88.8%)	X^2 = 1.67 (0.29)
White Race	31 (73.8%)	207 (62.9%)	X^2= 1.92 (0.18)
Disease Duration, Mean (SD), years	21.1 (12.4)	24.3 (11.0)	t = -1.65 (0.099)
High School Education or less	4 (9.5%)	109 (33.1%)**	X^2 = 9.8 (0.001)
Employed, N=94 (%)	20 (64.5%)	74 (40.2%)*	X^2 = 6.37 (0.012)

SD= Standard deviation

Missing values. Twenty seven people did not answer the yoga use question. The missing respondents had similar demographic characteristics to the yoga group for race and gender; however, they differed on age. The participants in the missing group were significantly (p<0.001) older (70.6 ± 9.0 years) than the yoga group (51.9 ± 13.7 years).

Table 2. T-test results assessing the difference between the yoga and non-yoga group

Variable (score range)	Yoga group (n = 42)	Non-yoga group (n = 329)	t - Test statistic (p-value)	Mean difference (95% CI)	Effect size: d (95% CI)
Pain (0-100)	29.1 (27.9)	39.5 (29.2)	2.2 (0.03)	10.5 (1.1, 19.8)*	0.36 (0.04, 0.68)
Fatigue (0-5)	2.3 (0.94)	2.6 (1.2)	1.53 (0.13)	0.29 (-0.08, 0.66)	0.26 (-0.07, 0.58)
PR - Depression (41-79.4)	47.6 (8.2)	48.8 (8.9)	0.79 (0.43)	1.14 (-1.71, 3.99)	0.14 (-0.19, 0.46)
PR - Sleep Quality (28.9-76.5)	41.6 (6.7)	41.9 (6.1)	0.30 (0.77)	0.33 (-1.85, 2.52)	0.05 (-0.27, 0.37)
PR - Physical Function (22.9-56.9)	46.8 (8.6)	40.8 (9.2)	6.02 (<0.001)	6.02 (3.09, 8.96)***	0.66 (0.33, 0.98)
HAQ Disability Index (0-3)	0.85 (0.64)	1.21 (0.77)	2.92 (0.004)	0.36 (0.12, 0.61)**	0.48 (0.15, 0.80)

Mean (SD) is given for the two groups. PR = PROMIS. HAQ = Health Assessment Questionnaire.

Table 3. The difference between the yoga and non-yoga group in mean outcomes, controlling for age and education status

Variable (score range)	Adjusted F (df, error df)	p-value	Adjusted Mean difference (95% CI)
Pain (0-100)	3.12 (1,365)	0.08	8.53 (-0.96, 18.03)
Fatigue (0-5)	1.68 (1,367)	0.2	0.26 (-0.13, 0.64)
PR - Depression (41.0-79.4)	0.66 (1, 367)	0.42	1.23 (-1.74, 4.20)
PR - Sleep Quality (28.9-76.5)	0.07 (1, 307)	0.8	0.31 (-1.98, 2.59)
PR - Physical Function (22.9-56.9)	6.63 (1, 363)*	0.01	3.96 (0.94, 6.98)*
HAQ Disability Index (0-3)	2.39 (1,367)	0.12	0.20 (-0.05, 0.45)

F and its associated p-value are results from the linear regression model controlling for age and education status. PR = PROMIS. HAQ = Health Assessment Questionnaire.

Symptoms

There was a significant difference in the mean pain scores between the yoga (29.07 ± 27.94) and non-yoga (39.54 ± 29.21) groups (Table 2); however, after controlling for age and education the significance level changed to p=0.12. As seen in Table 3, group membership had a small effect on pain (d=0.36).

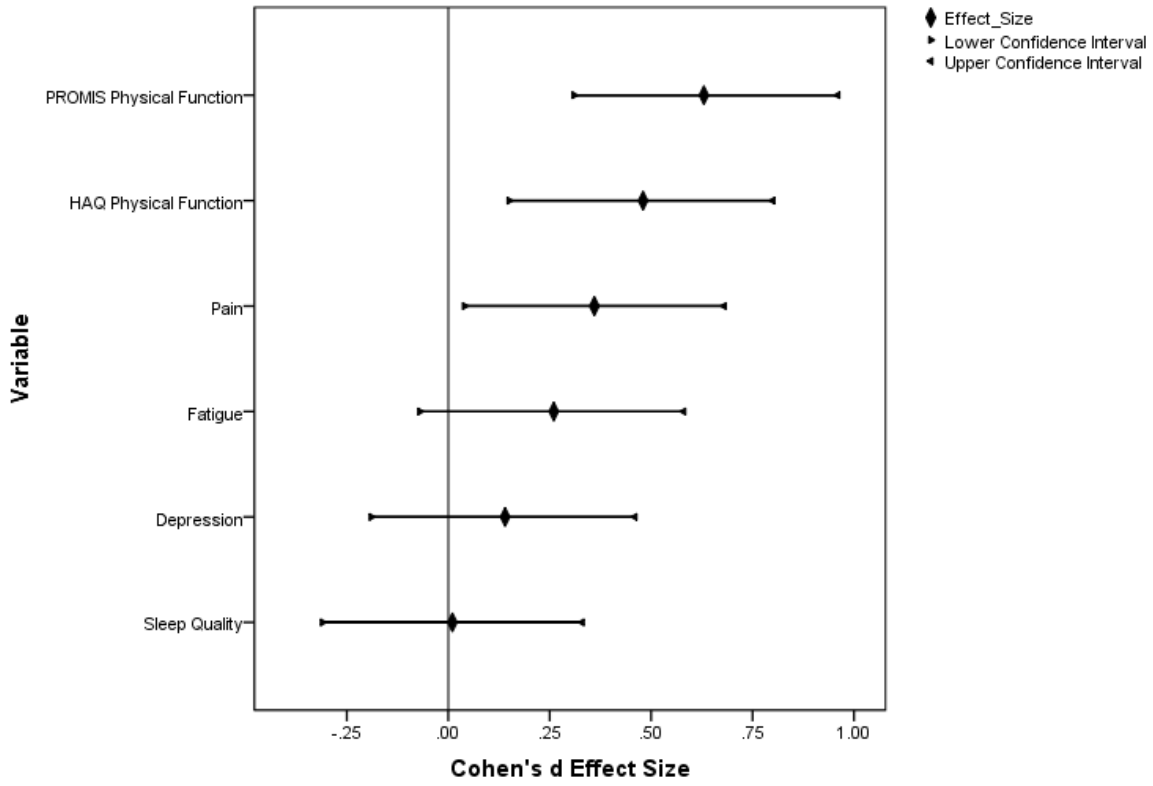
There was no significant difference in mean fatigue, depression, or sleep quality scores between the yoga and non-yoga group before or after controlling for age, education, and employment status. Group membership had a small effect on fatigue (d=0.26) and on depressive symptoms (d=0.14). Group membership had no effect on sleep quality (d=0.05).

Physical Function

PROMIS Physical function scale. As seen in Table 2, there was a significant difference in the mean physical function scores between the yoga (46.8 ± 8.6) and non-yoga (40.8 ± 9.2) group ($p < 0.001$). The yoga group reported significantly better physical function than the non-yoga group ($p = 0.01$) after controlling for age and education. Yoga participation is significantly associated with better physical function and can help predict variances in physical function regardless of age and educational status. Group membership had a large effect on physical function (d=0.66).

HAQ-Disability Index. There was a significant difference in the mean disability scores between the yoga (0.85 ± 0.64) and non-yoga (1.21 ± 0.77) groups ($p < 0.01$). However, there was no significant difference in the HAQ-DI physical function measure ($p = 0.23$) between the yoga and the non-yoga group after controlling for age, education, and employment. Group membership had a medium effect on disability (d=0.48).

