Community-Based Aquatic Exercise and Quality of Life in Persons with Osteoarthritis

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ABSTRACT

CADMUS, L., M. B. PATRICK, M. L. MACIEJEWSKI, T. TOPOLSKI, B. BELZA, and D. L. PATRICK. Community-Based Aquatic Exercise and Quality of Life in Persons with Osteoarthritis. *Med. Sci. Sports Exerc.*, Vol. 42, No. 1, pp. 8–15, 2010. **Purpose**: To evaluate the effectiveness of a community-based aquatic exercise program for improved quality of life among persons with osteoarthritis. **Method**: Two hundred forty-nine adults with osteoarthritis were enrolled in a 20-wk randomized controlled trial of a preexisting community-based aquatic exercise program versus control. Intervention group participants (n = 125) were asked to attend at least two aquatic exercise sessions per week. Control group participants (n = 124) were asked to maintain their usual activity levels. Demographics were collected at baseline, and patient-reported outcomes were collected at baseline and after 10 and 20 wk. Depressive symptoms, self-efficacy for pain and symptom control, physical impairment, and activity limitation were tested as potential mediators of the relationship between aquatic exercise and perceived quality of life (PQOL). Body mass index (BMI), ethnicity, self-rated health, and comorbidity were tested as possible moderators. **Results**: Aquatic exercise had a positive impact on PQOL scores ($P < 0.01$). This effect was moderated by BMI ($P < 0.05$) such that benefits were observed among obese participants (BMI $\geq$ 30), but not among normal weight or overweight participants. None of the tested variables were found to mediate the relationship between aquatic exercise and PQOL scores. **Conclusions**: Given the availability of existing community aquatics programs, aquatic exercise offers a therapeutic and pragmatic option to promote quality of life among individuals who are living with both obesity and osteoarthritis. Future investigation is needed to replicate these findings and develop strategies to increase long-term participation in aquatics programs. **Key Words:** REHABILITATION, PAIN, PHYSICAL ACTIVITY, RANDOMIZED CONTROLLED TRIAL, INTERVENTION, OLDER ADULTS

Arthritis and chronic joint pain are the leading causes of disability among US adults (9). The most common form, osteoarthritis, affects 27 million individuals, presenting a tremendous human and economic burden (25). Those living with osteoarthritis experience a cycle of disabling joint pain, decreased activity levels, and functional decline. In addition to individual consequences such as reduced quality of life (34), arthritis and other rheumatic diseases are responsible for more than \$80 billion annually in health care costs and \$47 billion in lost productivity (7). Given the high prevalence and significant economic costs of osteoarthritis, cost-effective management of osteoarthritis requires community-based approaches that use existing infrastructure to help individuals prolong function, minimize pain, and maintain quality of life.

As a noninvasive nonpharmacological treatment, physical activity is among the recommended initial approaches for the management of osteoarthritis symptoms (40). Although many types of physical activity can benefit individuals with osteoarthritis, aquatic exercise is of particular interest because it provides combined gentle joint movement, the therapeutic effect of warm water, and the cardiovascular benefits of moderate-intensity aerobic activity. Aquatic exercise may improve pain, depression, stiffness, walking time, range of motion, and postintervention activity levels in people with osteoarthritis (3).

Moderate-intensity physical activity, including aquatic exercise, has an additional advantage of helping to combat obesity, which is associated with lower functioning and quality of life (29) and is a known risk factor for osteoarthritis (13). The strong relationship between obesity and incident knee and hip osteoarthritis (11) may be partly explained by is the increased load on weight bearing joints

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experienced by overweight and obese patients. Evidence from the Framingham Study suggests that even a modest amount of weight loss can substantially reduce the risk of incident knee osteoarthritis (14).

From a public health perspective, aquatic exercise is best evaluated in the context of existing community-based programs, such as that provided by the Arthritis Foundation Aquatic Program (AFAP). The AFAP is nationwide standardized program aimed at improving the well-being of people with arthritis. Founded in 1983, the AFAP represents a collaborative effort between the Arthritis Foundation, certified instructors, and community pool facilities and reaches more than 140,000 individuals yearly.

