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Effect of Tailored Activity Pacing on Self-Perceived Joint Stiffness in Adults With Knee or Hip Osteoarthritis

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Abstract

OBJECTIVE—We examined the effects of a tailored activity-pacing intervention on self-perceived joint stiffness in adults with osteoarthritis (OA).

METHOD—Thirty-two adults with hip or knee OA were randomized to a tailored or general activity-pacing intervention. Participants' symptoms and physical activity over 5 days were used to tailor activity pacing. The outcome was self-perceived joint stiffness measured at baseline, 4 wk, and 10 wk. A linear mixed regression model was used.

RESULTS—The tailored group significantly improved in stiffness compared with the general group over time. We found a significantly different linear trend between groups (Time $\times$ Group, $p = .046$) in which the tailored group had decreasing stiffness over the three time points, denoting continued improvement. The general group's stiffness improved from baseline to 4 wk but returned to baseline levels at 10 wk.

CONCLUSION—Tailoring activity pacing may be effective in sustaining improvements in self-perceived joint stiffness in adults with OA.

Keywords

motor activity; osteoarthritis; range of motion, articular; self concept; treatment outcome

Osteoarthritis (OA) affects nearly 27 million U.S. adults (Lawrence et al., 2008) and is a leading cause of disability. Hip and knee OA in particular can be especially disabling given their negative effects on mobility and function (Guccione et al., 1994). Common symptoms of OA include pain, fatigue, and joint stiffness (Hunter, McDougall, & Keefe, 2008), and

increasing symptom severity is associated with reduced participation in activity over time (Machado, Gignac, & Badley, 2008).

OA pain and reduced function are widely accepted to be related; however, little is known about the relationship of joint stiffness and physical function. One study (Maly, Costigan, & Olney, 2006) has shown that higher levels of self-perceived joint stiffness were inversely related to confidence in the ability to perform physical tasks, which may in turn affect function. Our previous research has shown that OA pain and fatigue symptoms differentially affect function (Murphy, Smith, Clauw, & Alexander, 2008), and thus interventions targeting OA symptoms should take into account their varying contributions. Additionally, interventions designed to increase physical function should have an assessment of each major OA symptom as a separate outcome variable, process variable, or both. We previously reported in a pilot randomized trial the effects of two types of activity pacing intervention (tailored vs. general) on pain and fatigue in patients with OA (Murphy, Lyden, Smith, Dong, & Koliba, 2010). Pain severity decreased for participants in both groups, but only participants in the tailored activity-pacing intervention reported diminished fatigue. This finding led us to reexamine the data to explore the effect of activity pacing on self-perceived joint stiffness. Although stiffness was not originally considered a primary outcome, activity pacing may directly affect joint immobility.

Activity pacing is a behavioral strategy in which people balance work with rest to accomplish their necessary and valued activities (Murphy & Clauw, 2010). It involves teaching awareness of current symptoms and their effect on activity and the scheduling of breaks before symptom exacerbation. Scheduled rest breaks are designed to help attenuate the overactivity–underactivity cycle (Birkholtz, Aylwin, & Harman, 2004) in which periods of excessive activity result in symptom flares from which people need to recover, often resulting in a prolonged period of diminished function and productivity. The goal of activity pacing is to eliminate the highs and lows in activity patterns and to keep a steady pace throughout the day. Whereas pain and fatigue may result from overdoing activity and can be ameliorated with frequent short breaks in action, joint stiffness, which typically peaks in the morning and after long periods of inactivity (Altman, 1991; Gotlieb, 2003), may respond more readily to maintaining a steady pace and limiting prolonged sedentary periods.

Our objective in this secondary analysis was to examine the effect of two interventions—general and tailored activity pacing—on self-perceived joint stiffness at two time points post-intervention. We aimed to answer the research question, “Does a tailored approach to activity pacing improve self-perceived OA joint stiffness to a greater degree than a general approach?” Because the group receiving the tailored activity pacing intervention received more personally relevant instruction than the group receiving the general activity pacing intervention, we hypothesized that they would report less stiffness and would sustain this improved symptom report through a 10-wk follow-up period.