Figure 1. Effect Size with Confidence Intervals for Primary Outcomes



DISCUSSION

This study is novel because this is one of the first studies to evaluate community yoga practice the associations between RA symptomatology, physical function and employment status. The results of this study demonstrate that adults with RA who practice yoga had significantly less pain, had significantly better physical function, and were more frequently employed than those who did not practice yoga. Since there were pre-existing differences between the two groups in age and educational status we decided

to run a regression model where we could control for these differences between the two groups. Although the two groups also differed in employment status it was not included as a covariate because it is one of one of the main outcomes, and it is highly correlated with physical function, in addition, since not all participants reported employment status the sample size for all analyses would be greatly reduced. After running the regression model, the group that practiced yoga continued to have better physical function scores than the group that did not practice yoga.

The association between yoga participation and better pain and physical function scores found in this study are supported by findings from previous studies investigating yoga practice in adults with RA. Several studies have found that physical function scores improved from baseline after participation in a yoga program.[9,10,13] In addition, two yoga intervention studies have shown a decrease in pain as a result of participation in yoga.[10,12] Although the results of the current study are encouraging and are supported by previous findings in the literature, the cause for better pain and physical function scores in the current study cannot be determined. The cross-sectional study design used in this study measures the outcome scores at one point in time and this type of study cannot determine whether pain and physical function were better before the start of yoga practice or if they were improved as a result of the yoga practice. The RA participants may indeed have had less pain and better physical functioning than the non-yoga participants and that was the reason that they chose to practice yoga; however the evidence in the literature supports the likelihood that the yoga participants had less pain and better physical function as a result of the yoga practice.

Several of the demographic characteristics of the yoga participants in our sample are reflective of national samples of yoga participants. Nationally, yoga participants tend to be white, young, women, who have more years of education compared to non-yoga participants.[26] In our study the yoga and non-yoga groups did not differ significantly in gender or race but did follow national trends in age and education status. Our yoga practice group was younger and had more education than the non-yoga group. Educational status is seldom recorded in yoga studies in the literature, in fact only one other yoga study in RA adults mentioned it.[12] This is an important proxy measure for socio-economic status. It can be easily assumed that a person with a higher socio-economic status would have better physical function than a person with lower socio-economic status, simply because they are likely to have better access to medical care and treatments.[27,28] With the inclusion of this variable in our analysis we have removed the possible contribution of high socio-economic status to the improvement of physical function in our participants. Our yoga participation group showed significantly better PROMIS physical function scores than the non-yoga group after controlling for the influence of educational status.

Our yoga group was significantly younger than the non-yoga group. However, the RA cohort sampled for this study represents a much older sample of yoga participants than the average mean age of yoga participants in the US. The mean age of our yoga participants was 51.9, where the national mean age is 39.5 years. The sampling of older yoga participants is one of the strengths of our study, since it is more representative of the typical RA population. Other published yoga studies have sampled younger RA populations.

The participants in this study had overall fairly long disease duration, an average of twenty-one years. RA patients with longer disease durations do not respond as well to treatments compared to patients with early disease.[29] This potentially explains why despite a theoretical basis for yoga's ability to improve depressive symptoms, fatigue, and sleep quality, no association was found in the current study. Additionally, our findings were similar to the findings of Badsha et al, where only physical function was improved through yoga participation, but not pain, fatigue or depression.[9]

The sample population in this study did not have particularly severe depressive symptoms. Our depressive symptoms scores correspond with previous research on the association of depression and socioeconomic status in RA patients. Maragretten et al found that low socioeconomic status is a large determining factor in depression in RA patients.[30] The sample participants in this study had high socioeconomic status; they were highly educated Caucasians with insurance, who were seen at private rheumatology offices in North California. The PROMIS depression scores in both the yoga and non-yoga group were very similar to the average depression scores for the US population. Since the depression scores indicate that this population was not depressed more than the average person, it is not surprising that the PROMIS depression scores were not associated with yoga participation.

The correlation between poor sleep quality and severity of pain are well documented in multiple pain conditions.[31-33] Since our study population reported having low levels of pain, it follows that our population did not have particularly poor sleep

quality. Their means PROMIS Sleep scores were 41, which corresponds to one standard deviation better sleep quality than the average sleep quality score for the US population.

Multiple studies suggest that depression, sleep quality and disease activity are key predictors of fatigue.[34,35] Although disease activity was not measured in this population, it was likely that since they had such long disease durations, their RA was well controlled and that they had low disease activity. Since our sample population was not depressed, nor did they have poor sleep quality and likely did not have severe disease activity, it is not surprising that the severity of fatigue symptoms for the sample population were low; fatigue scores were in the mild to moderate fatigue range. Therefore, similar to depression, the fatigue scores did not improve with yoga participation.

Little work has been done to investigate the association between yoga and employment status in RA. In fact, no quantitative papers are known to the authors that examine the effect of RA in relation to employment status. In our study there was an association between yoga practice and employment. Our theoretical model for yoga practice as a symptom management strategy suggests that when RA patients have their symptoms well controlled, they have better physical function, and in turn would have better physical and mental ability to maintain employment. However, we do acknowledge that is possible for the converse to be true; people who are employed have better physical function and are more able to participate in yoga due to better financial and physical capabilities than an unemployed person. A controlled trial or longitudinal study would be required to further examine this relationship.

Some limitations in this study should be noted. There are inherent limitations in some of the methodologies chosen, including the study design and data collection

choices. As mentioned previously, cross-sectional studies can only describe associations and differences, but not causation or directionality. Intervention trial or longitudinal studies are necessary to determine the causal relationship between yoga practice and the outcomes of interest. The outcomes were measured using interviewer administered self-assessment patient-reported outcome (PRO) measures. In general self-assessment measures can be at risk for threats to content validity and re-call bias. However, the measures used in this study have been well validated and proved to have strong reliability in this cohort, therefore, the risk of invalid responses is minimized in this study. The risk of recall bias is minimized by asking questions about symptoms and function within the past month. In addition, the PRO questionnaires allow for capture of responses directly from the research participant, which represent the patient perspective more accurately than observational measures.[36] A yoga variable which quantified yoga participation would be more informative than the single-item dichotomous independent variable of yoga participation in the. However, this is a standard assessment method for yoga participation used in self-reported survey data collection.[37]

The sample population for this study may not be representative of the all adults with RA, thus limiting the generalizability of our findings. Our study participants are pooled from private rheumatology clinics in Northern California and are primarily white with relatively high income and education. In addition, many of the participants of this long-term cohort study of RA (active since 1982), have long disease durations and may represent a healthy survivor effect.

In spite of these limitations, this study has strengths and important implications. This is one of the few yoga studies in adults with RA assessing physical function and

symptoms using well-validated scales. This research further pushes the field of yoga research forward by providing a theoretical framework to explain the hypothesized mechanism of symptom improvement. The hypotheses of this work are grounded in the symptom management theory.[7] It was hypothesized that yoga can be used as a symptom management strategy to improve symptoms related to RA, such as pain, fatigue severity, poor sleep quality, and depressive symptoms and that improvement in physical function is then mediated by improvements in symptoms. Our results support this hypothesis generated by the symptom management theory. Additionally, it may be possible that work status is mediated by symptom and functional improvement.

Next steps should include more rigorous research into the encouraging results found here. A controlled trial or longitudinal study could answer many of the questions posed by the results of this study by providing a time course of events, where directionality of associations could be determined. Direct impacts of yoga participation could be investigated in a controlled yoga intervention study with a good sample size and validated instruments on an appropriate RA population would be necessary. Also RA specific yoga program would minimize risk of additional injury and provide the additional social and emotional benefit of a support group. Additionally, a qualitative study exploring patient perceptions about yoga practice in adults with RA would be useful to determine acceptance and attitudes about yoga practice in this population and thoughts about yoga practice as a tool for physical function improvement and symptom management.

In summary, yoga participation was significantly associated with less pain and better physical function in adults with RA compared to adults with RA who did not

participate in yoga. Yoga participation was not associated with improved sleep quality, fatigue severity, and depressive symptom severity in our population.

