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A group-mediated physical activity intervention in older knee osteoarthritis patients: effects on social cognitive outcomes

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Abstract

The objective of the present study was to compare a group-mediated cognitive behavioral (GMCB) physical activity intervention with traditional exercise therapy (TRAD) upon select social cognitive outcomes in sedentary knee osteoarthritis (knee OA) patients. A total of 80 patients (mean age = 63.5 years; 84% women) were recruited using clinic and community-based strategies to a 12-month, single-blind, two-arm, randomized controlled trial. Mobility-related self-efficacy, self-regulatory self-efficacy (SRSE), and satisfaction with physical function (SPF) were assessed at baseline, 3, and 12 months. Results of intent-to-treat 2 (Treatment: GMCB and TRAD) × 2 (Time: 3 and 12 month) analyses of covariance yielded significantly greater increases in SRSE and SPF ($P < 0.01$) relative to TRAD. Partial correlations revealed that changes in SRSE and SPF were significantly related ($P < 0.05$) to improvements in physical activity and mobility at 3 and 12-months. The GMCB intervention yielded more favorable effects on important social cognitive outcomes than TRAD; these effects were related to improvements in physical activity and mobility.

Keywords

Aging; Physical activity; Osteoarthritis; Exercise; Mobility

Introduction

Knee osteoarthritis (OA) is a progressive, chronic degenerative disease that serves as one of the primary causes of physical disability with advancing age (Felson et al., 1987). Although

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Compliance with ethical standards

Conflict of interest Brian C. Focht, Matthew J. Garver, Alexander R. Lucas, Steven T. Devor, Charles F. Emery, Kevin V. Hackshaw, Ciaran M. Fairman, Jessica Bowman, and W. Jack Rejeski declares that they have no conflict of interest.

Human and animal rights and Informed consent All procedures followed were in accordance with ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2000. Informed consent was obtained from all patients for being included in the study.

regular physical activity (PA) is now established as an integral component to the self-management of knee OA (American College of Rheumatology, 2000; Jordan et al., 2003), most OA patients do not achieve recommended levels of PA (Fontaine et al., 2004). Furthermore, PA interventions targeting knee OA patients are plagued by high attrition rates (Deyle et al., 2000; Ettinger et al., 1997; O'Reilly et al., 1999; Sullivan et al., 1998; van Baar et al., 2001) and failure to sustain long-term post-treatment exercise adherence is linked with the deterioration of the improvements in clinically-relevant outcomes accompanying PA in knee OA patients (Ettinger et al., 1997; Focht, 2006). Consequently, developing a more comprehensive understanding of how to sustain adherence to PA is critical to clinical programming that targets lifestyle behavior change in this patient population.

In this regard, Bandura's Social Cognitive Theory (SCT) (Bandura, 1997) has been used extensively in interventions designed to promote change in PA behavior (Gourlan et al., 2016; McAuley & Blissmer, 2000). Findings from the PA literature consistently demonstrate that change in SCT constructs are salient predictors of adoption and maintenance of regular PA (McAuley & Blissmer, 2000; Olson & McAuley, 2015; Stacey et al., 2015; Tougas et al., 2015). Within the context of SCT, self-efficacy (SE) beliefs are of particular importance to promoting PA among knee OA patients as a one's confidence in their ability to perform mobility tasks, (mobility-related SE), self-regulate the ability to plan and carry out PA in the face of challenges (self-regulatory SE) and overcome barriers to PA (barrier SE) all are integral to successfully adopting and maintaining regular PA (Focht et al., 2005). Furthermore, not only does SE directly impact behavior, it also indirectly influences PA through other social cognitive constructs such as one's self-regulatory skills and their outcome expectations associated with engaging in PA (Doerksen & McAuley, 2014; Tougas et al., 2015). Accordingly, given the well-established challenge in promoting PA maintenance in knee OA patients, determining the extent to which behavioral interventions may yield positive change in these SCT constructs is an integral consideration in enhancing the efficacy of implementing PA in the self-management of knee OA.

