The Association Between Yoga Use, Physical Function, and Employment in Adults With Rheumatoid Arthritis

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Mind-body exercises such as yoga offer patients with rheumatoid arthritis (RA) a symptom management strategy for improving physical and mental health. Studies have evaluated yoga to manage symptoms of RA and improve physical function; however, none has examined the relationship between yoga and work status in adults with RA. The objective was to describe differences in RA symptomatology, physical function scores, and work status between adults with RA who participate in yoga and those who do not. This cross-sectional study surveyed adults with rheumatologist-diagnosed RA regarding yoga use in the past year, symptoms, physical function, and work status. Differences between yoga and non-yoga participation groups were assessed with 2-sided *t* tests or Pearson χ^2 tests. Multivariate linear regression analyses were conducted to identify significant associations between yoga participation and primary outcomes. The sample included 398 adults with RA; 88% were females, 66% were white, mean age 61.8 years, mean disease duration 24.8 years; 10.6% participated in yoga. Vinyasa, Bikram, Hatha, Iyengar, and restorative yoga styles were practiced, mostly in a group setting. Yoga participants were significantly more likely to work full-time, less likely to be unable to work due to disability, and had better physical function. These findings characterize yoga practice and practitioners among adults with RA. In adults with RA, yoga participation is associated with full-time work status and better physical function than nonparticipation. This study adds additional information to the growing body of literature about adults with RA who practice yoga. **KEY WORDS:** *arthritis*, *employment*, *physical function*, *symptoms*, *yoga* *Holist Nurs Pract* 2019;33(2):71–79

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, depression, and impaired ability to work due to loss of function.[2] RA is a fairly prevalent chronic disease that affects at least 2 million adults in the United States (~1% of the population); 75% are women. The onset of RA can occur at any time but usually presents 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 multitiered approach. Patients are usually given medication, a prescription for exercise, and sometimes

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other therapies depending on the severity of their disease.[4] Although the American College of Rheumatology states that stretching, strengthening, and conditioning exercises preserve physical function,[5] physical activity is low in people with RA compared with those without chronic illness.[6] Increasingly, low-intensity physical activities, such as yoga, have been shown to be beneficial for improvements in physical function and problematic symptoms, such as pain, fatigue, depression, and sleep for people with RA.[6-9] In addition, yoga is increasingly becoming the most popular holistic physical activity used in the United States for people with chronic pain conditions.[10,11] The Symptom Management Theory (SMT)[12] asserts that, when symptoms are bothersome enough and interfere with activities of daily life such as work, 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 and impairment associated with the symptom. The SMT lends a plausible explanation for why many adults in the United States with chronic conditions such as RA are choosing to participate in yoga; yoga may be an effective symptom management strategy for improving the physical and mental health of adults RA.[11]

Several studies have emerged to evaluate the effect of yoga use in adults with RA, with promising results.[13-18] In these studies, yoga participants report reduced pain, disability, fatigue, and depressive symptoms, as well as improved mood, general health, and grip strength.[13-15,18,19] However, several of these studies focus on yoga participants with RA not representative of those most commonly affected by RA, those older than 35 years. Moreover, no studies have been published evaluating yoga practice in adults with RA and its association with work status.

Thus, research is needed to characterize symptoms, physical function, and work status in adults with RA who participate in yoga. To address the gap in our understanding, the objective of this cross-sectional study was to investigate whether participation in yoga is associated with less RA symptomatology, better physical function, and full-time work status, in adults with RA.

METHODS

Subjects and design

Data for this cross-sectional study were gathered as a part of a larger RA cohort study, Rheumatoid Arthritis Outcomes Study (RA-OS), conducted by the University of California, San Francisco (UCSF) Arthritis Research Group.[19] RA-OS participant data were collected via annual structured telephone interviews; data for this study were collected from 2013-2014. All RA-OS participants were a convenience sample recruited from rheumatology practices and clinics in Northern California, and met the criteria of at least 18 years of age, a physician diagnosis of RA, and English fluency. This study was conducted with oversight from the UCSF institutional review board.