In conclusion, RA symptoms and physical disability are a problem despite contemporary pharmacologic management; yoga may provide an effective, non-pharmacologic way to address these symptoms and disability. It has been well documented in the literature that physical activity is low in people with RA compared to those without chronic illness.[38] Low intensity physical activities, such as yoga, have been shown to be the most beneficial for improvements in physical function and problematic symptoms, such as pain, fatigue, depression and sleep.[38-40] The number of yoga users is increasing nationally; 9% (21 million) of the US population practiced yoga in 2012, up from 6% in 2007.[26,41] Additionally, yoga is the most popular complementary medicine practice used in the US and chronic pain conditions was the number one reason for its use.[42] This study adds additional strength to the growing body of research that suggests that yoga is an acceptable physical activity that may be able to improve physical function and decrease pain in adults with RA. This is an important finding in order to provide rheumatology clinicians another non-pharmacological option to offer patients who need help controlling their pain and improving physical function.

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Chapter 4

"Yoga Meets You Where You Are": A Qualitative Study Exploring Yoga Practice in Adults with Rheumatoid Arthritis

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ABSTRACT

Background. Physical activity is reported to improve physical function and reduce disease symptoms in adults with rheumatoid arthritis (RA); however adults with RA are less likely to participate in physical activity than adults with other chronic diseases. The dynamic mind-body physical activity of yoga may be an acceptable and beneficial way for RA adults to increase physical activity. However, little is known about how patients with RA are practicing yoga in the community and about the benefits they experience. The objective of this qualitative study was to explore yoga practice characteristics in addition to perceived benefits and facilitators of yoga practice in adults with RA.

Methods. A convenience sample of 17 adults, with rheumatologist-diagnosed RA, who had participated in yoga within the previous year, completed a semi-structured telephone interview with open-ended questions. An interview guide was used to explore: the decision to start, continue and stop yoga; perceived benefits of yoga; importance of components of a yoga session; and general thoughts about yoga as it relates to RA. Thematic analysis was used to analyze interview transcripts.

Results. The majority of the 17 participants were white (71%), female (94%), employed full-time (53%), had mean age of 56 years, had an average disease duration of 21 years, and had bachelor's or graduate degrees (65%). The primary style of yoga practiced was Vinyasa and Restorative/Gentle (47% combined). Three main themes were identified: (1) Facilitators, (2) Barriers, and (3) Benefits of yoga practice. Facilitators included: socialization, physical fitness, and improving practice. Barriers included:

finances and class mismatch. Benefits included: increased coping abilities and improved sleep, flexibility, energy, strength, balance, pain, mood, and physical function. There were many styles of yoga practiced and participants described various ways to adapt or change an existing yoga practice to meet the physical and emotional needs of the practitioner on any particular day. Study participant quotes illustrated how the dynamic exercise of yoga, which can be gentle with breath exercises, meditation, and relaxing stretches or can be a vigorous exercise with fast moving strenuous poses, suited their dynamic needs as a person with fluctuating symptom burden.

Conclusion. In this study RA patients described how yoga practice helped improve physical function and numerous RA disease symptoms. Yoga practice can provide many benefits for adults with RA when it is practiced at the right pace for the individual. Yoga practices vary and yoga may not be beneficial for every adult with RA, in fact it may be harmful if practiced inappropriately. Next steps include further investigating the role of the yoga teacher and the physical yoga practice environment as facilitators and barriers to practice.

INTRODUCTION

Rheumatoid arthritis (RA) is a prevalent chronic inflammatory autoimmune disease that affects at least two million adults in the United States (approximately 1% of the population); 75% are women.[1] RA is characterized by pain, stiffness, swelling and loss of joint function. RA can affect any joint, but preferentially affects the small joints of the hands and feet. This painful chronic condition is often accompanied by reduced quality of life, fatigue, depression, and loss of physical function.[2] The American College of Rheumatology states that stretching, strengthening and conditioning exercises preserve physical function.[3] In addition, physical activity is reported to improve physical function and reduce disease symptoms in adults with RA.[4-11] There are a number of physical activities that have been shown to be beneficial for physical function; however, few of these physical activities have demonstrated benefits for emotional and psychological symptoms experienced by adults with this type of chronic pain condition.

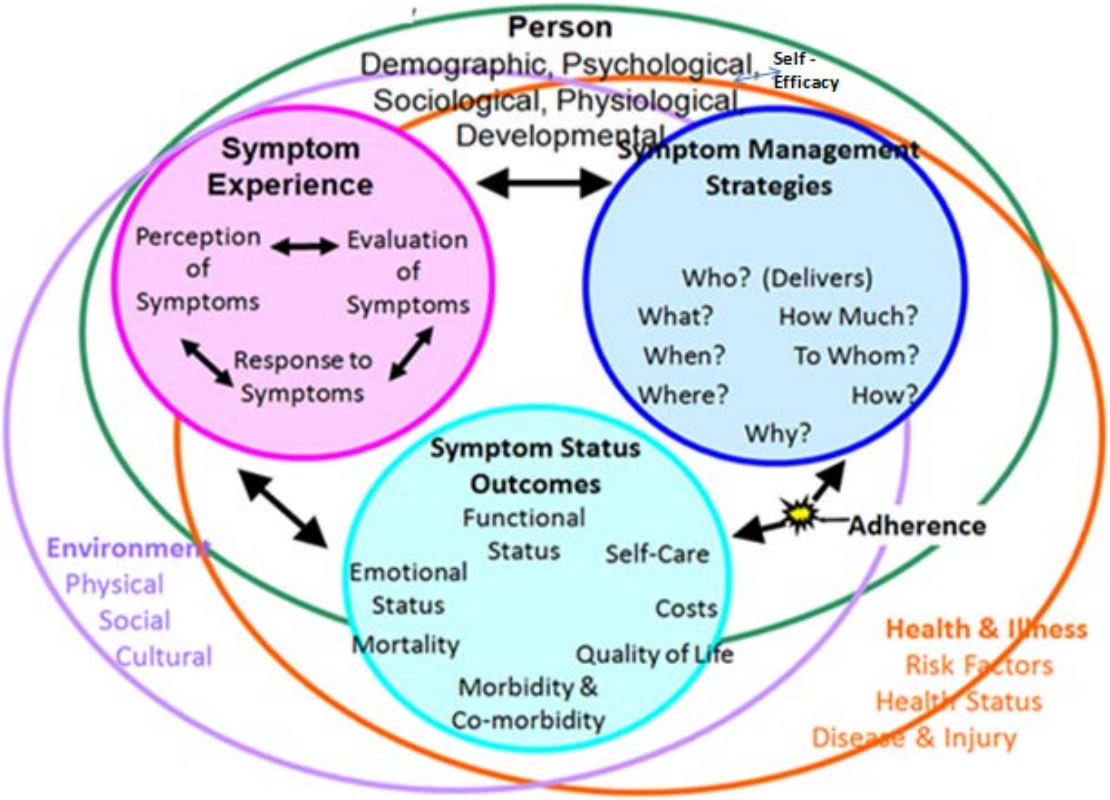
Studies that evaluate the use of therapeutic mind-body exercises, such as yoga, for improved physical function in adults with RA are beginning to emerge in the literature with promising results. [10-15] Participants in yoga programs reported reduced pain, disability, fatigue and depressive symptoms, as well as improved physical function, sleep, mood, general health and grip strength.[10-12,15-17] Yoga offers RA patients a way to improve their physical and mental health by incorporating meditative breathing with physical exercise.[18] Yoga is an ancient practice that emphasizes stretching, strengthening and breathing and is gaining popularity in western countries as an intervention for conditions that cause pain. [19,20]

RA patients often express an interest in non-pharmacological management strategies, therefore studies that demonstrate the effectiveness of yoga for improvement of physical and psychological symptoms are important to demonstrate the benefit of a non-pharmacological therapy to assist in the management of RA.[21] However, little is known about how patients with RA are practicing yoga and the benefits they experience. RA patient attitudes about yoga, requirements for practice, and perceptions of yoga practice for symptom management were studied in one qualitative study.[22] Another qualitative study explored the perception of an Iyengar yoga intervention program on physical function, pain, mood, social benefits and suitability for people with RA.[23] While these studies provide important insight, they focused on RA patients who had not yet participated in yoga and people who have practiced yoga only as part of a research study. No studies have been published using qualitative methods to evaluate how adults with RA are participating in yoga in the general community or to explore the factors that influence commitment to continue with yoga. Thus, research is needed to provide an understanding of how and why yoga is being practiced, by whom, and what factors influence yoga participation in adults with RA who practice yoga in the community.