Most trials of aquatic exercise have used study-specific interventions, which provide a good test of efficacy but may not provide a useful indication of what benefits could be expected in a broader, more realistic setting. One exception is that of Suomi and Collier (37) whose 8-wk study of 30 adults found that both the AFAP and the Arthritis Foundation's land-based exercise program provided physical functioning and strength benefits relative to a control group. In keeping with the study's focus on physical functioning, however, outcomes assessment consisted of tests of functional ability rather than on patient-reported outcomes. Similarly, Wang et al. (39) recently reported beneficial effects of a 12-wk AFAP-based aquatic intervention versus control on physical measures but found no effect on patient-reported measures. Although well conducted, this study was small (*N* = 38) and had a relatively short intervention, suggesting that a larger sample size and a longer duration of participation in such a program may be required to obtain measurable effects on patient-reported quality of life.

A related possibility that has remained unexamined is whether aquatic exercise may benefit only certain subgroups of individuals, which could lead to an underestimation of the effectiveness if such moderating variables are not recognized and taken into account. Similarly, no studies have examined the pathways by which aquatic exercise may improve quality of life for people with arthritis. Both of these questions are essential to consider as we determine whether, how, and for whom aquatic exercise should be recommended.

An excellent framework for understanding these complex relationships is provided by the Model of Health Promotion for People with Disabilities (21,31). This model posits that quality of life is a distinct outcome that is influenced by (a) the disabling process, (b) the individual and social environment, and (b) opportunity. Each of these three "planes" is composed of various influences and points of intervention. The model allows for complex interactions between factors and planes, reflecting the ideas that there are multiple possible paths of influence an intervention may take and that the effect of an intervention may differ for different subgroups of a population.

Understanding the effects of aquatic exercise on quality of life therefore requires testing possible mediators and moderators of this relationship (Fig. 1). Identification of mediators (process variables) provides information about the pathways through which an intervention affects the outcome of interest, whereas identification of moderators provides understanding about which population subgroups experience the greatest benefit (4).

The purpose of the current study was therefore to determine the effect a 20-wk randomized controlled trial of a community-based aquatic exercise intervention (the

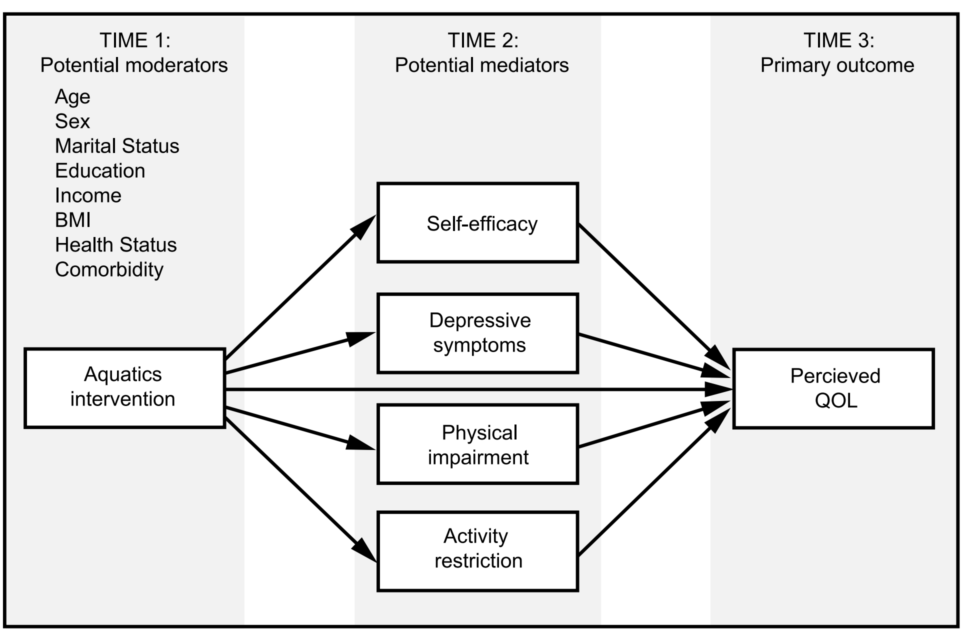

FIGURE 1—Relationship between participation in the AFAP and PQOL.