Measures

Yoga participation

Subjects who acknowledged practicing yoga in the past year were asked the style of yoga practiced most frequently, the frequency of practice, the duration of yoga practice, and the most common location of practice. Subjects who participated in yoga were categorized as either yoga practitioners (practiced for 1 or more years or for at least 3 months and had practiced at least 1 day per week in the past month) or yoga participants (practiced <1 year and had not practiced at least 1 day per week in the past month).

Pain

Pain was assessed using a single-item continuous numeric rating scale (NRS) of current pain on a scale of 0 (no pain) to 100 (worst pain possible). The NRS has high test-retest reliability ($r = 0.96$) in patients with RA and a high construct validity compared with the visual analog scale for pain ($r = 0.95$) in patients with chronic pain.[20]

Depression

The 4-item National Institutes of Health PROMIS[21] (Patient-Reported Outcomes Measurement Information System) Depression scale was administered. Higher scores indicate more depressive symptoms.

Fatigue

Fatigue was assessed using a single-item categorical scale rating of the severity of fatigue experienced in the past 2 weeks. Response options ranged from 0 (no fatigue) to 5 (severe fatigue).

Sleep quality

Sleep quality was measured using the PROMIS[21] Sleep Disturbance Short form 8b. Higher scores indicate worse sleep quality.

Physical function

Physical function was measured using both the 4-item PROMIS physical function scale and the Health Assessment Questionnaire (HAQ) Disability Index. Higher scores on the PROMIS[21] scale indicate better function.

The HAQ Disability Index is the most commonly used measure of functioning for studies of RA. Scores range from 0 to 3, with higher scores indicating worse function.[22]

Employment status

Employment status was evaluated based on questions asking the current employment status, the number of weeks worked per year, the average number of hours per week, and date of last employment. Five categories of employment status were assigned from the answers to these questions: full-time work, part-time work, retired, unemployed disabled, and unemployed abled. The status of employed was assigned if persons selected working, had a job, or looking for work, and acknowledged that they worked for pay within the past year. Full-time was assigned to those who worked more than 20 hours per week for more than half the year and part-time was 20 hours per week or less or worked for less than half the year. The status of unemployed disabled was assigned if people said they were unable to work or were disabled. The status of unemployed abled was assigned if they were keeping house or enrolled as a student and did not work any number of hours in the past year.

Statistical analysis

All PROMIS measures were scored as recommended and converted to T-scores, with a population mean of 50 and standard deviation (SD) of 10, using PROMIS scoring documentation available at http://assessmentcenter.net. Means and SDs are shown as descriptive statistics of continuous variables. Frequencies and percentages of the total group sample are provided 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 practitioner and non-yoga groups were analyzed by the unpaired t test or χ^2 test where appropriate. Multiple linear regression analyses were used to estimate the unique contribution of yoga practice to differences between the yoga and non-yoga groups on the continuous outcomes of interest, controlling for age and education. Missing variables were excluded listwise. 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 $< .05$.

RESULTS

Of the 438 patients eligible for phone interviews based on completing the prior year's interview, 398 patients completed the surveys (89%). Of these, 371 answered the question about yoga participation and 42 (10.6%) responded that they had participated in yoga in the past year. The demographic characteristics for the yoga group as a whole (n = 42), yoga practitioners (n = 35), and yoga participants (n = 7) were then compared with the 329 respondents who had not participated in yoga. All 4 groups—the yoga group as a whole, the yoga practitioners, the yoga participants, and the non-yoga group—had similar demographic characteristics for sex, race, and disease duration. As seen in Table 1, all yoga groups were significantly younger ($P < .001$) and had significantly more people with higher education ($P < .01$) compared with the non-yoga group. Age and education were therefore included as a potential confounder in all regression analyses. Comparisons of symptoms and physical function were made between the non-yoga group and the practitioner yoga group. The yoga participant group was removed from the whole yoga group for analysis of main symptom and physical function variables of interest since significance trends remained consistent after they were removed and their participation in yoga was considered minimal. Therefore, analysis of symptom and physical function variables was performed between the yoga practitioner group (n = 35) and the non-yoga group (n = 329).