An important theoretical framework that can inform thinking about yoga as a mind-body therapy to improve symptoms of RA is the middle range theory of Symptom Management (Figure 1).[24] Utilization of theory assists researchers in organizing their thoughts around a shared framework of understanding.[25,26] In addition, theories can also help researchers articulate how research findings can contribute evidence for clinical practice.[25,27] The Symptom Management Theory (SMT) gives researchers a way to address the subjective experience, or symptom, of an individual's illness. A symptom is a

patient-reported subjective experience, which often reflects changes in biological, psychological and social functioning. The SMT[24] describes three main concepts/domains: patient symptom experience, symptom management strategies, and symptom status outcomes. This paper will focus on the concept of the symptom management strategy, which is used to describe an individual's efforts to avert, delay, or minimize the symptom experience.

Figure 1. Adapted 2008 Symptom Management Theory[24]



The objective of this qualitative study was to explore yoga participation as a symptom management strategy in adults with RA who acknowledged that they participated in yoga at some point in the past year. Utilization of the SMT framework for investigating symptom management strategies requires consideration of several important factors: Who is practicing yoga? What type of yoga was practiced? Why was yoga

chosen, why was it continued, or stopped? What are important characteristics of yoga? What benefits were experienced? Where was yoga practiced? How much yoga is practiced (dose)? How long has yoga been practiced?

METHODS

Participants

Participants were a convenience sample of physician-diagnosed RA patients from outpatient Rheumatology clinics in Northern California who participated in the UCSF RA Cohort telephone survey in previous years. The inclusion criteria were: being at least 18 years old, having a physician diagnosis of RA, being fluent in English, and having responded that they participated in yoga within the past 12 months in the previous year's telephone survey. Institutional review board approval was acquired from the University of California, San Francisco Committee on Human Research. Anonymity and confidentiality were upheld according to their guidelines. An introductory letter explaining the purpose of this new research and requesting interviews was sent via US Mail to the 42 participants who had responded that they had participated in yoga in the 2013 UCSF RA Cohort survey. Three participants responded that they did not wish to participate. Approximately three weeks after the mailing, telephone contact seeking to arrange interviews was attempted for the remaining 39 participants. Seventeen of the original 42 participants completed the telephone interview.

Data Collection and Analysis

Data collection for this qualitative study began January 2015 and ended in March 2015. Interviews were conducted via telephone using a structured interview guide with

open-ended questions. The audio-taped telephone interviews were conducted by a single researcher (HMG) and lasted approximately 30 minutes. The initial open-ended questions in the interview guide were framed by the symptom management strategies in the SMT and addressed how and why the participants practiced yoga and on perceived benefits; questions included: 1) style, content, duration, frequency, and location of yoga class; 2) why yoga class was chosen initially; 3) importance of components of yoga class; 4) why yoga practice was continued or stopped; and 5) perceptions of benefits received from yoga participation. Open-ended questions from the interview guide are presented in Table 1. Thematic analysis was used to guide the data analysis.[28] Coding was used to analyze the transcripts of the interviews in order to determine key categories in the data. Categories as well as relationships between the categories were identified using theoretical memos and were discussed among two researchers (HMG, HL). To ensure scientific rigor an experienced researcher (KL) validated whether the identified categories were in agreement with the raw data. Demographic and quantitative data regarding the dose and duration of yoga practice were analyzed using SPSS version 21.0.

Table 1. Interview guide, open-ended questions

Why did you decide to try yoga for the first time?
What benefits did you experience after practicing yoga?
Why did you continue to go to yoga?
What are important components in a yoga session?
Why did you stop doing yoga / Why don't you do yoga more?
Do you have any thoughts about yoga as it relates to your RA?

RESULTS

Participant Characteristics

The average age of the 17 participants was 56 years (range 35-72 years), the majority of the participants were white (71%), had bachelor's or graduate degrees (65%), and 16 of the 17 participants were female. Average disease duration was 21 years (range 5-44 years). Demographic characteristics of the participants are presented in Table 2.

Table 2. Demographic and Clinical Characteristics of RA Participants

Variable	Yoga Group (N=17)
Age, Mean (SD), years	56.1 (10.7)
Female (%)	16 (94%)
White Race	10 (59%)
Disease Duration, Mean (SD), years	20.9 (10.7)
Education	
High School Graduate	1 (6%)
Some College (<Bachelor's)	5 (29%)
College Graduate/Bachelor's Degree	5 (29%)
Masters/PhD/Professional Degree	6 (35%)
Employment	
Part-Time (≤20 hrs/wk)	1 (6%)
Full-Time (≥21 hrs/wk)	9 (53%)
Retired	7 (41%)

RA= Rheumatoid Arthritis, SD= Standard deviation

Yoga Practice Characteristics

The yoga styles practiced by participants varied from the very common well known Vinyasa yoga (24%) to lesser known styles like Forest yoga (6%), and several styles in between: Restorative/Gentle (24%), Iyengar (12%), Hatha (12%), Hot-power Flow (6%), Bikram (6%) and hybrid styles created by instructors like "Joe's yoga" which is a hybrid-style combination of Vinyasa and Ashtanga (6%). Two participants did not know the type of yoga practiced.

Since yoga styles vary greatly between yoga lineage and instructor, participants were asked to describe the components of their yoga sessions. Yoga sessions typically included the following components: stretching (100%), strengthening (94%), aerobic physical exertion (65%), breathing exercises (88%), meditation (82%), positive verbal statements from the instructor (88%), spirituality (29%), and chanting (12%) (see Table 3). The average duration of a yoga session was 56 minutes (range 30-90 minutes). Frequency of yoga use was about 3 times per week (range 0-6). The average number of years practicing yoga was 12.6 (range 0-45). The locations of yoga sessions were most commonly in a gym (41%), a yoga studio (29%), or at home (29%). The participants' reported percentage of time spent in each component of their yoga class is presented in parentheses in Table 3.