AFAP) versus control on perceived quality of life (PQOL) among 249 adults with hip and/or knee osteoarthritis. Secondary aims were (a) to determine whether demographic characteristics, self-efficacy, impairment, or activity limitation moderated the relationship between participation in an aquatics program and quality of life and (b) to examine possible mediators of this relationship. A frequent limitation of mediation analyses is the inherent uncertainty associated with causal pathways in cross-sectional data (38). By reassessing potential moderators and mediators at the midpoint of the study, this study eliminates such ambiguity. In addition to addressing the specific research questions described above, this research contributes to the broader goal of large-scale health promotion for persons with osteoarthritis through a discussion of the issues and challenges of community-based aquatic programs.

MATERIALS AND METHODS

Study Design and Sample

Data were collected from 1997 to 1998 as part of a randomized controlled trial to evaluate the cost-effectiveness of the AFAP versus control for older adults with hip and/or knee osteoarthritis in the state of Washington (33). Detailed descriptions of study design, recruitment, and adherence have been presented previously (5,36). Briefly, individuals were eligible if they self-reported a clinical diagnosis of osteoarthritis, were 55–75 yr of age, had permission from their physician to participate in aquatic exercise, were able to enter and exit the pool with minimal assistance and perform aquatic physical activity, and lived sufficiently near an AFAP that they were willing and able to travel to the aquatics class twice per week. Individuals were excluded if they were already physically active ($\geq$60 min$\cdot$wk^{-1} of total activity), were scheduled for joint surgery, or had urinary incontinence or multiple sclerosis. Prior participation in aquatic exercise was not an exclusion criterion. Informed written consent was obtained from all participants.

A sex-stratified randomization process was used to assign eligible individuals to either an aquatic exercise intervention ("exercise group") or a delayed entry control group ("control group"). Exercise group participants (n = 125) were asked to attend at least two AFAP sessions per week for 20 wk. Control group participants (n = 124) were asked to maintain usual activity levels and refrain from engaging in new exercise programs.

All participants completed a baseline questionnaire, which included demographic information and outcome measures. Outcome and process variables were reassessed at the midpoint (10 wk) and at the end (20 wk) of the study. Questionnaires were self-administered and were collected by study staff who were blinded to group assignment. Participants also completed weekly postcard diaries to record aquatic exercise class attendance. Controls were eligible for paid participation in the AFAP after completing the 20-wk study period. All study procedures were approved by the institutional review board at the University of Washington.

Intervention

This study used the AFAP, a standardized, preexisting, community-based program aimed at improving the well-being of people with arthritis. Instructors are certified by the Arthritis Foundation to conduct classes in pools with water temperatures ranging from 84°F to 92°F. Range of motion, muscle strengthening, and endurance exercises form the base of each class. In this study, classes ranged from 45 to 60 min and were taught two to five times per week depending on the pool location.

Outcome Measure

The primary outcome in this study was the Perceived Quality of Life (PQOL) scale (30,32). This measure is based on human needs theory and is consistent with the World Health Organization Quality of Life definition of quality of life. The PQOL assesses level of satisfaction or dissatisfaction with the major areas of life posited by Maslow et al. to define a high level of quality of life and covers the health categories of the Sickness Impact Profile for examining the relationship between function and quality of life. A summary score was obtained from the mean of the 19 items (each scored on a Likert scale from 1 to 10); scores were dropped for participants who completed 14 or fewer items. Higher scores represent better POQL.

Potential Mediators or Moderators

Self-efficacy, physical impairment, depressive symptoms, and activity limitation were targeted as potential mediators of the relationship between participation in an aquatic program and quality of life. Potential moderators were age, sex, marital status, education, income, body mass index (BMI), health status, and comorbidity.

Self-efficacy. The eight-item version of the Arthritis Self-efficacy scale was used to assess self-efficacy for pain and symptom control (26,28). This scale has been shown to be reliable, valid, and internally consistent (19). Each item is reported on a 10-point Likert scale. The total score, obtained from the mean of eight item responses, ranges from 1 to 10, with higher values indicating greater self-efficacy.