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, gender, and employment; however, they differed on age. The participants in the missing group were

TABLE 1. Demographic and Clinical Characteristics of Rheumatoid Arthritis Sample

Variable	Whole Yoga Group, n = 42	Yoga Practitioner Group, n = 35	Yoga Participant Group, n = 7	Non-Yoga Group, n = 329	Whole Yoga vs No Yoga Statistic (*P* Value)	Yoga Practitioner vs No Yoga Statistic (*P* Value)	Yoga Participant vs No Yoga Statistic (*P* Value)
Age, mean (SD), y	51.9 (13.7)	53.4 (13.9)	44.0 (9.7)	62.4 (11.9)	$t = -5.29$ (<.001)[a]	$t = -4.15$ (<.001)[a]	$t = -4.04$ (<.001)[a]
Female	40 (95.2%)	33 (94.3%)	7 (100%)	292 (88.8%)	$\chi^2 = 1.67$ (.29)	$\chi^2 = 1.012$ (.40)	$\chi^2 = 0.885$ (1.0)
White race	31 (73.8%)	26 (74.3%)	5 (71.4%)	207 (62.9%)	$\chi^2 = 1.92$ (.18)	$\chi^2 = 1.775$ (.13)	$\chi^2 = 0.213$ (1.0)
Disease duration, mean (SD), y	21.1 (12.4)	21.8 (13.1)	17.4 (8.3)	24.3 (11.9)	$t = -1.65$ (.10)	$t = -1.18$ (.24)	$t = -1.52$ (.13)
High school education or less	4 (9.5%)	4 (3.5%)	0	109 (33.1%)	$\chi^2 = 9.8$ (.001)[a]	$\chi^2 = 6.96$ (.005)[b]	NA

Abbreviations: NA, not available; SD, standard deviation; y, years.
[a]$P < .001$.
[b]$P < .01$.
$P < .05$.

significantly ($P < .001$) older (70.6 ± 9.0 years) than the yoga group (51.9 ± 13.7 years).

Work status

There was a significantly greater proportion of people employed full-time in all 3 yoga groups (whole yoga group n = 21, 50%; yoga practitioners n = 16, 46%; and yoga participants n = 5, 71%) than in the non-yoga group (n = 70, 21%), *P* = .000-.007 (Table 2). Adults in all yoga groups are more likely to be employed full-time compared with adults who do not do yoga. There was a significant difference between yoga practitioners (n = 1, 2.9%) and the non-yoga group (n = 76, 23.1%) in the number of those who were disabled unemployed. Yoga practitioners were significantly less likely to be disabled unemployed than the non-yoga group (*P* = .002). There was no difference between the yoga participants and the non-yoga group in being disabled unemployed. There were no significant differences in people who were retired, working part-time, or abled unemployed between any of the yoga groups and the non-yoga group.

Yoga

There was no significant yoga practice difference between the yoga practitioners and the yoga participants in yoga style, location, or number of classes attended per month; however, the yoga practitioner group had been practicing yoga for a significantly longer period (99.6 months) compared with the yoga participant group (2 months), $P < .001$. Therefore, yoga practice patterns will be described for the yoga group as a whole (n = 42). The mean number of yoga classes taken per month was 5.3 (SD = 5.9). The styles of yoga practiced were Bikram (11.9%), Vinyasa (11.9%), Hatha (9.5%), Iyengar (7.1%), and restorative (2.4%); 57% of participants did not know the type of yoga they practiced. Most people practiced yoga in a class setting with other individuals (54.8%), some practiced at home alone (19%), and others combined home and class practices (26.2%). See Table 3.

Symptoms

There was a significant difference in the mean pain scores between the yoga (29.1 ± 27.9) and non-yoga (39.5 ± 29.2) groups (Table 4). After controlling for age and education, the difference was no longer