Method

This research was approved by the University of Michigan Institutional Review Board. A detailed description of all study procedures, including recruitment, randomization, and the intervention protocol, has been reported elsewhere (Murphy et al., 2010).

Sample

In brief, between September 2006 and October 2007, 178 community-dwelling adults were recruited for this study in response to public advertisements in the southeastern Michigan area and subsequently screened for eligibility. The main analyses were conducted on a sample of 32 participants who completed all components of the study.

An initial telephone screening took place to determine preliminary eligibility. Participants were included if they were ages 50–80, scored ≥ 26 on the Mini-Mental State Examination (Folstein, Folstein, & McHugh, 1975), and spoke English. Participants also needed to have symptomatic knee or hip OA as defined by these criteria: radiographic evidence of OA (≥ 2 on the Kellgren–Lawrence scale; Kellgren & Lawrence, 1957, 1963), self-reported joint pain for ≥ 1 mo, and a pain score of ≥ 4 of 5 on the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC; Bellamy, Buchanan, Goldsmith, Campbell, & Stitt, 1988) Pain subscale, with two items rated moderate pain or greater (Goggins, Baker, & Felson, 2005). Participants were excluded if they reported a medical condition that interfered with performance of activities of daily living (ADLs) or caused pain and fatigue (e.g., cardiopulmonary diseases), joint surgery of the knee or hip in the previous 6 mo, were currently receiving treatment (not including pharmacological treatment) to reduce OA symptoms (e.g., occupational therapy), were nonambulatory, or were unable to operate the accelerometer used for daily symptom and activity reporting.

Procedures

After admission to the study, participants signed an informed consent form. They were stratified by age and gender and randomly assigned to a tailored or general activity-pacing intervention group. Over a 10-wk period, participants took part in a baseline assessment, three 5-day home monitoring periods, two weekly intervention sessions, and a follow-up assessment at 10 wk. Home monitoring periods were scheduled immediately after the baseline assessment, second intervention session, and follow-up assessment. At the beginning of the second home monitoring period, participants also received the same questionnaires to complete as they did at the baseline and 10-wk outcome assessments.

Assessment

Demographic and health history information, including educational level, marital status, race, body mass index, chronic medical conditions, and number of painful or stiff joints, was collected at baseline. For both the baseline and 10-wk follow-up assessments, participants completed physical performance assessments conducted by trained research staff blinded to the study hypotheses and group assignment of participants, and they also completed questionnaires related to OA symptoms.

Physical activity, OA symptoms, and activity-pacing behaviors were assessed during three separate 5-day home monitoring periods. Assessment was accomplished using a wrist-worn accelerometer (Actiwatch–Score [Actiwatch–S]; Mini-Mitter, Bend, OR) placed on the participant's nondominant wrist. Participant training for use of this device was conducted at the baseline assessment. The accelerometer objectively measured physical activity over each 5-day period. Additionally, audible auto-alerts were set to remind participants to input symptom severity and frequency of activity-pacing behaviors (i.e., going slower and taking breaks to do activities and breaking activities into manageable components) into the watch. The Actiwatch-S input schedule included 2, 4, 8, and 12 hr after waking, as well as 30 min before bedtime. Finally, participants completed a log book—a data confirmation tool for the symptom ratings input into the watch—and recorded types of activities engaged in each day.

Interventions

Two activity-pacing intervention groups were designed for this study, one with tailored and one with general activity-pacing content. Each group received a total of 1.5 hr of intervention over a 2-wk timeframe (i.e., two 45-min sessions once a week for 2 wk). Two occupational therapists led the intervention sessions, one therapist per group. The therapists delivered the content to individual participants in their assigned group and were blinded to the content of the other intervention. Although the goal of the overarching study was to test the feasibility of these interventions, strategies were used to improve treatment fidelity (methods used to ensure that a behavioral intervention is reliably and validly implemented; Bellg et al., 2004). Treatment fidelity strategies included having each therapist complete a training module with the primary investigator on the intervention protocol, completion of written reports on the intervention session that were reviewed by the primary investigator (Susan L. Murphy), and scheduling regular check-in phone meetings between the therapists and the primary investigator.