Physical impairment. Physical impairment was measured by (a) arthritis pain, (b) the number of swollen joints, and (c) the number of tender joints. Arthritis pain was measured using a visual analog scale (VAS) from the Stanford Health Assessment Questionnaire (HAQ), which has been validated for arthritic patients (20). Scores were based on the location of a vertical mark placed by the participant on a line extending from 0 (no pain) to 100 (severe pain) and were later converted to a score between 0 and 3. Participants completed separate checklists to indicate swollen joints and tender joints. Each joint checklist contained 10 areas (hands/knuckles/fingers, wrists, elbows, shoulders, hips, knees, ankles, toes, neck, and back). For each area, the participant could check "right," "left," or both. The total count was used as a general measure of the total number of body areas affected by osteoarthritis. Although swelling and pain/tenderness of joints are often correlated, they were retained as separate variables because of evidence that improvement on one measure does not necessarily lead to improvement on the other (12).

Activity limitation. The 19-item disability index (DISINDX) of the HAQ was used to measure activity limitation on the basis of the eight activities of daily living (dressing, arising, eating, walking, hygiene, reach, grip, and activities) (18). This index is valid, reliable, and sensitive to changes in function in people with osteoarthritis (17). Participants indicated their ability to perform various tasks by responding on a four-point scale from 0 ("without any difficulty") to 3 ("unable to do"). The DISINDX score is the mean of all items. Thus, scores ranged from 0 to 3 with higher scores representing greater disability.

Depression. The 11-item Center for Epidemiological Studies Depression (CES-D) scale was used to assess depressive symptoms (24), which has been shown to retain the psychometric properties of the original 20-item version while reducing respondent burden and has been validated for use in populations of people with arthritis (6). Responses to 11 items with four-point scales ranging from 0 ("rarely or none of the time") to 3 ("most or all of the time") were summed. Scores were dropped for individuals who answered fewer than nine items. Scores ranged from 0 to 33, with higher scores indicating more depressive symptoms.

Potential Moderators

Age, sex, marital status, income, education level, BMI, comorbidity, and self-rated health were tested as possible moderators of the relationship between participation in aquatic exercise and quality of life. These variables were all collected via self-report as part of the baseline questionnaire; BMI was then calculated from self-reported height and weight and categorized as nonobese (BMI < 30 $kg \cdot m^{-2}$) and obese (BMI ≥ 30 $kg \cdot m^{-2}$).

Baseline comorbidity was represented by the total number of chronic conditions positively indicated by each participant on a "yes/no" checklist of 16 conditions (e.g., high blood pressure, heart disease, diabetes, cancer). Individuals who responded to fewer than 12 items were coded as missing.

Baseline self-rated health was a single-item variable used as an indicator of participants' general perception of health status. Participants responded to the question, "Would you say, in general, your health is…" using a Likert scale ranging from 1 (poor) to 5 (excellent). This global variable is particularly important given that an estimated 28.6% of individuals with arthritis rate their health as fair or poor compared with only 8.3% of individuals without arthritic (8).

Data Analysis

All statistical procedures were conducted using Stata 7.0 (Stata Corporation, College Station, TX). The use of a "real-world" community-based setting was an integral part of the basis for the study; therefore, all participants for whom outcome data were available were included in analyses, regardless of adherence or nonadherence to the intervention. This "complete case" approach was chosen because of the relatively low proportion of loss to follow-up (9%), the observed comparability between completers and noncompleters concerning baseline values, and the potential pitfalls of imputing missing data. Baseline characteristics were computed using percentages, means, and standard deviations, and between-group tests were conducted using chi-squared tests and *t*-tests.

To test for moderation, the interaction term of group assignment (intervention vs control) and each potential moderator (age, sex, marital status, income, education level, BMI, comorbidity, self-rated health, self-efficacy, physical impairment, activity limitation, and depressive symptoms) was included in a regression model predicting PQOL at the midpoint of the study (10 wk), controlling for baseline values. Regression models were estimated using ordinary least squares on continuous outcome measures. A statistically significant interaction term would suggest moderation (2), providing evidence of differing intervention effects on the outcome according to the level of the moderating variable. One measure, that is, the number of swollen joints, was not normally distributed at 10 wk; therefore, a negative binomial regression model was used for that analysis. Because the chance of a Type I error increases with multiple testing, a conservative cutoff of $P < 0.01$ was used to evaluate statistical significance of potential moderators.