TABLE 2. Employment Characteristics of Rheumatoid Arthritis Sample

Variable	Whole Yoga Group, n = 42	Yoga Practitioner, n = 35	Yoga Participant, n = 7	Non-Yoga Group, n = 329	Whole Yoga vs No Yoga Statistic (*P* Value)	Yoga Practitioner vs No Yoga Statistic (*P* Value)	Yoga Participant vs No Yoga Statistic (*P* Value)
Employment Status							
Employed FT	21 (50%)	16 (45.7%)	5 (71.4%)	70 (21.3%)	$\chi^2 = 16.6$ (.001)[a]	$\chi^2 = 10.5$ (.002)[b]	$\chi^2 = 9.9$ (.007)[b]
Employed PT	5 (11.9%)	5 (14.3%)	0	31 (9.4%)	$\chi^2 = 0.262$ (.58)	$\chi^2 = 0.84$ (.37)	NA
Retired	10 (23.8%)	10 (28.6%)	0	124 (37.7%)	$\chi^2 = 3.11$ (.09)	$\chi^2 = 1.13$ (.19)	NA
Unemployed[c]	6 (14.3%)	4 (11.4%)	2 (28.6%)	104 (31.6%)	$\chi^2 = 5.36$ (.02)[d]	$\chi^2 = 6.8$ (.01)[d]	$\chi^2 = 0.029$ (1.00)
Disabled unemployed[e]	2 (4.8%)	1 (2.9%)	1 (14.3%)	76 (23.1%)	$\chi^2 = 7.54$ (.004)[b]	$\chi^2 = 7.78$ (.002)[b]	$\chi^2 = 0.301$ (1.00)
Abled unemployed[f]	4 (9.5%)	3 (9.7%)	1 (14.3%)	28 (8.5%)	$\chi^2 = 0.049$ (.77)	$\chi^2 = 0.000$ (1.00)	$\chi^2 = 0.29$ (.47)

Abbreviations: FT, full-time; NA, not available; PT, part-time; SD, standard deviation.
[a] $P < .001$.
[b] $P < .01$.
[c] Unemployed = not having worked any hours in the past year; this category includes: looking for work; keeping house; going to school; unable to work; disabled.
[d] $P < .05$.
[e] Disabled unemployed = "disabled" or "unable"
[f] Abled unemployed = "looking for work" or "keeping house" or "going to school."

statistically significant; our regression model predicts that all of the differences in pain scores between the yoga and non-yoga groups were due to differences in education (Table 5). There were no significant differences in mean fatigue, depression, or sleep quality scores between the yoga and non-yoga groups before or after controlling for age and education.

Physical function

PROMIS physical function scale

As seen in Table 4, there was a significant difference in the mean physical function scores between the yoga (29.6 ± 6.2) and non-yoga (34.3 ± 8.1) groups ($P = .001$). Higher scores on the PROMIS physical function scale denote worse physical function. The difference between groups remained statistically significant after controlling for age and education (Table 5). Therefore, the yoga group had significantly better physical function than did the non-yoga group.

HAQ Disability Index

There was a significant difference in the mean HAQ scores between the yoga (0.89 ± 0.65) and non-yoga (1.21 ± 0.77) groups ($P < .01$); see Table 4. However, after controlling for age and education, our regression model predicts that these differences between the 2 groups were explained by group differences in education and age (Table 5).

DISCUSSION

This is one of the first studies to describe the association of community yoga practice in adults with RA symptomatology, physical function, and employment status. The results of this study suggest that adults with RA who practice yoga had significantly better physical function, were more likely to be employed full-time, and were less likely to be unemployed with a disability than those who did not practice yoga. Since there were preexisting differences between the 2 groups (age and educational status), a regression model adjusting for these differences was used. In the adjusted models, the group that practiced yoga continued to have better physical function scores than the group that did not practice yoga. Although the 2 groups also differed in employment status, it was not included as a covariate because it was one of the main outcomes and is highly correlated with physical function.

TABLE 3. Yoga Practice Characteristics

Variable	Whole Yoga Group, n = 42	Yoga Practitioner, n = 35	Yoga Participant, n = 7	Yoga Practitioner vs. Yoga Participant *t* Test (*P* Value)
Yoga frequency, classes per month, mean (SD)	5.29 (5.87)	6.03 (6.16)	1.57 (1.27)	$t = -1.89$ (.07)
Yoga duration, months of practice, mean (SD)	83.4 (111.1)	99.66 (115.12)	2.14 (0.90)	$t = -5.01$ (<.001)[a]
Yoga style				
Bikram	5 (11.9%)	5 (14.3%)	0	NA
Vinyasa	5 (11.9%)	3 (8.6%)	2 (28.6%)	$\chi^2 = 2.0$ (.16)
Hatha	4 (9.5%)	4 (11.4%)	0	NA
Iyengar	3 (7.1%)	3 (8.6%)	0	NA
Restorative	1 (2.4%)	1 (2.9%)	0	NA
Do not know	24 (57.1%)	19 (54.3%)	5 (71.4%)	$\chi^2 = 0.7$ (.4)
Yoga location				
Home alone	8 (19%)	7 (20%)	1 (14.3%)	$\chi^2 = 0.12$ (1.0)
Class	23 (54.8%)	18 (51.4%)	5 (71.4%)	$\chi^2 = 0.94$ (.33)
Both	11 (26.2%)	10 (28.6%)	1 (14.3%)	$\chi^2 = 0.62$ (.43)

Abbreviations: NA, not available; SD, standard deviation.
[a] $P < .001$.