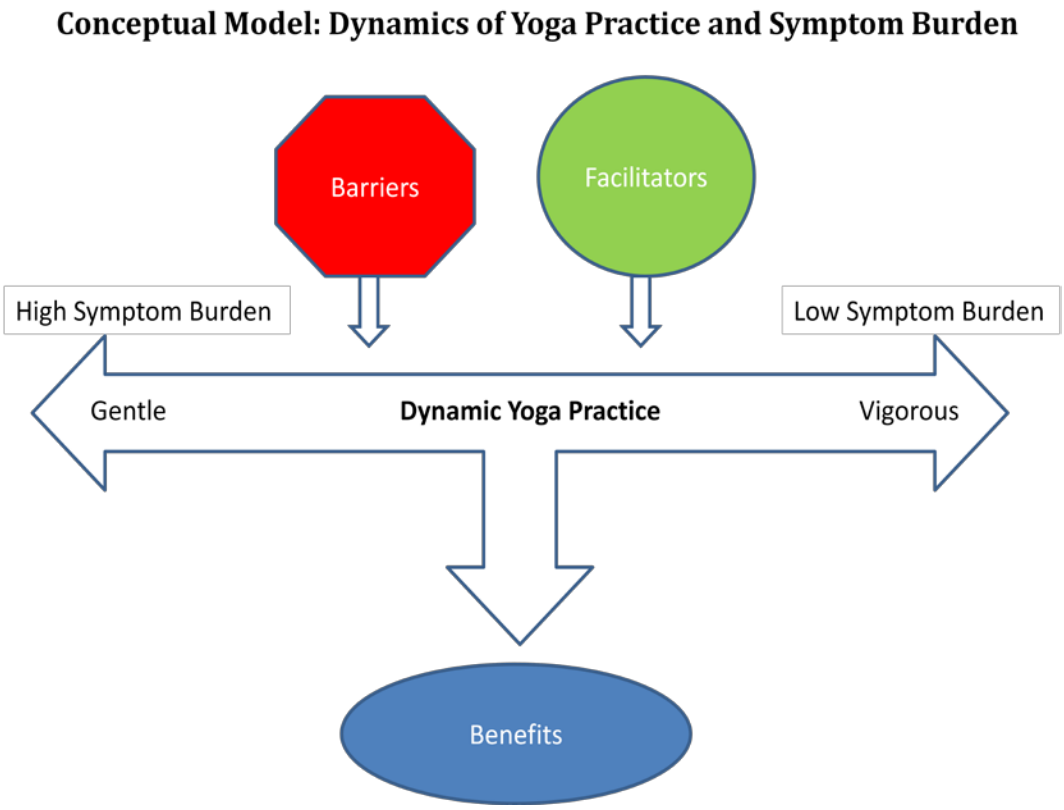
Table 3. Yoga Practice Characteristics

Characteristic	Yoga Group (n=17)
Yoga Style Practiced – N (%)	
Vinyasa	4 (24%)
Restorative/Gentle	4 (24%)
Iyengar	2 (12%)
Hatha	2 (12%)
Forrest	1 (6%)
Hot-Power Flow	1 (6%)
Bikram	1 (6%)
Hybrid Styles	1 (6%)
Yoga Session Components – N (%)	
Stretching	17 (100%)
Strengthening	16 (94%)
Aerobic physical exertion	11(65%)
Breathing exercises	15 (88%)
Meditation	14 (82%)
Positive verbal statements from the instructor	15 (88%)
Spirituality	5 (29%)
Chanting	2 (12%)
Yoga Duration per session, mean (range), minutes	56 (30-90)
Yoga Frequency, sessions per week, mean (range)	3 (0-6)
Years Practicing Yoga, mean (range)	12.6 (0-45)
Yoga Location – N (%)	
Gym	7 (41%)
Yoga Studio	5 (29%)
Home	5 (29%)

Overarching Theme: Yoga meets you where you are

A recurrent, unifying theme emerged from the data during the coding of the participant discussions about the initial questions: "yoga meets you where you are." Within this overarching theme, three specific sub-themes emerged describing the barriers or facilitators to practicing yoga and what benefits resulted from their yoga practice: facilitators, barriers, and benefits to yoga practice.

Figure 2. Conceptual Model for the dynamic practice of yoga



"Yoga meets you where you are," a common mantra in yoga, means that the practice of yoga is adaptive, versatile and holistic to suit the needs of the practitioner. There are many styles of yoga practice and various ways to adapt or change an existing yoga practice to meet the physical and emotional needs of a participant on any particular day. The physical and emotional needs of RA patients are as diverse and dynamic as the disease itself. In an inflammatory disease like RA, a patient's symptom burden often fluctuates with disease activity; they must daily re-assess their physical abilities according to their symptoms and disease activity. In addition, emotional needs are different for each patient and can change. Some RA patients need more emotional support at the beginning of their disease, when they face uncertainty in their abilities and

some need it later in their disease when they are having difficulty dealing with the chronic pain associated with this condition. Participants illustrate how the dynamic exercise of yoga, which can be gentle with breath exercises, meditation, and relaxing stretches or can be a vigorous exercise with fast moving strenuous poses, suits their dynamic needs as a person with fluctuating symptom burden.

Many of the RA participants explained that they practice yoga because it is a physical activity that they felt was the right pace and gentle enough to be able to participate in it given the physical limitations of their disease. A 66 year-old female practicing gentle yoga for 2 years said,

> *"It was a slow start, but I noticed stuff right away, so that encouraged me to keep going …It was a great experience... it was gentle… I was encouraged that I could do it, and I sort of wasn't overwhelmed, so I wasn't like, 'oh my gosh, this is too hard for me, I can't go back,' so, it was just my right pace."*

A 72 year-old female illustrates the desire for a gentle exercise that met her perceived physical limitations. This woman had been practicing yoga for over seven years and said,

> *"I thought it would help me building up my strength because I couldn't do a lot of the things, the more active things, and I have had shoulder issues, so I couldn't swim anymore, so I was looking for something I could do and I just happened to find a class that was gentle yoga."*
> Similarly, a 65 year-old female who had practiced for 3 years said,
>
> *"I wanted something more gentle than the hard core aerobics stuff that I was doing. And I thought that it would help me stretch out and um, hopefully give me more mobility."*

Many participants were looking for a physical activity that would be the right pace for them given the physical limitations of their disease. The health and illness of the participants, specifically their RA disease activity, played an important role in the

decision to start yoga. Participants illustrated that yoga met them where they were because it was gentle, inviting, and something they could envision doing despite perceived limitations.

Sub-Theme 1: Facilitators

Participants described a variety of facilitators to the initiation and continuation of yoga practice which included desire for physical fitness, being influenced by others, and experiencing increased benefits with more practice.

Desire for physical fitness. Participants expressed a desire to improve physical fitness such as wanting to build strength, improve flexibility, posture and balance. For example, A 53 year-old female who had been practicing for 2 years said,

> *“I've always been into fitness, but probably the first, my primary reason was I wanted to try it out because I like the contemplative types of physical activity that I had done before, and wanted to try yoga as one of those things and also for flexibility reasons because of the RA"*

Similarly, a 57 year-old female who had practiced for over twelve years said that she got started doing yoga because she wanted to be a better gardener.

> *"I was very much into gardening at the time and I wanted to be stronger in my legs so that I could lunge from side to side and carry more things and be more strong."*

In addition to preserving and promoting physical fitness, some participants used yoga to help with the aging process. A 67 year-old female who had practiced yoga for 10 years said,

> *"I'm older now and I needed to do something about balance and posture."*

***Being influenced by others*.** Several participants described being brought to yoga by some other force, the suggestion of another person, winning a yoga studio class-pass, or having a special at the yoga studio. Most people were brought to yoga by a desire for

improvement in their physical body; however, some were also brought to yoga by the influence of others or society, such as with a 35 year-old female who had tried yoga 3 times. She said,

> *"…just wanted to be more flexible, and also, it was the trend."*

For some participants, the health care profession played a role in the motivation to try yoga. A 63 year-old male who was new to practicing yoga (4 months) said,

"When I got into the Pain Management Program, they suggested that I get into yoga."

Other participants were influenced to start yoga by their friends and social circles. A 48 year-old female who had practiced Iyengar yoga for over ten years said,

> *"…actually friends of mine…they used to have a yoga instructor come to their home and she said…why don't you give it a try."*

Similarly, a 47 year-old female who has been practicing Bikram yoga five days a week for the past 2 years said she started from the influence of friends,

> *"A group of friends here at work had talked about doing Bikram yoga, and there was a deal, so I tried it."*

Increased benefits. In addition to finding an exercise that fit their initial physical activity needs, many participants felt like the benefits of yoga grew over time and got better the more they practiced it. A 48 year-old female who had practiced Iyengar yoga for over 10 years said,

> *"in the beginning, my joint stuff was really bad, it was kind of hard for me to do all the poses, but as I started doing it, I did notice that there were certain poses like the triangle pose, and stuff, that, I hated at one point, but then I was able to do it, so I noticed that my flexibility did improve."*

Sub-Theme 2: Yoga Practice Barriers

There were several reasons given for not practicing yoga as much as one would like or for ceasing yoga practice all together. Participant stated barriers to practicing yoga included financial issues, yoga class mismatches, and symptom burden.

Financial issues. A 72 year-old female who had been practicing yoga for over seven years said that her instructor recommended that she practice yoga more often, but she wasn't able to afford it.

> *"She recommends that I have it twice a week, but financially I just can't do that."*

Yoga class mismatches. Yoga practice was ceased by some participants. Two people with RA did not continue practicing due to not finding the right yoga class fit. A 35 year-old female who had tried a yoga class three times felt that yoga would be beneficial for mood and other health benefits, but ultimately felt like the class she tried didn't meet her physical needs,

> *"it was really hard to bend, like my joints, I felt like it wasn't for me or like people with arthritis."*

Similarly a 56 year-old female who had tried yoga only one time expressed that the class she tried didn't seem like it met her physical needs,

> *"I think I would like to try yoga again but it would have to be in a therapeutic environment, meaning, I would need, probably pillows or other things that would help me to do the exercises, you know."*

Both of those that decided to stop practicing due to class mismatch said they would like to try it again if there was a class suited to their needs.

