

# Promoting Adherence to a Yoga Intervention for Veterans With Chronic Low Back Pain

Global Advances in Integrative Medicine and Health

Volume 14: 1–11

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DOI: 10.1177/27536130251323247

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## Abstract

**Background:** Research demonstrates that yoga can be effective for improving chronic low back pain (cLBP) among military veterans and non-veterans. Attendance of yoga interventions is necessary to obtain benefits, yet yoga class attendance can be a challenge both within and outside of research, especially for persons who lack resources.

**Objective:** Our objective was to describe efforts to boost attendance within a randomized trial of yoga for cLBP, and to examine factors related to attendance.

**Methods:** A previous trial of yoga for cLBP among military veterans randomly assigned participants to 2x weekly yoga for 12 weeks, or delayed treatment. After the second of 6 intervention cohorts, efforts were made to improve participant attendance. Attendance and reasons for missing yoga sessions were tracked using sign-in logs and phone calls. Regression analysis was used to examine factors related to attendance.

**Results:** After efforts to boost attendance, mean attendance increased from 10.2/24 sessions, (42% attending at least half of sessions), to 13.3/24 sessions, ( $df(1,74)$ ,  $t = -1.44$ ;  $P = 0.15$ ) (59% attending half of the sessions). The most common reasons for non-attendance were transportation, financial problems, other health issues, and work or school conflicts. Living status and back pain-related disability at baseline were significantly associated with attendance ( $P < .001$  and  $P = .038$  respectively). When including all participants, yoga session attendance was significantly associated with reduced pain severity ( $P = 0.01$ ).

**Conclusions:** Efforts to boost attendance appeared meaningful but the changes were not statistically significant. Attendance rate in later cohorts were comparable to those in other studies. Reasons provided for non-attendance by participants, and the regression results suggest that resources such as transportation, a stable living situation, and disability levels at baseline were related to attendance rates for this in-person intervention. Remotely delivered yoga may address some of these barriers but hybrid interventions that bring in-person yoga closer to participants may be the best option.

## Keywords

chronic low back pain, yoga, veterans, complementary and integrative health

Received October 18, 2024; Revised January 31, 2025. Accepted for publication February 10, 2025

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## Background

Chronic low back pain (cLBP), defined as low back pain with a duration of 12 weeks or longer,<sup>1</sup> is a prevalent condition that often results in functional limitations,<sup>2</sup> lower quality of life,<sup>3</sup> and enormous costs to society in terms of health care costs and lost productivity.<sup>4,5</sup> While some clinicians still focus on treatments such as medication, injections, or other invasive treatment options, cLBP is a condition for which yoga and other behavioral or mind-body treatment options are now recommended as first-line treatments in clinical guidelines.<sup>6</sup> These recent guidelines are based on the accumulation of high quality research demonstrating the effectiveness and comparative safety of these treatments with invasive or pharmacological options.<sup>7-11</sup> These recommendations may also be especially salient for U.S. military veterans, who have higher rates of cLBP<sup>12,13</sup> and opioid usage,<sup>14,15</sup> and have experienced significant adverse consequences as a result of the overuse of opioid medication pain treatments.<sup>16</sup>

A common challenge across many different treatments for cLBP is treatment adherence. Although conventional wisdom often suggests that people would rather take a pill than exercise or make other lifestyle changes, at least one study found preferences for lifestyle changes over medication when they believe it will be effective.<sup>17</sup> Despite evidence linking better adherence to better health outcomes in both behavioral<sup>17,18</sup> and mind-body interventions,<sup>19</sup> data suggest that optimal adherence to both pharmacological<sup>20-22</sup> and non-pharmacological treatments<sup>23-26</sup> can be difficult to achieve in both research and clinical care settings, especially among subgroups with fewer resources<sup>27-30</sup> and greater comorbidity.<sup>29,31,32</sup>