Although PA is consistently integrated into treatment of knee OA, in these approaches to PA promotion relatively little attention has been devoted to the systematic development of the self-regulatory skills or change in key SCT constructs that are integral to promoting the adoption and maintenance independent, self-managed PA (Rejeski & Focht, 2002). One recent approach, a group-mediated cognitive behavioral (GMCB) PA intervention, is designed to promote the systematic development of self-regulatory skills, and through the use of the group as an agent of behavioral change, facilitate motivation to develop and implement these behavioral skills in order to maintain long-term, independent involvement in PA. The GMCB intervention has yielded significant improvements in clinically relevant behavioral and functional outcomes in chronic disease patients with compromised physical function (Rejeski et al., 2002, 2005, 2011). Results from our recently conducted pilot study, the Improving Maintenance of Physical Activity in Knee Osteoarthritis (OA) Trial-Pilot (IMPACT-P), demonstrated the GMCB intervention resulted in superior improvements in PA participation and mobility relative to traditional, center-based exercise intervention in sedentary knee OA patients (Focht et al., 2014). The objective of the current investigation was to examine changes in select SCT constructs targeted in the GMCB intervention, and to explore the extent to which change in these constructs were related to improvements in PA

participation and mobility performance observed across the IMPACT-P trial. It was hypothesized that the GMCB intervention would result in superior improvements in the social cognitive constructs of interest assessed in IMPACT-P and that improvements in these SCT constructs would be associated with change in PA participation and mobility across the 12 month trial.

Methods

Participants

A total of 80 (67 women, 13 men) sedentary, older knee OA patients (*M* age = 63.5 years *SD* = 6.52; 67% Caucasian; 26% African American; 4% Latino; 2% Asian) participated in the study. The primary inclusion criteria were: (a) age >55 years; (b) knee pain on most days of the month; (c) less than 20 min/wk of structured exercise during the prior 6 months; (d) self-reported difficulty with basic daily functional tasks due to knee pain; and (e) radiographic evidence of Kellgren–Lawrence scale stage II or III (mild to moderate) tibiofemoral OA. Primary exclusion criteria included having a serious medical conditions such as active cardiovascular disease, cancer, or pulmonary disease; inability to walk without a cane or other assistive device; and physician documented radiographic evidence of knee joint varus or valgus malalignment.

Procedures and interventions

IMPACT-P was a 12 month, two-arm, single-blind, randomized controlled pilot trial designed to compare TRAD and GMCB exercise interventions among sedentary knee OA patients. A total of 80 adults with radiographically-confirmed, symptomatic knee OA were recruited using clinic and community-based strategies and randomly assigned to either the GMCB (n = 40) or TRAD (n = 40) interventions. The study spanned from September 28, 2009 to October 19, 2011. The primary objective of the IMPACT-P trial was to examine the comparable efficacy of the interventions upon change in physical activity and mobility performance (Focht et al., 2014). The current paper focuses upon change in select social cognitive outcomes accompanying the interventions in the trial.

Detailed descriptions of the study design, trial procedures, and interventions have been published previously (Focht et al., 2012, 2014). However, a brief description of the trial procedures, interventions, and measures is provided here. Participants completed a telephone screening to assess eligibility and interest in the study followed by a baseline screening visit during which informed consent, HIPAA waiver, medical history, and assessments of mobility performance, patient reported outcomes, including all the social cognitive measures, and physical activity were obtained. Outcomes assessments were obtained using the same procedures at the 3 and 12 month follow-up visits by study staff blinded to treatment arm assignment.

Interventions

TRAD exercise intervention—The TRAD exercise intervention involved 3 months of 3 center-based, group exercise sessions per week for a total of 36 contact hours with study staff. Each exercise session consisted of 30–40 min of moderate intensity walking (RPE 12–

14: Somewhat Hard) and 20 min of lower body strength training involving the leg extension, leg curl, step-up, and calf raise exercises performed for 1–3 sets of 8–12 repetitions. The exercise prescription was tailored to each individual's abilities and exercise tolerance/capacity and exercise duration and intensity were gradually increased across the intervention to reach targeted goals. TRAD intervention participants were also encouraged to increase independent exercise and physical activity participation to accrue weekly physical activity levels ≥150 min of moderate intensity physical activity and were provided with standard OA self-management advice (via Arthritis Foundation educational pamphlets) to facilitate exercise motivation and participation. Participants in the TRAD intervention were not provided with any formal staff intervention contact in months 4–12.

GMCB exercise intervention—The GMCB intervention, based on the group dynamics literature and social cognitive theory (Bandura, 1997), received the exact same exercise prescription and equivalent total of 36 contact hours provided to the TRAD arm. However, the structure, sequencing, and goals of the contacts in the GMCB arm differed from those provided in the TRAD arm. The objective of the GMCB intervention was to integrate group-based cognitive behavioral counseling with exercise therapy to facilitate the development, practice, and mastery of key activity-related self-regulatory skills (i.e., self-monitoring, group and individual goal setting, barrier problem solving, action planning, relaxation/pain management strategies), while using group dynamics as an agent supporting behavior change, to promote exercise adherence, increased physical activity participation, and reengagement in challenging ADLs. The GMCB approach concomitantly titrates away from supervised center-based exercise emphasizing progressively more independent self-regulation of exercise behavior (Rejeski et al., 2003, 2011). Description of the timing and content of the contacts provided in the GMCB and TRAD intervention arms is provided in Table 1.