Several of the demographic characteristics of the yoga participants in our sample are reflective of national samples of yoga participants. The percentage of yoga participants in our study (10.6%) is similar to the percentage of the US population practicing yoga: 9% (21 million).[23,24] Nationally, yoga participants tend to be white, young, women, and have more years of education compared with non-yoga participants.[24] Following this national trend, our yoga participants were younger and had more education than the non-yoga participants. Research has consistently shown that individuals with RA who have higher education have better functioning and less severe disease manifestations.[16] Our yoga participation group showed significantly better PROMIS physical function scores than the non-yoga group even after controlling for the influence of educational status. Although, our yoga group was significantly younger than the non-yoga group, 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 United States. The mean age of our yoga participants was 51.9 years, whereas 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.

TABLE 4. Differences Between the Yoga Practitioner and Non-Yoga Group in Symptoms and Physical Function

Variable (Score Range); Mean (SD)	Yoga Practitioner Group (n = 35)	Non-Yoga Group (n = 329)	Yoga vs Non-Yoga *t*-Test Statistic (*P* value)	Yoga vs Non-Yoga, Mean Difference (95% CI)
Pain (0-100)	28.2 (28.2)	39.5 (29.2)	2.2 (.03)[a]	11.3 (1.2 to 21.6)[a]
Fatigue (0-5)	2.2 (0.95)	2.6 (1.2)	1.95 (.052)	0.40 (−0.003 to 0.81)
PR-depression (41-79.4)	47.6 (8.4)	48.8 (8.9)	0.75 (.45)	1.18 (−1.92 to 4.29)
PR-sleep quality (28.9-76.5)	49.9 (9.9)	50.8 (11.1)	0.48 (.64)	0.93 (−2.91 to 4.76)
PR-physical function (22.9-56.9)	29.6 (6.2)	34.3 (8.1)	3.29 (.001)[b]	4.67 (1.86 to 7.45)[b]
HAQ Disability Index (0-3)	0.89 (0.65)	1.21 (0.77)	2.35 (.02)[a]	0.32 (0.05 to 0.59)[a]

Abbreviations: CI, confidence interval; HAQ, Health Assessment Questionnaire; PR, PROMIS; SD, standard deviation.
[a] $P < .05$.
[b] $P < .01$.

TABLE 5. Differences Between the Yoga and Non-Yoga Groups in Symptoms and Physical Function, Controlling for Age and Education Status[a]

Variable (Score Range)	R^2	Adjusted *F* (*df*, Error *df*)	*P* Value	Significance of Yoga on the Overall Model *t* (*P* Value)	95% CI for Significance of Contribution of Yoga to the Model
Pain (0-100)	0.082	11.8 (3, 358)	<.001[b]	−1.81 (.07)	−19.51 to 0.83
Fatigue (0-5)	0.028	4.47 (3, 360)	.004[b]	−1.70 (.09)	−0.77 to 0.06
PR-depression (41.0-79.4)	0.018	3.19 (3, 360)	.02[b]	−0.74 (.46)	−4.39 to 1.98
PR-sleep quality (28.9-76.5)	0.003	1.34 (3, 360)	.26	−0.89 (.38)	−5.74 to 2.17
PR-physical function (22.9-56.9)	0.072	10.33 (3, 360)	<.001[c]	−2.18 (.03[d])	−5.94 to −0.93
HAQ Disability Index (0-3)	0.052	7.68 (3, 360)	<.001[e]	−1.28 (.20)	−0.45 to 0.10

Abbreviations: CI, confidence interval; df, degrees of freedom; HAQ, Health Assessment Questionnaire; PR, PROMIS.
[a] *F* and its associated *P* value are results from the linear regression model controlling for age and education status.
[b] Only education contributed significantly to the model.
[c] Yoga practice, age, and education all contributed significantly to the model.
[d] $P < .05$.
[e] Only age and education contributed significantly to the model.