While definitions of optimal and adequate adherence can vary by health care condition, intervention type, and other intervention characteristics,<sup>33</sup> previous full-scale randomized controlled trials (RCTs) of yoga for cLBP<sup>34,35</sup> reported 60%–67% of participants attended at least half of the 12 once-weekly sessions. In another yoga RCT that compared 1x weekly to 2x weekly yoga, participants were considered adherent if they met a more stringent criteria of attending at least 75% of in-person yoga sessions. In that study, a higher proportion of 1x-weekly yoga participants were adherent (65%) than 2x weekly yoga participants (44%) reflecting the importance that intervention characteristics play on adherence.<sup>36</sup> Finally, although not well studied, there is a relationship between intervention adherence and study attrition.<sup>37</sup> Both adherence and attrition are indicators of acceptability and feasibility during pilot studies,<sup>38</sup> and are quality indicators for full-scale RCTs,<sup>38,39</sup> which may subsequently impact intervention implementation. A search of research literature did not locate any previous yoga studies that evaluated efforts to boost attendance but one ongoing study plans to examine the amount of remote yoga performed and associated factors in relation to outcomes.<sup>40</sup> In broader literature on physical activity interventions, adherence

motivation<sup>41,42</sup> and information technology<sup>43,44</sup> have been widely studied for improving behavioral adherence, but in general, that has been done prospectively and not mid-trial. Therefore, a better understanding of the factors that influence mind-body intervention adherence and methods for improving adherence appears to be important for enhancing research quality, promoting long-term adherence, and maximizing intervention outcomes.

The objective of this analysis was to study the impact of specific efforts to boost intervention attendance during an RCT of yoga for cLBP in military veterans and to examine the baseline participant characteristics associated with attendance rates. Examining the impact of efforts to boost attendance were retrospective analyses without a priori hypotheses. Based on literature cited above, we hypothesized that indicators of lower socioeconomic status<sup>27-30</sup> and/or greater morbidity<sup>29,31,32</sup> would be associated with lower adherence.

## Methods

A detailed description of the study design and methods have been previously published,<sup>45</sup> with prior results having been disseminated.<sup>9,46,47</sup> Briefly, from 2013–2015, 150 Veterans Affairs (VA) patients were consented, enrolled, and randomized to either the yoga intervention or to a delayed treatment (DT) comparison group. The study was conducted at a large VA Medical Center and approved by the facility's IRB. Yoga consisted of twice weekly, in-person yoga sessions, with home practice of yoga strongly encouraged on non-session days. DT participants received ongoing usual care for 6-month and were then offered the same 12-week yoga intervention. Research assessments occurred at baseline, 6 weeks, 12 weeks, and 6 months after baseline. The primary outcome was pain-related disability measured by self-report. Pain severity and other secondary outcomes were also collected.<sup>47</sup> Participant recruitment primarily occurred through referrals to the study by VA clinicians from primary care, physical medicine and rehabilitation, psychology, behavioral medicine, and pain medicine clinics. Informational flyers were also posted and distributed at the medical center. Criteria for inclusion/exclusion were described to participants in a pre-screening phone call and were applied by a VA research clinician at an in-person screening exam. The criteria have been published previously.<sup>45</sup> Participants were enrolled in 6 cohorts of approximately 25 participants each.

## Yoga Intervention

The yoga intervention consisted of twice weekly, instructor-led yoga sessions for 12 weeks, resulting in attendance of up to 24 in-person sessions. Given the large catchment area, and inability to provide online yoga due to technology limitations in 2012, we emphasized home practice and defined adequate in-person attendance as 12 of 24 sessions. The duration of sessions was 60 minutes. In-person sessions were conducted

at the main VA Medical Center on weekdays late-morning based on the most common preferences of participants. In addition, home practice of yoga, guided by a printed manual, was strongly encouraged on days without instructor-led sessions. At the beginning of the study, participants were contacted and encouraged to resume attendance and assessed for adverse events if they missed two consecutive in-person yoga sessions.

The yoga consisted of hatha yoga classes designed for individuals with cLBP who may be new to yoga. Depending on functional levels, participants either sat on the floor or on a chair. Classes began with some basic breathing exercises and a few minutes of meditation. This was followed by gentle movement and warm-up stretches, after which participants were led through a series of nine standing postures, eight seated postures and seven floor postures, ending with at least five minutes of relaxation in a supine resting pose (savasana). Pose modifications were offered throughout to accommodate participants of varying functional ability. Participants were encouraged to gradually increase the pace of movement and depth of the stretches over the 12-week intervention. Yoga was taught by a certified yoga instructor (RYT-500) with eight years of teaching experience and previous experience teaching yoga to veterans with cLBP. A detailed description of the yoga intervention is available in prior publications.<sup>9,45</sup>