Symptom burden. Some people with RA could not practice as often as they would like and one could not continue practicing at all due to their hyper-disease activity, commonly called a "flare." Although none of the yoga participants mentioned an RA

flare when asked why they did not practice as much as they liked, many mentioned having to modify exercises or stop exercising for a period of time due to a flare. A 48 year-old female and long-time Iyengar yoga practitioner said that when she had an RA flare she had to stop all exercise until her flare subsided.

> *"I stopped all the gym stuff, then started in the pool and worked up to yoga again."*

A 53 year-old female who has been practicing Vinyasa for the past 2 years felt like she could continue to exercise during a flare if she switched to a gentle style class during a flare.

> *"I don't generally have a lot of pain, but I remember the times when I did, and yoga, as long as it was gentle enough, that I could do when I was flaring, it would be something that would be useful to me."*

However, 68 year-old female who had practiced Vinyasa yoga for over 30 years said she had to stop practicing yoga do to her persistent RA flares.

> *"I had to stop doing yoga because of my RA. I needed something more gentle, so I do Qigong now. I actually tried yoga again recently, but it caused a flare, so I said, okay, well, I've got to stop doing that."*

It was interesting to find that one person had the completely opposite reaction to having an RA flare. She felt like she needed to keep moving and exercising through a flare. This 67 year-old female, diagnosed with RA at age 23, had practiced gentle yoga for over 20 years and said,

> *"if your ankle or your wrist or your shoulders or whatever were…hot, and you were having a flare…the doctors…wanted you to go to bed and take care of the swelling you know. And that was not the right way to do it and because I was 23 I wasn't about to sit down in the chair and miss out on my life. I think in that way, I learned early, that forcing yourself to take the next step, and get out of the chair, and go look at the garden or whatever you want to do…I learned very early that the harder you push yourself without hurting yourself, the better the outcome is going to be…The more active you stay, no matter what your issues are, the better off you're going to be."*

These quotes illustrate how participants' physical limitations, general outlook, symptom status, and disease activity played a major role as a barrier to yoga practice.

Sub-Theme 3: The Benefits of Yoga Practice

The curiosity, influence of others and the desire for physical fitness was what brought people to yoga but it was the wealth of physical and mental benefits that they found in this dynamic physical activity that kept them coming back. Participants found benefits whether they were practicing gentle yoga or vigorous yoga. Participants of yoga practice discovered that in addition to the physical improvements in pain, fatigue, and sleep disturbance, they also experienced mental and psychosocial benefits such as improved: coping skills, mental focus, mood, relaxation and socialization. The benefits of yoga practice included: physical and psychosocial benefits, pride and achievement, and a tool to cope.

Physical and psychosocial benefits. Participants in yoga expressed noticeable benefits in improved physical and psychological well-being. A 66 year-old female who had practiced gentle yoga for the past two years explained the utility of yoga as a symptom management technique,

> *"it just helps me with my overall mobility, I just feel like I am able to move so much better...I have improvement in all of those things, pain, energy, mood…I really, really like it, I feel it's so worth it, I do enjoy it very much. Sometimes, you know, it's hard to go, you're like, 'Oh gosh' but every time I go I always feel so much better after, when I'm leaving, so it's great."*

A 72 year-old female who had practiced Iyengar yoga for seven years believed that yoga could be a powerful tool for pain relief and helped with flexibility.

> *"I think the savasana part is a wonderful pain reliever. They allowed me to use my iPhone, with that on it, with my earphone when I went into surgery for my new*

knee, and I hardly needed much in the way of medication, really, I got my 90 degrees in no time and I really give yoga the credit."

In addition, yoga was used to manage mental health symptoms. A 48 year-old female who practiced Iyengar yoga for over 10 years said,

"It does help with the energy I think and flexibility. And if I do a lot of the meditation part of it and centering I think it helps my mood also."

Similarly, a 68 year-old female who practiced yoga for over 35 years also indicated how yoga helped with her mood,

"Well, it just made me feel better, more flexible, it made me feel, um, more calm, more better inside, stronger….it helps my mood, outlook and energy"

The physical practice of yoga helped many of the participants lead healthier lives off of their yoga mat. A 47 year-old female who had practiced Bikram yoga for the past two years describes how yoga helped significantly with not only pain, function, and mood, but also with mental focus and inner discipline.

"I definitely feel improvement with less pain, less stiffness, I eat better, I sleep better, my focus is much better, more disciplined for the things that I need to stay healthy for my RA."

The majority of participants found the social aspect of yoga to be beneficial. One 63 year-old male continues to go to yoga for the social component, in addition to the benefits of pain relief, mood, and flexibility.

"It was, the fellowship, the people. You know, you get hear somebody else griping about their toes hurting and their elbow hurtin, and then you know, we all get in there and we start doing our exercises and stuff and then we're talking about grandkids, you know, catchin crab or salmon and we start talkin about other stuff instead of you know, whatever hurts, so that part of it is a big uplift."

But at times, the group social environment could be experienced as negative. One person mentioned that it was important not to compete with others in class:

"it's important to have the teacher remind you to limit yourself and just do what is comfortable for you and not worry about anybody else, 'just focus on your own mat'"

The participants chose to start yoga for different reasons, but they had the shared experience of improvement in RA symptoms. Participants describe achieving improved pain, sleep, mobility, mood, energy, relaxation, focus, and flexibility with yoga practice. These experiences illustrate the participants' perception of yoga practice as an effective symptom management strategy for improved functional and emotional status and overall quality of life.

Pride and achievement. While describing the benefits, it also became apparent that the benefits were linked to a sense of pride or accomplishment. Participants expressed a sense of accomplishment or pride in their physical abilities and commitment to themselves to get to class. A 65 year-old female who had practiced Vinyasa hybrid for 3 years talks about the pride she feels in practicing yoga,

"I was pretty proud of myself for getting through it…when I do certain moves, I can feel pretty good about myself"

Another participant, a 57 year-old female who had practiced for 12 years, was very proud of herself for going to class.

"The feeling of fulfillment of actually having gotten myself to the class in this positive mode…I'm not really a class person, so it was sort of a big deal."

Participant expressions of pride, illustrate the confidence in one's abilities, or self-efficacy, necessary to make the empowered choice to participate in yoga practice and to do the work necessary to make changes in their own health and well-being.

A tool to cope. A prominent and important theme of yoga practice as a coping tool emerged as participants described turning to yoga as a symptom management tool for their physical, mental and emotional needs.

A 63 year-old male who struggles with the pain from his RA uses yoga meditation as a tool to cope with pain.

> *"It can help with the mood and some of the symptoms, the stiffness, but the aching and the physical pain, I mean that's there. The pain medication or the meditation can help with the pain, oh yeah…you don't sit around the house having a pity party, your energy is up, so you're out doing things."*

A 72 year-old female talked about how yoga has helped her cope with the negative emotions associated with RA.

> *"I think the breathing and the meditation are a big part …it's just, when you have RA you can get a lot of negative thinking and this really helps with that…yoga is really helpful, like a tool to turn to."*

Similarly, a 47 year-old female who has practiced Bikram yoga for the past two years feels that yoga helps to cope with and release negative emotions associated with RA.

> *"It gets rid of the emotional stuckness and junk in your joints. It's just a release, and I think that's what made me feel better. And I think that with RA there is definitely an emotional component, um, or the stressors that get built up and for most people you try to overcome them and hold on to a lot and there's no release and this is an emotional release."*

The dynamic physical, mental, and social benefits of yoga are illustrated by quotes from a 42 year-old female who started practicing gentle yoga and now is a hot-power flow practitioner. She expressed pride in her physical ability to practice yoga,

> *"I would also say, it is a confidence booster just in terms of just being able to be physical, and being able to participate in something that makes you feel good."*

She described how yoga helped her cope with her disease mentally.