The first component of the initial intervention visit was the same for both groups and consisted of a study-specific educational module on activity pacing. General principles of activity pacing as they relate to OA were provided and included preplanning and prioritizing activities, alternating activity and rest before symptom exacerbation, and changing positions. The difference in the initial visit for the intervention groups related to the focus of the session. The general activity-pacing group received the educational module, generic examples of how activity pacing relates to fatigue and pain in performance of daily activities, and general recommendations for activity-pacing strategies. The tailored activity-pacing group's session, however, focused on a participant-specific activity report that summarized and visually displayed the symptom and physical activity data collected during the initial home monitoring period. The relationship between the participant's symptoms and activity was highlighted, and personalized examples in which symptoms appeared to affect activity were offered. Individual goals were also formulated for activity pacing. Whereas changing positions was a general activity-pacing strategy, a person experiencing stiffness, for example, was encouraged to change positions by getting up and walking briefly during specific sedentary activities identified in the home monitoring period. The second intervention session was the same for both groups; it addressed individual progress with activity pacing and barriers to recommended strategies.

Outcome Measures

The primary outcome of interest for this study was self-perceived knee or hip joint stiffness measured on a 5-point scale ranging from 0 (*no symptoms*) to 4 (*extreme*) using the WOMAC. The WOMAC is a validated, disease-specific questionnaire assessing pain, stiffness, and dysfunction associated with OA and is sensitive to change in OA symptoms (Bellamy et al., 1988). The WOMAC Stiffness subscale included two questions: “How severe is your stiffness after first wakening in the morning?” and “How severe is your stiffness after sitting, lying, or resting later in the day?” The two responses were summed for each assessment; possible score ranged from 0 to 8. The Stiffness subscale psychometric properties include a test–retest reliability of .58 (intraclass correlation; Guyatt, Walter, & Norman, 1987), internal consistency (Cronbach’s α) between .75 and .88 (Bellamy et al., 1988), and construct validity of $r = .57$ when compared with the 6-Minute Walk Test (Boardman, Dorey, Thomas, & Lieberman, 2000).

Data Analysis

Baseline group differences in participant characteristics (age, gender, marital status, education, race) were compared using analysis of variance. To examine the group differences in stiffness over time, we performed a linear mixed regression with random coefficients (using SAS Version 9.2 PROC MIXED; SAS Institute, Inc., 1992), controlling for age and gender. We initially included race and marital status as covariates but omitted them because they were not significant and did not improve the model fit.

Results

Participant Characteristics

Demographic information and clinical findings for participants are presented in Table 1. Although age differences between the groups were not significant ($p = .10$), participants in the general activity-pacing intervention group were, on average, younger than participants in the tailored activity-pacing intervention group. Marital status (coded as *married* or *not married*) significantly differed between groups, with more participants in the tailored activity-pacing group being married. No significant differences were found between the two groups in gender, racial composition, osteoarthritic joint, or baseline WOMAC joint stiffness.

Joint Stiffness Changes by Group

On the basis of the linear mixed regression model, controlling for age and gender, we found that the Time $\times$ Group interaction was significant ($p = .046$), meaning that the two intervention methods had a different linear effect on self-perceived joint stiffness across the course of the study. Table 2 displays means and standard errors of self-perceived joint stiffness on the WOMAC by group at each time point. Stiffness levels reported by participants in both the tailored and general intervention groups declined from baseline to 4 wk (an average of 1.05 and .85, respectively). Self-perceived stiffness in the tailored intervention group continued to decline, on average, an additional 0.13 units through the 10-

wk follow-up assessment, whereas the general intervention group's reported stiffness increased 0.72 units, returning this group back to baseline stiffness levels.

Discussion

This study showed that self-perceived joint stiffness significantly improved over time for participants in the tailored activity-pacing intervention compared with participants in the general activity-pacing intervention. Although, on average, participants in both the tailored and the general activity-pacing interventions had improved stiffness from baseline to 4 wk, the general activity-pacing group's self-perceived joint stiffness returned to baseline levels at the 10-wk follow-up, whereas the tailored activity-pacing group's reported stiffness continued to improve. Thus, it appears that the sustainability of symptom management depended on the individualized nature of the activity-pacing intervention. The tailored instruction may have been more conducive to continued behavior change given that it targeted a person's most problematic symptoms and the examples used were based on the person's home monitoring period, which were likely more personally relevant than the examples used in the generalized instruction. In parallel with findings from the parent study (Murphy et al., 2010), this study provides further evidence supporting the need for practitioners to carefully consider each individual's unique symptom reports when designing an activity-pacing intervention targeting osteoarthritis symptoms.