### ***Adherence Intervention Strategies***

During the RCT described above, yoga session attendance was tracked for each participant. By the second cohort, it became apparent that attendance rates were suboptimal. The research team, including the PI, co-investigators, study staff, and the yoga instructor met to strategize about improving attendance. Though attendance continued to be an issue for some, participant input was not considered in strategizing due to the relatively small number of participants. Five complementary strategies were devised to attempt to improve attendance rates. First, was the utilization of a “Reasons for Participation” questionnaire (Supplement Material-Appendix A) a co-investigator created and used in a prior study.<sup>48</sup> Participants rated their level of agreement with nine statements about why they were participating in this research study. The primary purpose for this data was to facilitate a conversation with the study Principal Investigator (PI) to address possible concerns with active participation. The second strategy that was implemented comprised of each participant briefly meeting individually with the study PI. These meetings occurred immediately after the participant had completed the baseline assessment and before they had been randomized. The “Reasons for Participation” questionnaire was reviewed and led to discussion of the importance and impact of randomization and good research data, the importance of attendance, how chronic pain may respond to activity both short-term and long-term, etc. Next, study staff agreed the yoga instructor would provide stronger

emphasis and describe the benefits of attendance and home practice in each session. Fourth, study staff were directed to make contact participants after each missed session instead of waiting for two consecutive missed sessions. Each call assessed reasons for missed sessions, including adverse events or other logistical or social factors impacting attendance, and provided encouragement to return regardless of how many sessions had been missed. The goal was to further examine reasons for missing sessions where study staff can help problem solve or that can inform future changes to yoga sessions. Finally, investigators decided to provide basic refreshments such as bottled water and small healthy snacks at each yoga session.

### ***Attendance, Adherence, and Retention***

The importance of attendance at the yoga sessions and regular home practice of yoga were emphasized at the baseline assessment and reinforced by the yoga instructor during sessions. Consistent with resources provided to many VA patients for travel to clinical care appointments, participants received \$5 per yoga session attended to offset travel costs and encourage attendance. Initially, study staff contacted participants if they missed more than one consecutive yoga session without explanation, which later changed to calling participants after every missed yoga session. Following completion of the intervention, all participants were contacted by study staff on a monthly basis to remind them and/or schedule their next assessment, and in the days shortly before each scheduled assessment. Participants were compensated \$30 for each assessment completed.

### ***Measures***

Data used in this analysis were collected via self-report questionnaires and VA medical records in 2012-13. The primary measure of adherence for the study was attendance of in-person yoga sessions. Attendance was tracked with a sign-in sheet that was checked and verified by the yoga instructor each week. Attendance was entered into the VA medical record after each session. Yoga home practice was tracked using weekly home practice logs. Participants indicated on the logs which days home practice occurred, the duration of practice, the estimated physical exertion level, and whether an instructor, video, or other guide was used. However, many participants were unable to regularly track their home practice and deliver tracking logs to study staff. Due to inconsistent and ultimately inadequate compliance with tracking log data, those data were not used in this analysis.

Sociodemographic characteristics were assessed with a brief self-report questionnaire and age was determined from the medical record. The regression analysis included age and the first seven questions (age in years, gender, education level, race/ethnicity, employment status, current living status, history of homelessness in the past 5 years (Yes/No), and time

to travel to the VA) from (Supplemental Materials Appendix A).

The regression also tested the association of participant clinical or health characteristics at baseline with subsequent attendance. The primary outcome in the original trial was back-pain related disability measured by the Roland-Morris Disability Questionnaire (RMDQ)<sup>49</sup> consisting of 24 questions about back pain-specific, functional limitations. Pain severity was an important secondary outcome measured by the short version of the Brief Pain Inventory (BPI), a 13-item measure that was previously validated in persons with cLBP,<sup>50</sup> and was used to assess both pain severity and pain interference.<sup>51</sup> The impact and severity of fatigue was assessed with the Fatigue Severity Scale (FSS).<sup>52,53</sup> Physical and mental health aspects of health-related quality of life (HRQOL) were assessed with the Short-form 12 (SF12)<sup>54</sup> and global HRQOL was assessed with the EuroQol (EQ-5D).<sup>55,56</sup> Self-efficacy for managing one's cLBP was measured using items adapted for cLBP based on a measure by developed by Lorig et al for mixed chronic disease populations.<sup>57</sup>