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; yoga participants were more likely to be employed full-time and less likely to be disabled-unemployed. 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. This study merely describes the employment status of adults with RA who practice yoga in the community. A controlled trial or longitudinal study with more employment variables would be required to further examine this relationship.

This study is also one of the few published studies describing yoga practice trends among adults with RA in the community. The majority of the literature on yoga in adults with RA explores outcomes related to a research-study-prescribed yoga style. Vinyasa, Bikram, and Hatha were the most popular styles–most frequently practiced in a group setting about once a week. This study adds useful information to the conversation about the style, frequency, and location of yoga classes that adults with RA prefer.

The association between yoga participation and better physical function scores found in this study is 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.[13,14,17] In addition, 2 yoga intervention studies have shown a decrease in pain as a result of participation in yoga.[14,16] It is interesting that yoga use was associated with better physical function when it was measured using the PROMIS measure and not with the HAQ. The disparity in the physical function assessments with use of the PROMIS and HAQ is likely due to the nature and inherent limitations of each instrument. The PROMIS physical function measure performs better than the HAQ in a population that is fairly well functioning, as in our sample of adults in this study.[25] The overall PROMIS physical function score of our sample is in the range of the population who can perform daily tasks without much difficulty. The HAQ is better used in a sample of people who have poor functioning due to the ceiling effects of this instrument.[26] Although the physical function results are encouraging and are supported by previous findings in the literature, the cause for better physical function scores cannot be determined because of the cross-sectional study design. We cannot determine whether physical functions were better before the start of yoga practice or if they were improved as a result of the yoga practice. The yoga participants may indeed have had better physical functioning than the non-yoga participants leading to their choice to practice yoga; however, the evidence in

the literature supports the possibility that the yoga participants had better physical function as a result of the yoga practice.

Despite a theoretical basis for yoga's ability to improve pain, depressive symptoms, fatigue, and sleep quality, no association was found in the current study. These findings were similar to the findings of Badsha et al,[13] where only physical function was improved through yoga participation, but not pain, fatigue, or depression. A likely explanation for the lack of difference between the group in pain, depression, fatigue, and sleep is that our population did not have particularly severe symptoms in these areas. This study population reported having low levels of pain and did not have poor sleep quality. Their mean PROMIS sleep scores correspond to 1 SD better sleep quality than the average sleep quality score for the US population. The PROMIS depression scores in both the yoga and non-yoga groups were also very similar to the average depression scores for the US population. In addition, since Margaretten et al[27] found that low socioeconomic status is a large determining factor in depression in patients with RA, it follows that this study sample who had high socioeconomic status, were highly educated Caucasians with insurance, and were seen at private rheumatology offices in North California did not have depressive symptoms. Multiple studies demonstrate that pain, depression, fatigue, and sleep are correlated.[28-32] Since this sample population did not have a lot of pain, was not depressed, nor did they have poor sleep quality, it is not surprising that the severity of fatigue symptoms for the sample population was low; fatigue scores were in the mild to moderate fatigue range.

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 recall 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.[33] The sample population for this study may not be representative of all adults with RA, thus limiting the generalizability of our findings. Our study participants are derived 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 employment and yoga practice in the community. Next steps should include more rigorous research such as a controlled trial or longitudinal study where directionality of associations could be determined. Also, an RA-specific yoga program may be more effective than a standard program because it might minimize risk of injury and provide the additional social and emotional benefit of a support group.

In summary, in this descriptive cross-sectional study, adults with RA who practice yoga are significantly more likely to be employed full-time and have better physical function than adults with RA who do not. Yoga participation was not associated with improved pain, sleep quality, fatigue severity, and depressive symptom severity in our population. Adults with RA in this study preferentially chose to participate in Vinyasa, Bikram, and Hatha yoga in a group setting about once a week. This study adds additional information to the growing body of literature about adults with RA who practice yoga. In addition, these findings may provide clinicians with useful information when talking to patients about nonpharmacological strategies to improve physical function.

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