Although stiffness is a commonly reported symptom of OA (Altman et al., 1986), most OA treatment focuses only on pain. The results of this study highlight that stiffness was also a problematic symptom reported by adults with OA and support that stiffness can be improved over time when addressed with occupational therapist–delivered activity pacing. Therefore, a need to address stiffness when evaluating adults with OA is apparent, and tracking this symptom throughout the course of an activity-pacing intervention may be beneficial in reducing overall OA disease burden.

This study's findings have limited generalizability because of its small sample size and minimal racial diversity. Additionally, intervention effectiveness may have been biased by the therapist's skill in administering the intervention. Only one therapist per intervention arm was trained to deliver the activity-pacing protocol. Thus, future research with a larger, more racially diverse sample and with more occupational therapist interventionists may help to confirm these findings.

Implications for Occupational Therapy Practice

This study provides preliminary evidence that self-perceived joint stiffness, a symptom receiving little attention in OA treatment, is an important symptom to assess and treat in adults with hip or knee OA. In addition to the positive effect of this intervention on fatigue (Murphy et al., 2010), a tailored, occupational therapist–led activity-pacing intervention was also effective in improving self-perceived joint stiffness over time. Note that the occupational therapists' skill level and professional competency may have played a role in this intervention's effectiveness. Although replication is needed in a larger study, this analysis provides support for a brief, individualized activity-pacing intervention on another

important symptom in OA. In summary, the clinical implications of this study are as follows:

- Self-perceived joint stiffness is an important OA symptom that can be addressed through behavioral strategies.
- A tailored, occupational therapist-led, activity-pacing intervention improved self-perceived joint stiffness in adults with OA.

Conclusion

This analysis focused on the effect of activity pacing on hip and knee self-perceived joint stiffness in adults with OA. Tailoring activity-pacing instruction based on symptoms and physical activity patterns was effective in improving and sustaining improvements in self-perceived joint stiffness in this population. Future research should address how activity pacing alters physical activity levels and its subsequent effects on OA symptoms.

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Table 1
Demographics and Clinical Characteristics of Participants (N = 32)

Characteristic	General Activity-Pacing Group (n = 15)	Tailored Activity-Pacing Group (n = 17)	Test of Group Differences	
			F ^a	p
Age, mean (SD)	59.5 (6.6)	63.9 (7.8)	2.91	.098
Women, n (%)	11 (73)	13 (76)	0.04	.844
Race, n (%)			2.59	.118
White	10 (67)	15 (88)		
African-American	4 (27)	2 (12)		
Pacific Islander	1 (7)	0 (0)		
Marital status, n (%) ^b			4.88	.036
Married	3 (25)	11 (65)		
Not married ^c	9 (75)	6 (35)		
Symptomatic OA joint, n (%) ^d			0.01	.910
Knee	10 (67)	11 (65)		
Hip	5 (33)	6 (35)		
WOMAC stiffness; mean (SD)	4.4 (1.9)	4.0 (1.6)	0.42	.523

Note. OA = osteoarthritis; SD = standard deviation; WOMAC = Western Ontario and McMaster Universities Osteoarthritis Index.

^a All degrees of freedom (df) were (1, 30) except for marital status, for which df = (1, 27).

^b Marital status was missing for 3 participants in the General Activity Pacing Group.

^c Not married included those never married, divorced, or widowed.

^d Participants reported the most symptomatic joint (either hip or knee).

Table 2
Western Ontario and McMaster Universities Osteoarthritis Index Joint Stiffness
Reported by Each Group for Three Time Points ($N = 32$)

Group	Baseline		4 wk		10 wk	
	Mean	SE	Mean	SE	Mean	SE
General activity pacing	4.38	0.47	3.53	0.40	4.25	0.45
Tailored activity pacing	4.07	0.45	3.02	0.49	2.89	0.43

Note. SE = standard error.