### Statistical Analysis

The mean number of sessions attended and the proportion of participants attending at least 12 sessions (50%) were compared for cohorts 1-2 with cohorts 3-6. Means were compared using t-tests and proportions were compared using the chi-square test. Regression analyses were used within SPSS software to examine whether attendance was significantly related to changes in the primary (back-pain related disability) and main secondary outcome (pain severity) of the trial. Sociodemographic variables were examined as covariates. Insignificant covariates were removed from the multivariable model using backward selection and only covariates with  $P < 0.10$  were included in the final model.

### Results

A total of 24 participants were randomized to yoga in cohorts 1-2 and 51 participants were randomized to yoga in cohorts 3-6. The mean number of sessions attended increased from 10.2 for cohorts 1-2 to 13.3 for cohorts 3-6 ( $df (1,74)$ ,  $t = -1.44$ ;  $P = 0.15$ ). Only 10 of 24 participants (42%) had attended at least 50% of in-person instruction yoga sessions across cohorts 1 and 2. Three participants attended zero sessions and another three attended only one session each. After implementing the attendance improvement strategies described above, 59% of participants from cohorts 3-6 attended at least 50% of sessions as shown in Table 1. Across all six cohorts, 53.3% of participants attended at least 12 sessions. Although the proportion attending adequately increased from 42% to 59%, the change was not statistically significant ( $\chi^2 (1) = 1.93$ ;  $P = 0.16$ ). Given the relatively small

**Table 1.** Yoga Intervention Adherence by Recruitment Cohort.

	Attended 50% (12 of 24)
Cohort 1	42%
Cohort 2	42%
Adherence intervention	
Cohort 3	54%
Cohort 4	75%
Cohort 5	54%
Cohort 6	54%
Total	53%

sample sizes when comparing cohorts 1-2 ( $n = 24$ ) to cohorts 3-6 ( $n = 51$ ), effect sizes may be informative. For the dichotomized attendance variable chi-square test, the effect size is small (0.16). The difference in means compared in the  $t$  test results in a Hedges  $g$  of 0.36, which is a small to moderate effect.

As reported previously, despite less than optimal in-person attendance, yoga participants had significantly greater decreases in disability at 6 months, significantly greater decreases in pain severity, pain interference, and fatigue, and significantly greater increases in quality of life and self-efficacy over time. Thus, home practice may have played an important role even though it was hard to measure. Those participants that returned home practice logs reported practicing yoga a mean of 4.2 times per week. There were no significant differences between cohorts 1-2 vs 3-6 on the proportion of participants returning logs (62% vs 49%;  $P = 0.33$ ) or the mean days of home practice (4.5 vs 3.9;  $P = 0.26$ ), yet the slight drop is intriguing, nonetheless.

When looking at the distribution of sessions attended (Figure 1), we see what resembles a bi-modal distribution, with quite a few participants attending 0-3 sessions and another larger grouping that avidly attended, with 26 participants attending 20 or more sessions. When contacted by phone, reasons for low or non-attendance were provided as shown in Table 2. Transportation/financial problems were the most common explanation, followed by "other health issues" and yoga sessions conflicting with work or school. Of the 8 "other health issues", all were unrelated to yoga, five reported involved injuries to limbs or joints such as the arm, shoulder, knee, wrist, or pelvis, three reported were allergies or common cold/flu, one reported a stroke, and five reports did not specify. This totals more than eight because some participants reported more than one "other health issue" as a reason for non-attendance.