> *"I think it helps mentally with acceptance that you have a disease, so yeah, definitely a mental aspect of just sort of allowing it to be a part of your life…somebody with debilitating disease, we are kind of messed up mentally... it does something to your head and makes you feel weak and small…yoga changes the way you think about your RA."*

She described the mental and social benefit of being with other people in a practice that she described as ageless and limitless.

> *"The benefit of being included in activity, so like the community, the social aspect of yoga, so even though it's an individual practice in a group, it was nice to be included in something I could do with others. So I guess it's like ageless or it's like, there's no physical limitations for it…I think yoga is just quiet time in the beginning but it's a place for you to feel like you are still part of the community, you're not an invalid, you're not hiding in your house suffering alone"*

The dynamic nature of yoga practice met her where her physical limitations and emotional needs were as they changed from her initial diagnosis of RA, where she was physically incapable of doing anything but laying in her yoga mat and breathing in a community of other people, to a stable RA disease state, where she has been able to compete in triathlons.

> *"I couldn't even take care of myself or my kids in the beginning and now I do triathlons...and I give yoga the credit."*

Her experience and words sum up the phrase of "yoga meets you where you are."

DISCUSSION

This study adds important new information to the discussion about community yoga practice in adults with RA. This study used qualitative methods to describe how adults with RA participate in yoga and their perception of benefits for symptom management. One overarching theme emerged from the analysis of the interview transcripts "yoga meets you where you are." Within this overarching, unifying theme, three specific sub-themes emerged describing the barriers or facilitators to practicing yoga and what benefits resulted from their yoga practice. This research provides an understanding about how and why yoga is being practiced, by whom, what factors influence its practice, and what benefits are received in adults with RA who practice yoga in the community.

The current study highlights yoga practice as beneficial for relief of a number of symptoms of RA. Primary benefits mentioned by participants included: decreased pain and stiffness, and improved mobility, flexibility, energy, sleep, relaxation, mood, well-being, mental focus, and socialization. Our participant descriptions of improvements in pain, quality of life and mental health are consistent with previous findings of quantitative studies of Iyengar yoga for young adults with RA.[13,14] In addition our qualitative finding of participant stated improvements in physical and mental RA symptoms is supported by qualitative findings from a previous study where authors found RA patients consistently reported improvements in energy, relaxation, and mood after participation in Iyengar yoga.[23]

The majority of participant experiences with yoga were positive; however, some participants mentioned negative experiences as well. Yoga practices vary and yoga may not be beneficial for every adult with RA, in fact it may be harmful for adults with RA. Participants expressed feelings that yoga was not meant for people with RA, that yoga caused a RA flare and that yoga was too difficult on the floor without props and other support in the environment. Yoga participant perceptions about the harms and negative aspects of yoga have not been previously captured in the literature. Investigation into poses and environments that cause flares or discomfort for RA yoga participants may help adults with RA practice more safely.

The questions in this study were guided by the Symptom Management Theory (SMT).[24] Few studies in yoga research have used a theoretical framework, such as SMT, to guide their research questions and interview process. This study demonstrates how the SMT may be a useful framework for formulating initial interview questions and for

assessing health behaviors. The SMT describes personal and environmental factors as key concepts in assessing health behaviors. The results of this study illustrate how the personal and environmental factors did indeed influence yoga participation among adults with RA. The personal factors of the participants in this study, in addition to their perceived physical limitations, likely influenced which type of yoga style they preferred, hot flowing yoga versus slow gentle yoga, and contributed to the barrier of class mismatch. The participant quotes illustrate how the environmental factors, a participant's social and cultural environment, can influence an individual's physical activity choice. In addition to affecting the decision to start yoga, environmental factors such as the social class environment greatly affected the decision to continue yoga practice. Environmental and personal factors also influenced barriers to yoga practice in this study. Yoga practice styles and dose of practice varied widely, illustrating the individual nature of the practice. One size does not fit all. Ultimately, individuals need to try a few different kinds of classes and teachers to locate a class that is right for them. These results support previous findings regarding the varying needs of individuals for a physical activity program.[29] The participants in this study suggested that programs tailored specifically for people with RA would be a facilitator to yoga practice. Indeed other studies have considered non-RA specific classes as a barrier to performing yoga.[14]

There are some categories the emerged in this analysis that do not fit into the SMT's structure. The sub-category of Pride/achievement fits within the Social Cognitive Theory's (SCT)[30] key construct of self-efficacy. Self-efficacy is useful to consider in the promotion and assessment of physical activity. Self-efficacy is considered to be the confidence in one's ability to overcome barriers and undertake an action successfully.[31]

Many of the participants in this study felt pride in their ability to get to a yoga class and complete it successfully. This finding in our study is supported by previous qualitative work, where authors found that participating in physical activity was associated with pride, satisfaction and improved self-efficacy in adults with RA.[14,23,32] The SCT also states that self-efficacy can be achieved through an improvement in physical and emotional stress. Since most participants in our study describe significant physical and emotional benefits from yoga practice, it is likely that self-efficacy was improved in our yoga group. Self-efficacy is considered by many health scientists to be the most important personal factor in health behavior change.[33] It is potentially through improvements in self-efficacy that many of our participants were able to achieve healthy habits in several aspects of their lives, such as eating better and maintaining healthy habits to help control RA symptoms.

This study has some limitations. Participants of this study were from one limited geographical area. Including other areas across the United States may reveal the impact of different weather conditions, socio-economic backgrounds, cultural influences and available resources. Another limitation of this study may be the use of structured interview guide to direct the participants instead of the use of a pure grounded theory method to collect the data; therefore we cannot claim to have captured all aspect of participants' perceptions about yoga. Despite these limitations, this is the first study to explore qualitatively how yoga is being practiced by adults with RA.

This study also has a number of strengths. The interviews were conducted by a nurse practitioner with experience in rheumatology, skilled in listening, asking probing questions, and giving time for participants to elaborate. The scientific rigor of this study

was enhanced by the use of researchers who were not involved in the data collection to check the data analysis. This study adds depth to the discussion of yoga use with the inclusion of interviews of participants with limited yoga experience and those who did not view yoga as beneficial for patients with RA. Furthermore, this study demonstrates how theory may be a useful framework for assessing health behaviors and potentially in the design of yoga programs. The findings from this study add to the field of physical activity research in people with RA by providing more details to these understudied aspects of community yoga practice in adults with RA.

While the findings from the current study are novel and contribute to new knowledge, next steps should include studies that explore barriers to consistently practicing yoga, maintenance of benefits from yoga practice, and further investigations into personal factors that may influence continued participation in yoga after it is introduced to an adult living with RA. The participants interviewed in this study mentioned improved benefits of yoga with consistent practice and noticed symptoms return when they did not practice; this potential void of benefits after yoga is discontinued deserves further investigation. In addition, further investigation into the yoga practice environment and personal factors that influence yoga practice facilitators, barriers and harms would assist in guiding future yoga physical activity programs for adults with RA.

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Chapter 5

Summary and Conclusions

The overall purpose of this dissertation was to describe the physical activity of yoga and its role in symptom management and physical function for adults with Rheumatoid Arthritis (RA). Physical activity has been studied as a means of improving physical function and symptoms in adults with RA for over thirty years, however, rates of physical activity in RA patients remains below that of patients with other chronic diseases.[1] Yoga has been gaining popularity nationally[2] and may be an acceptable form of physical activity in this population. Yoga has been reported to improve physical function and symptoms of RA and offers RA patients a way to improve their physical and mental health by incorporating meditative breathing with a dynamic physical exercise.[3,4] Despite the promising benefits of yoga, this physical activity has received little attention in RA research.