Mediation analyses of the relationship between aquatic exercise and quality of life were conducted for four variables (self-efficacy, physical impairment, activity limitation, and depressive symptoms) using the standard criteria set forth by Baron and Kenny (2). A variable was considered a mediator if, after controlling for other baseline variables, (a) group assignment was associated with the mediating variable at time 2, (b) group assignment was associated with quality of life at time 3, and (c) the relationship between group assignment and quality of life was considerably reduced or nonsignificant when the mediator was included in the model, with the coefficient for the mediator remaining significant.

We hypothesized that the intervention would reduce impairment, activity limitation, pain, number of swollen joints, number of tender joints, and depressive symptoms and would increase self-efficacy for pain and symptom control. We predicted the intervention would improve PQOL both directly and indirectly. Missing values for baseline measures

TABLE 1. Baseline characteristics of study participants (N = 249)[a].

	Control Group	Exercise Group
n	125	124
Age (yr)	66.0 (6.1)	65.7 (5.9)
Female	86.3%	85.6%
Non-Hispanic white	96.0%	92.0%
Married	59.7%	60.0%
Annual household income ($)		
<10,000	11.3%	5.65%
10,000–39,999	53.2%	52.8%
≥40,000	31.4%	34.4%
Education		
<High school	6.4%	7.2%
High school or some college	59.7%	63.2%
>College graduate	33.1%	28.8%
BMI ($kg \cdot m^{-2}$)	31.8 (7.0)	31.4 (6.1)
Self-rated health status mean[b]	3.0 (0.8)	3.0 (0.7)
No. of chronic conditions	4.1 (2.2)	3.9 (2.0)
Self-efficacy for pain/symptom control[b]	6.1 (1.9)	6.2 (2.0)
Pain rating	1.4 (0.6)	1.5 (0.6)
No. of swollen joints	2.6 (2.8)	2.7 (2.8)
No. of tender joints	6.5 (3.6)	6.8 (3.7)
Depressive symptoms (CES-D)	7.7 (5.0)	7.3 (5.3)
DISINDX	1.0 (0.6)	1.0 (0.5)
PQOL[b]	6.7 (1.7)	6.5 (1.5)

Values are presented as mean (SD) or percentage (%).
[a] No baseline differences were observed between study groups ($P < 0.05$).
[b] Higher scores are better. On all other measures, lower scores are better.

ranged from 0 to 14, with the high number reflecting participants who declined to provide their household incomes. Missing baseline values were imputed using a predicted value calculated from responses to other questionnaire items that were significantly related to each variable of interest in bivariate correlations. Baseline variables that were not found to predict any outcome and were not part of the mediation analyses were removed from final models for parsimony. Imputation was not used for outcome data. Whereas controlling for study site is common in multisite trials, we did not do so because of the large number of intervention sites (n = 48) in our trial and the potential for a single participant to take classes at multiple sites.

RESULTS

Sample characteristics. No significant differences were observed in baseline characteristics between the two study groups (Table 1). The sample was predominantly white (94%), female (86%), and averaged 66 yr of age. More than half were married (60%) and had an income between $10,000 and $39,999 per year (53%). Thirty-one percent were college graduates. The mean BMI was 31.6 (SD = 6.6) $kg \cdot m^{-2}$ with 51% of participants in the obese category (BMI > 30 $kg \cdot m^{-2}$). On average, individuals rated their health status as "good" on a five-point scale from poor to excellent, listing four chronic conditions in addition to osteoarthritis.

Participants reported slightly lower PQOL than the general population's mean for older adults (32). The mean self-efficacy for pain and symptom control was 6.2, similar to scores reported in previous studies (27). The mean pain rating was 1.5, approximately the midpoint of a scale from no pain to severe pain. Nearly 90% of participants reported taking pain medication, which may have mitigated the self-reported pain rating. Participants averaged 2.6 swollen joints and 6.7 tender joints (each checklist named 10 possible joints).