Regression analyses examined baseline participant characteristics associated with better attendance (Table 3). From the set of sociodemographic characteristics entered, an ordinal question about living status was a significant predictor of attendance. Item 6 of the sociodemographic questionnaire (Supplement Materials-Appendix B) asked about current living status, and responses ranged from experiencing

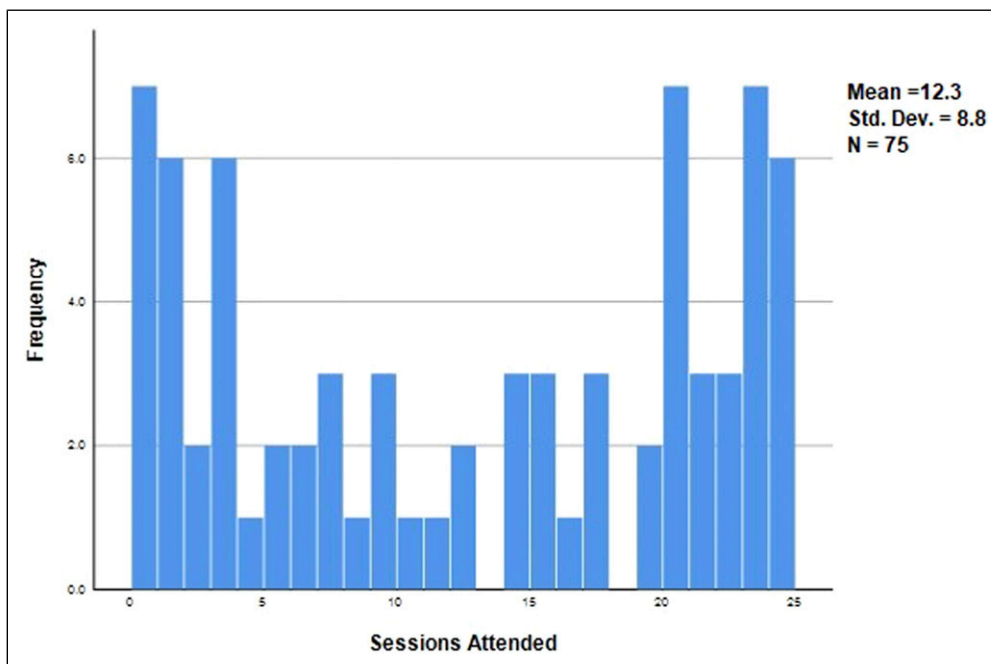


Figure 1. Histogram of number of yoga sessions attended.

Table 2. Primary Reason provided for Low or Non-attendance.

	Participants that Attended <12 Yoga Classes (35/75; 47%)
Transportation/financial problems	11
Other health issues	8
Work/school conflict	8
No contact or no show	3
Depression	1
Fight / Post traumatic stress issues	1
SUD rehabilitation	1
Became homeless	1
Back pain worsened	1

Table 3. Regression (Dependent Variable–Yoga Sessions Attended).

	B	SE	$\beta$	P
Current living status	2.204	.540	.472	<.001
Back pain-related disability at baseline	-.391	.184	-.246	.038

homelessness to living in or owning a house. Living status typically associated with greater independence and functioning were significantly associated with better attendance and is related to having resources. When baseline clinical characteristics were added to the model, RMDQ score (back pain-related disability) was also significantly associated with attendance. Greater disability at baseline was associated with lower attendance.

Our final analysis examined whether yoga session attendance was related to improved health outcomes. When only

including the participants initially randomized to yoga, session attendance was not significantly associated with improvements in disability, pain severity, or pain interference. However, our delayed treatment control group participants were also offered yoga after 6 months. Thus, when including all participants in the study with pre-post yoga intervention data, yoga session attendance was significantly associated with reduced pain severity. ( $r(117) = -0.24; P = .01$ ). Pre-post change and 95% CIs are presented for these outcomes in Table 4.



**Table 4.** Mean Pre-post Intervention Change for all Participants With Data.

	$\Delta$ Mean	95% CI	P
RMDQ (n = 120)	-1.78	(-2.55; -1.01)	<.001
Pain Severity (n = 118)	-0.29	(-0.52; -0.06)	.013
Pain Interference (n = 117)	-0.58	(-0.91; -0.26)	<.001

## Discussion

Using data from a previous RCT of hatha yoga for cLBP, the current analysis presents and tests the effect of strategies to improve yoga session attendance mid-trial. Although procedural changes during a clinical trial should be minimized, improving attendance was deemed crucial to the success of the trial. The study was framed as a pragmatic trial as opposed to a tightly controlled efficacy trial, enabling the flexibility to make these changes. Data from at least two prior RCTs showed yoga was beneficial for non-Veteran community samples, and this trial examined the effectiveness of yoga for cLBP among military veterans within the VA Health care System. For the trial with veterans showing feasibility of a yoga program for cLBP, the methods,<sup>45</sup> main results,<sup>9</sup> and a number of subsequent analyses have been published.<sup>46,47,58</sup>