The findings from the three studies presented in this dissertation provide an important contribution to our current understanding of yoga practice in adult with RA. The first study (Chapter 2) took a look at the literature on physical activity interventions in adults with RA. This literature review explored the effectiveness of yoga interventions for symptom and physical function improvements compared to other forms of physical activity interventions in adults with RA. Analysis of this literature revealed that yoga, in addition, to other physical activities with a combination of aerobic and strengthening components are effective for improvements in pain, depressive symptoms, fatigue and physical function. The second study (Chapter 3) explored associations between yoga participation and better RA symptomatology and physical function in a cross-section of adults with RA. In this study yoga practice was associated with less pain and better physical function compared to adults with RA who did not participate in yoga. In

addition, yoga participation was also associated with employment. The third study (Chapter 4) qualitatively examined perceptions of benefits, barriers and facilitators of community yoga practice in adults with RA. Adults with RA who participated in yoga described multiple benefits from a yoga practice, including: improved mood, sleep, flexibility, mobility, relaxation and coping abilities. Not only did the yoga participants describe finding benefits, but they also describe finding a physical activity that was dynamic enough to meet their needs as they changed throughout the life of their disease.

The three study findings in this dissertation provide evidence that yoga is a dynamic exercise that is beneficial for symptom and physical function improvement. The findings from this dissertation have pertinent implications for occupational health, aging, clinical practice, theoretical frameworks and for future research.

Occupational Health and Aging Implications

Information about the employment status of physical activity and yoga participants in intervention studies was consistently missing in the literature. This represents a gap in knowledge about how yoga and physical activity in general impact ability to work in the adult RA population. The typical age of adult RA onset is between the ages of 35-60 years, these are the prime working years in an adult's life. Inclusion of employment information in physical activity intervention studies is important to assess the activity's impact on this important component of an adult's life.

An analysis of the 2003 National Health Interview Survey estimates that roughly 1 out of every 4 Americans has clinician-diagnosed arthritis, with working-age adults (45-64) accounting for about 30% of these arthritis cases.[5] Musculoskeletal problems

such as arthritis have been shown to be a major cause of work disability.[6] A 2013 study estimates that 25% of people with arthritis will experience premature retirement or arthritis-related work limitations.[7] In addition to the physical and financial impact of arthritis, the chronic nature of this disease has psychological impact and often leads to depression, with subsequent worse health outcomes. Studies have suggested that participation in physical activity can help increase physical function and reduce depression in adults with arthritis.[8] Mind-body physical activities, such as yoga, may be beneficial in the prevention of depression and physical function decline, thereby decreasing rates of pre-mature retirement and arthritis-related work limitations.

As life expectancies continue to rise, people may include "ability to work" in their definition of successful aging, both for their own satisfaction and for their financial security. As our work force ages it is important for occupational health providers to promote healthy habits that enable older adults to participate in work. Older adults must be mindful to participate in and access appropriate exercise classes that will not cause further joint damage. Often the exercises suggested are not tailored to suit every individuals needs, possibly leading to further joint stress and musculoskeletal damage.[9] As people age, the physiology and structure of the musculoskeletal system changes, necessitating a refinement in the concept of physical activity to include more stretching and strengthening.[10] Occupational health care providers can help reduce occupational injuries in older working adults by promoting dynamic stretching and strengthening physical activities, like yoga.

The review of the literature presented in Chapter 2., which investigated yoga practice for improvement of arthritis-related function and symptoms, found promising

results; however, to date, there are no studies available focusing on older adults in the investigation of yoga practice for improvement of arthritis symptoms and its associated benefit of increased physical function and ability to work.[11-15] Thus, additional work is needed to investigate the use of therapeutic mind-body strengthening and stretching strategies, such as yoga, to decrease symptoms of arthritis in older adults and to gain an understanding of how decreasing these symptoms can lead to improvement in physical function and impact rates of pre-mature retirement and arthritis-related work limitations.

Clinical Implications

The dissertation findings have several important implications for clinical practice for the care of adults with RA. The results demonstrating the effectiveness of yoga practice for improvement in physical function and symptoms provides scientific evidence to guide clinician recommendations for physical activity participation. Yoga practice can be seen as another tool in the tool box of clinicians to help provide patients with RA with improved symptoms and physical function. In addition, the results of the quantitative cross-sectional study show that yoga use among adults with RA mimics the national trend in yoga use prevalence; about eleven percent of adults with RA surveyed in this study and nationally participate in yoga.[2] This is an important finding to urge clinician to open up the discussion to talking about yoga use with their patients. Although yoga use in increasing yoga practitioners still underreport their use to their medical providers. The knowledge that it is being used can open up the door for encouraging physical activity and for discussions regarding how to practice yoga safely within the context of their disease.

Theoretical Implications

The dissertation findings have some important implications for the use of theoretical frameworks to guide research hypothesis generation, study design and data analysis. The Symptom Management Theory[16] was used as a framework to guide the generation of hypothesis, study design and data analysis in this dissertation. Few studies in yoga research have used a theoretical framework, such as SMT, to guide their research questions and interview process. This study demonstrates how the SMT may be a useful framework for formulating initial interview questions and for assessing health behaviors. SMT was used to describe how personal and environmental factors were key concepts in assessing health behaviors around yoga participation. There are some aspects of health behaviors discovered in this dissertation that do not fit into the SMT's structure. The sense of pride and achievement expressed by participants in yoga fits within the Social Cognitive Theory's (SCT)[17] key construct of self-efficacy. Self-efficacy is useful to consider in the promotion and assessment of physical activity. Self-efficacy is considered to be the confidence in one's ability to overcome barriers and undertake an action successfully.[18] Many of the participants in this study felt pride in their ability to get to a yoga class and complete it successfully. This finding in our study is supported by previous qualitative work, where authors found that participating in physical activity was associated with pride, satisfaction and improved self-efficacy in adults with RA.[19-21] When approaching physical activity related health behaviors it may be useful to consider a hybrid model of the SMT, where self-efficacy is incorporated as personal factor influencing health behaviors and also as an outcome of physical activity participation.

Implications for Future Research

While the findings of this dissertation are unique and interesting, there is much work still needed to be done in the field of yoga research in adults with RA. Although patient perceptions of benefits and a conceptual model for the basis of yoga as effective for depressive symptoms and fatigue relief, this dissertation does not provide powerful evidence for its effectiveness. This was possibly due to lack of severe depressive and fatigue symptoms in the population studied. Future investigations into yoga practice using RA adults with severe depressive and fatigue symptoms would provide better structure for looking into yoga practice as a tool for relieving these symptoms. In addition, as previously mentioned, inclusion of important employment variables in future intervention studies would assist in determining the impact of physical activity on ability to work.

Utilization of theory in the design and analysis of research is beneficial to put results in a larger contextual framework. This dissertation suggests that the use of both the SMT and SCT would be beneficial in future yoga research studies. Future work utilizing a hybrid of the SMT and self-efficacy piece of the SCT to explore the role of self-efficacy in yoga practice would assisting in determining where self-efficacy fits within the SMT. Future work is needed to investigate into how self-efficacy relates to yoga practice as either a personal factor contributing to yoga practice selection or as an outcome of yoga practice. Determination the role of self-efficacy in yoga practice would assist in development of physical activity recommendations and investigations by clinicians and researchers.

This dissertation did not spend time assessing the effective dose or style of yoga for symptom and physical function improvement in adults with RA. In addition to style of yoga, there are individual pose modifications that may be beneficial for adults with RA. This topic deserves further investigation in order to assist in clinician yoga practice recommendations.

CONCLUSION

In conclusion, yoga offered adults with RA a tool to cope with the symptoms and loss of physical function that resulted from their chronic pain-related disease. This dissertation provided evidence that yoga was most effective at relieving pain and improving physical function, although relief of other symptoms was also reported. While most yoga practitioners found many benefits from yoga, yoga may not be beneficial for every person with RA. In addition, all physical activities, including yoga, should be tailored to the needs and limitations of the individual and should be used in compliment with other rheumatologist-recommended treatment modalities. Much work remains in the study of yoga and adult on-set RA. Next steps should aim to: determine the impact of yoga on employment; assess the impact of the teacher and modifications on yoga practice; assess the appropriate dose of yoga practice; and assess the role of self-efficacy in yoga practice.

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