The mean CES-D score was 7.5, with approximately one-third of the sample scoring at or higher than 9, the standard cutoff used to represent probable clinical depression (24). The mean score on the DISINDX was 1.0, representing an average rating of "with some difficulty" for all activities of daily living; this is comparable to previous evidence that individuals with osteoarthritis tend to have less activity limitation than individuals with other types of arthritis (16).

Adherence and retention. Intervention group participants averaged 31 aquatic exercise sessions during the study period, or approximately 1.6 sessions per week (78% of study goal). Two (1.6%) of the 124 control group participants and 21 (16.8%) of the 125 intervention group participants dropped out of the study. The four most common reasons for dropping out were illness other than arthritis (n = 7), pain (n = 4), pool conditions (n = 3), and personal issues (n = 3). Individuals who did not complete the study were slightly younger those who did (64 vs 66 yr; $P < 0.05$), but there were no statistically significant differences between individuals who dropped out and completers on other measures at baseline. All individuals for whom 20-wk follow-up data were available were included in analyses, regardless of adherence to the intervention protocol.

Outcome and process variables. After controlling for covariates, assignment to the aquatic exercise intervention was significantly associated with higher PQOL score at 20 wk ($P < 0.01$; Table 2). The effect did not seem to occur through any of the potential mediating pathways examined in this study (self-efficacy, CES-D, activity limitation,

TABLE 2. Linear regression model predicting PQOL at 20 wk.[a]

Variable	β	P^b
Study group (exercise vs control)	0.36	0.008
PQOL (baseline)	0.62	<0.001
Self-efficacy	0.11	0.031
CES-D	−0.03	0.109
Pain rating	−0.10	0.468
No. of swollen joints	0.04	0.279
No. of tender joints	−0.01	0.655
DISINDX[c]	−0.10	0.515
Ethnicity	−0.17	0.563
BMI ($kg \cdot m^{-2}$)	−0.01	0.291
No. of chronic conditions	−0.03	0.394
Annual household income ($)		
<10,000	Reference	
10,000–39,999	0.32	0.158
≥40,000	0.50	0.038
Study group × BMI interaction[d]	0.05	0.014

[a] Model R^2 = 0.67. Variables were measured at baseline. Variables for age, sex, marital status, living alone, education, and self-rated health were removed from the model because they (a) were not statistically associated with any outcome in preliminary models and (b) were not confounders of the relationship between study group and outcomes.
[b] Results from ordinary least squares regression.
[c] DISINDX (from HAQ).
[d] Results from separate model including all covariates listed in table plus the interaction term study group × BMI (<30.0 vs ≥30).

physical impairment), and the intervention was not associated with any of these variables at 10 wk after randomization.

BMI was not related to baseline values of outcome measures but was a significant moderator of the relationship between aquatic exercise and PQOL ($P < 0.05$) such that a benefit was observed among obese participants (BMI $\geq$ 30; $P < 0.01$), but no effect was observed for those who were at a normal weight ($18.5 \leq \text{BMI} < 25$) or were overweight ($25 \leq \text{BMI} < 30$). Age, sex, marital status, education, income, health status, and comorbidity did not moderate the relationship between aquatic exercise and quality of life. All analyses controlled for baseline PQOL score.

DISCUSSION

As the US population ages, it will face an unprecedented economic burden of lost productivity, medical visits, and pharmacological costs due to osteoarthritis. Equally important are the psychological and social ramifications of arthritis-related physical impairment and reduced ability to perform the activities associated with a full and independent lifestyle. Although several physical activity interventions aimed at management of arthritis have been tested in efficacy trials, accessible community-based approaches are the real key to providing assistance to a large population of individuals. This study provides evidence that the AFAP, an existing and widely available community-based program, is effective in improving PQOL among adults with osteoarthritis. The small but significant benefits of aquatic exercise observed in this study are consistent with those of previous research (10,15,39) and are particularly meaningful from the perspective of evaluating a large-scale program such as the AFAP.