The results from this analysis suggest that the increase in attendance that occurred between the first two cohorts and four cohorts after strategies were implemented (42% (n = 24) → 59% (n = 51)) was not statistically significant in this sample (n = 75) but it appeared important and meaningful during the study. With 75 participants total assigned to the yoga arm, this analysis may have lacked statistical power. Among the five strategies implemented to boost attendance during the study, there was no indication which of the strategies made the difference, and it may have differed for each person. Regardless, it was necessary to implement the strategies immediately to address adherence issues for this trial due to time limitations. The “Reasons for Participation” questionnaire and the short meeting with the PI before randomization required extra effort, but the meeting may have given them a better understanding of how they were contributing to a greater cause as opposed to only trying to help themselves. The desire to help other veterans was important and specific to military veterans. Therefore, research conducted with veterans should consider trying to capitalize on this interconnection where appropriate. This finding would not specifically generalize to studies with non-veterans, but other populations may have other cultural or social connection points that can be leveraged to promote motivation and attendance. This pre-randomization discussion may also have adjusted expectations around yoga being a quick or rapid fix by conveying the importance of consistency and slow progress, not pushing oneself too hard, communicating with the instructor, participating for the full 12 weeks, and that pain may increase short-term. The other three strategies

were less effort intensive and can be considered for any behavioral intervention trial.

Although yoga session attendance rates remained less than optimal in the trial, it is not always clear what constitutes adequate attendance. Adequate attendance may be influenced by a number of factors including the number of instructor-led sessions per week and the provision of and adherence to home practice of yoga. In the current study, participants were considered adequately adherent if they attended 50% or 12 of the 24 sessions (2x weekly). An important study by Saper (2013) compared 1x and 2x weekly yoga sessions and found that participants assigned to 1x weekly yoga attended a higher % of sessions and had similar health benefit despite attending a lower total number of sessions attended; 10/12 sessions (83%) vs 16/24 sessions (67%) for 1x weekly and 2x weekly respectively.<sup>36</sup> Home practice in minutes was very similar between the two groups (93 vs 97 minutes in 1x and 2x weekly groups, respectively). Participants were deemed “adherent” in that study if they attended 75% of instructor-led classes, which translates into nine classes at 1x weekly and 18 classes in the 2x weekly arm. A study conducted in the UK in community centers defined adherent as attending half of the 12 1x weekly classes, but also required that this include at least three of the first 6 classes. The study found significant benefits with 60% of participants considered adherent. In another study of non-veterans, Sherman et al (2011) considered attendance of 8 of 12 1x weekly classes to be adherent and reported 65% of yoga participants were adherent, with a mean of 10 sessions attended. This study also found significant benefits of yoga for reducing disability and pain “bothersomeness” when compared to self-care. Thus, although just 53% of participants were considered adherent in the present study, offering 24 sessions resulted in total mean sessions attended of 12.3, easily exceeding sessions attended in the 1x weekly 12 session yoga interventions mentioned above. Ultimately, the RCT on which the present study is based found significant benefits with small to moderate effect sizes in intent-to-treat analyses, with larger effects among more adherent participants.

Other factors that may affect yoga intervention attendance and make it hard to compare attendance rates across studies are the interconnected factors of target population, access, resources, and overall health status. All participants in the present analysis were patients at a major VA medical Center in a relatively large metropolitan area. Evidence suggests that VA patients are different from all military veterans more broadly and from non-veterans because of eligibility criteria for VA health care.<sup>58</sup> VA patients tend to have fewer resources and more comorbid conditions. Compared to the other studies with non-veterans described above<sup>34,35</sup> our sample tended to be older, have fewer women, have more racial and ethnic diversity, be less educated, have a longer duration of cLBP, have a history of homelessness, and higher rates of opioid medication use.<sup>9</sup> These characteristics are often not measured in the same way across studies and are therefore hard to

compare directly, yet they may play a role in terms of intervention attendance challenges. Various sociodemographic factors can contribute to decreased access and resources such as education, income, homelessness, other comorbidities, or substance abuse. Data from the current analysis in Table 2 indicate that the most common reason provided for non-attendance was transportation issues or financial problems which are often related. For example, some participants reported taking public transportation, resulting in commutes of 60 minutes or more each way. Yet the same commute may only be 30 minutes by car. Thus, income may also play a factor in participants' ability to take time off of work, pay for gas, or public transportation, or pay for necessary childcare to attend in-person yoga sessions.

The present study also found that current living status, which ranged from experiencing homelessness or being unhoused, to group living situation, to more independent living situations such as having one's own apartment, or owning a home, was one of the strongest predictors of subsequent attendance. The current living situation variable appears to be a strong proxy for socioeconomic status. Participants with few resources and less independence may be more likely to prioritize other more basic needs such as the need for shelter, clothing, and food over intervention attendance.<sup>59,60</sup> However, this does not mean they should be excluded from participation. Behavioral intervention studies including or targeting underserved people that lack resources should consider and plan for potential barriers to attendance, such as bring interventions to them and adapting to their needs. Online or hybrid formats partially address transportation challenges but may introduce other barriers such as IT requirements, privacy issues, etc. and reduce the benefits of social contact or developing a sense of community.

The other participant characteristic that was associated with attendance was RMDQ baseline score (back pain-related disability). The negative beta values indicate that higher disability scores at baseline were associated with lower attendance. This finding is consistent with Table 2 in which "health issues" were reported as one the second most common reasons for non-attendance. Some non-attendance because of disability may be unavoidable because cLBP is a fluctuating condition. Participants may have felt they were able to attend regularly when enrolling but the course of their health during the intervention may have changed. Some participants came once or twice and did not return, yet it is often hard to fully document or understand their reasons. Multiple participants repeatedly told study staff they planned to come back and they would "be there for sure" only to not attend. These results are not surprising and have been found in a variety of other chronic diseases and types of interventions, including medication<sup>61</sup> or exercise<sup>32</sup> adherence in persons with cancer, and physical activity after joint replacement<sup>62</sup> or for cardiac rehabilitation.<sup>29</sup> The systematic review by Ruano-Ravina found that participants lacking resources or with greater comorbidity were less adherent to

cardiac rehabilitation across multiple studies and in multiple different countries.<sup>29</sup>

At least one other study of yoga for CLBP was conducted with military veterans,<sup>63</sup> and two other studies were conducted with active-duty military personnel,<sup>64,65</sup> which may allow for better comparisons of attendance and adherence. Roseen et al. randomized military veterans with CLBP to either yoga or health education, and both were 1x weekly for 12 weeks.<sup>63</sup> They found that yoga participants were less likely to be adherent compared to education participants (48% vs 69% respectively) and that yoga was not superior to education on most outcomes. This same research group found that 83% of non-veterans participants were adherent using the same criteria in the same metro area setting. Similarly, a study of yoga for CLBP in low income, racially diverse adults conducted by these investigators found that just 44% of participants attended 9 of 12 sessions, and median attendance was 7 of 12 yoga sessions.<sup>66</sup> Thus, when taken along with the current results, these findings support our conclusions that sociodemographic differences associated with military veteran status and receiving VA care including less access, fewer resources, and more comorbid conditions present barriers to yoga attendance and may limit its' effectiveness.

Two other yoga studies have been conducted with active-duty military personnel with CLBP but they differ from the two studies with veterans in multiple ways. A feasibility study by Groessl et al<sup>64</sup> found that 57% of participants attended half of the 12 sessions, reflecting some attendance issues, yet the sample characteristics and reasons cited for attendance issues were quite different. Participants were a mean of 33 years old, 67% married, and were trying to maintain their military career. Time, stress, and scheduling were cited as reasons for non-attendance. Finally, a study by Highland et al<sup>65</sup> found that 86% of military personnel completed 9 of 12 yoga sessions, but these were individual 1 on 1 yoga sessions offered at the medical center where they were receiving treatment. Thus, the ability to schedule or reschedule individual sessions provides a unique scenario compared with group yoga classes offered at specific times each week. Given these findings, barriers to attendance are unlikely to be specific to military populations but instead are more likely co-occurring factors as noted above.