More importantly, these data are the first to address the question of which subgroups of the population with osteoarthritis are most likely to benefit from aquatic exercise. BMI was found to moderate the relationship between aquatics and quality of life, suggesting that promotion of aquatic exercise is beneficial for obese but not nonobese individuals. This finding is important because the added burden of excess body weight on joints can exacerbate osteoarthritis symptoms (13). Although a variety of types of exercise may have beneficial effects for arthritis, aquatic exercise may be particularly appealing to obese individuals because the buoyancy of water helps support the body, allowing for pain-free motion (1). The opportunity to exercise without full body weight may therefore improve well-being and quality of life even before weight loss from increased activity is realized.

Several other baseline variables (age, sex, marital status, education, income, self-rated health, and comorbidity) were tested but found not to moderate the relationship between the intervention and outcome, suggesting that the broad community-based approach is useful for a wide variety of groups. Although some may expect aquatic exercise to appeal mainly to women, this study provides evidence that men are equally likely to benefit from such programs and should be encouraged to participate.

Contrary to study hypotheses, the effect of the intervention on PQOL was not mediated by self-efficacy, impairment, or activity limitation. This is perhaps unexpected given the breadth of literature reporting the impact of physical activity on improving depression, pain, function, and disability but may be due to the interrelationship between these possible mediators and PQOL. Although we used the midpoint (10 wk) measurements of potential mediators to account for temporal sequence, it is possible that measurement at an earlier or later time would yield different results in mediation analyses.

As noted by a recent Cochrane Collaboration review (3), few rigorous aquatics trials have been conducted for osteoarthritis. The present study combined strong methodology (e.g., randomized controlled design, a relatively long intervention period, detailed measurement of outcomes using validated scales) with a community-based intervention. Although most exercise trials use study-specific interventions designed by the investigator, by using a preexisting and widely disseminated program, this study provided a stronger and more realistic "real-world" test of aquatic exercise. The results of this study are therefore more appropriate for informing public health initiatives. Finally, the study was able to demonstrate a significant benefit of aquatic exercise with only moderate levels of overall adherence, further supporting the conclusion that community-based programs are likely to be effective in uncontrolled settings.

One limitation of this study was the unequal dropout rate between study arms; two participants dropped out of the control group, whereas 21 dropped out of the intervention group. Seven of these 21 exercisers cited illnesses other than arthritis as the main reason for dropping out, suggesting that the intervention was not feasible for some participants who had preexisting or newly acquired health problems. This is consistent with previous research showing that acquisition of medical problems was associated with poorer adherence to a home-based exercise program among older adults with functional limitations (22). Unequal dropout rates and low or moderate adherence to study protocols are common in studies of physical activity interventions. The level of compliance observed in this study is therefore not unexpected, particularly because individuals with arthritis or other functional limitations tend to be inactive relative to the general population (35).

A second limitation is the use of self-reported height and weight, which introduces measurement error in the BMI measure. Third, mediation analyses were limited by the modest main effect of aquatic exercise on PQOL. The intervention was associated with significant improvements in pain at the midpoint of the study ($P < 0.05$); however, this did not seem to be a factor in the causal pathway between aquatics participation and quality of life. The relationship between aquatic exercise, pain, and quality of life can be elucidated by future trials using larger samples, more frequent exercise sessions, and strategies to increase adherence. Finally, our VAS pain assessment was limited by the compression of the original data (scored on a range from 0 to 100) into a simpler scale (from 0 to 3). The uncoded variable is no longer available; therefore, we chose to present the compressed version despite the loss of some precision.

Aquatics present an opportunity to provide the large population of patients with osteoarthritis with a form of physical activity that is joint-friendly and appealing to older adults. This study adds to previous research supporting the use of aquatic exercise for osteoarthritis and provides new evidence that participation in a community-based aquatics program can improve overall perceptions of quality of life among individuals with osteoarthritis. Our findings also indicate that aquatic exercise is particularly beneficial in the context of obesity. Continuing research is needed to confirm and expand upon these findings and to compare the effects of different types of aquatics programs. Future study is also needed to examine the use of behavioral strategies to enhance adherence, including exercise-related goal setting and self-efficacy.

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