The impact of conducting in-person behavioral interventions in a relatively large metropolitan area is not easily assessed but may be a factor. For example, one yoga study conducted with older adults in a small midwestern US city had very high attendance.<sup>67</sup> That study offered 3x weekly yoga for 8 weeks and participants attended a mean of 19.2 of the 24 sessions (81%). Investigators reported that commutes were short and parking was widely available. The latter findings contrast with the current study where long commutes were more common for participants and parking options more limited. However, the parent RCT for this analysis was conducted specifically with VA patients in a wide catchment area (San Diego County) and few obvious solutions were

found. Researchers knew there may be access issues from prior trials, but all VA patients knew how to get to the main VA Medical Center. Finding specific locations to conduct interventions in the community that (a) required new transportation routes for many participants and (b) were central enough to work for a cohort of people proved challenging. Recruiting through the VA and holding interventions at VA facilities remained the optimal choice from among these options.

One way to address the issue of access and transportation is through synchronous remote delivery of yoga. The effectiveness and value of this approach has been demonstrated with veterans in a large metro area through broadcasting yoga to smaller VA clinics, retaining the social connection aspect of yoga.<sup>68</sup> Most of the research on teleyoga has been done with yoga for general wellness<sup>69</sup> or with persons with mental health or substance use challenges<sup>40</sup> in which yoga safety may be less of a concern with no live instructor present. However, there are recent studies showing teleyoga can be safe and effective in persons with chronic pain.<sup>70,71</sup> Hybrid studies in which participants attend one or two initial in-person sessions, or a 1 on1 remote session may promote safety by allowing an instructor to get to know each participant and teach them basic safety approaches before accommodating participant preferences for in-person or remote delivery format.

Another area for future research is measurement and promotion of long-term maintenance of yoga practice after a 12-week intervention ends. In the trial cited here, reduced pain and disability were maintained 6 months after baseline, but the proportion of participants doing yoga 2-3 x per week dropped from 59% to 20%. Although one yoga study tracked longer-term yoga practice out to 12-month,<sup>19</sup> an important area for future research is both tracking long-term yoga practice and intervening to promote yoga as a lifelong health practice in persons with chronic pain.

### Limitations

The study was conducted with veterans within the VA Health care System. However, the strategies to boost attendance and the factors linked to attendance such as socioeconomic status and disability levels were not specific to veterans. Thus, we expect our finding to be generalizable beyond yoga interventions with military veterans. The efforts to boost attendance were not planned, and thus a priori hypotheses were not presented. The changes were instituted mid-trial to boost attendance in order to improve the chances of conducting a successful RCT. The results of those efforts may be unique to our study and may not generalize. Similarly, we present some qualitative data on reasons for non-attendance. These assessments and analyses were not planned a priori. Study staff asked informal questions, typically by phone, and recorded reasons for nonattendance in a note section of an attendance tracker when calling to encourage attendance and check on

adverse events. This also would not have included reasons for non-attendance from participants who did not return, limiting the understanding of reasons for those with the biggest attendance obstacles.

### Conclusions

Specific strategies to boost attendance mid-trial in this RCT appeared to be beneficial but did not meet statistical significance in this study. Participant characteristics at baseline such as living situation (socioeconomic status), and disability were associated with attendance rates. When including all participants with pre-post yoga intervention data, yoga session attendance was significantly associated with reduced pain severity. Given the characteristics and challenges faced by VA patients who are older, have more co-morbidity, lower incomes, and higher rates of homelessness<sup>72,73</sup> than the general US population,<sup>74</sup> the attendance rates for this trial were sufficient and not unexpected. These findings and lessons learned may benefit other researchers in the VA Health care System and beyond.

Overall, most published studies of yoga for CLBP report good attendance,<sup>75</sup> but publication bias may be a factor to consider, and we recommend that future systematic reviews examine and report on attendance in more detail.

### Acknowledgements

This research was funded by a grant from VA Rehabilitation Research and Development (VA RR&D grant # RX000474).

### Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

### Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This study is supported by VA Rehabilitation Research and Development; RX000474

### Trial Registration

This study was registered at <https://www.clinicaltrials.gov/>; # NCT02524158.

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### Supplemental Material

Supplemental material for this article is available online.



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