Measures

Self-efficacy—Multiple measures were used to assess participants' relevant self-efficacy beliefs. Specifically, *Self-Regulatory Self-Efficacy (SRSE)*, one's belief in their ability to successfully organize, plan, and schedule regular exercise and/or physical activity (24) and *Mobility-Related Self-Efficacy (MRSE)*, one's belief in their ability to successfully complete more challenging increments of walking during the 400 m walk task (Focht et al., 2012; Rejeski et al., 2003, 2005, 2011) were assessed. Both measures were developed consistent with Bandura's recommendations involving hierarchically organized items assessing beliefs in successfully completing incrementally more challenging aspects of each behavior/task on a ten point confidence scale (Bandura, 1997). Each measure has demonstrated to have adequate validity and reliability in prior lifestyle intervention trials targeting older adults. (Focht et al., 2012; Rejeski et al., 2003, 2005, 2011).

Satisfaction with physical function (SWF)—The 6 item measure assessed patients' SWF on a 7 point scale ranging from −3 (Very Dissatisfied) to +3 (Very Satisfied). This measure has previously demonstrated appropriate psychometric properties (Reboussin et al., 2000) and has been used as an assessment of satisfaction and function-related outcome

expectancies in prior lifestyle intervention trials in older adults (Focht et al., 2012; Rejeski et al., 2003, 2005, 2011).

Physical activity and mobility performance—Changes in the primary outcomes of physical activity, assessed using the LIFECORDER Plus accelerometer (Suzuken Kenz Inc Limited, Japan), and mobility performance assessed using the 400 Meter Walk Test have been reported previously (Focht et al., 2014). Both measures have well established validity and reliability and have been used in prior lifestyle intervention trials (Rejeski et al., 2005, 2011). The physical activity and mobility measures are included in the present study to evaluate the extent to which the select social cognitive measures are related to these important behavioral and performance outcomes in IMPACT-P.

Statistical analysis—The effects of the GMCB and TRAD interventions on changes in the social cognitive outcomes were analyzed using separate 2 (Treatment: GMCB and TRAD) × 2 (Time: 3 and 12 month) analysis of covariance (ANCOVA). Baseline adjusted changes in each social cognitive measure were used as the outcomes with age, gender, BMI, and baseline values of each measure included in the models as covariates. ANCOVA analyses were conducted using the intention to treat principle with the last value carried forward approach used to account for missing data. Effect sizes (Cohen's *d*) were calculated by taking the mean difference and dividing by the pooled standard deviation to determine the magnitude of differences observed for each outcome. Finally, partial correlation analyses controlling for age were conducted to examine the relationship between the social cognitive outcomes and physical activity at the 3 and 12 month follow-up assessments.

Results

The Consolidated Standards of Reporting Trials (CONSORT) diagram summarizing flow of participants through the IMPACT-P trials is provided in Fig. 1. Of the 80 participants randomized, 72 (90%) completed the baseline assessment and at least 1 follow-up assessment. Adherence to supervised exercise sessions was 71% in the GMCB intervention and 63% in the TRAD intervention.

Self-efficacy outcomes

The descriptive statistics for change in SRSE, MRSE, and SWF are summarized in Table 2. ANCOVA analysis of SRSE yielded a significant treatment main effect ($F[1,76] = 16.54$, $P < 0.01$). The GMCB intervention resulted in superior increases in SRSE at 3 months ($d = .63$) and 12 months ($d = .95$) relative to the TRAD intervention. Baseline SRSE was also a strong predictor of change in SRSE ($F[1,76] = 20.06$, $P < 0.01$) with those reporting the lowest SRSE at baseline demonstrating the greatest increases across the trial. Results of the ANCOVA analysis of baseline-adjusted change in MRSE revealed the treatment main effect approached significance ($F[1,76] = 3.36$, $P = 0.07$). Although this analysis did not reach conventional levels of significance, inspection of the group means provided in Table 2 demonstrates that the GMCB intervention resulted in more favorable improvements in MRSE at 3 months ($d = .27$) and 12 months ($d = .44$) relative to the TRAD intervention.

SWF

ANCOVA analysis of SWF yielded a significant treatment main effect (F[1,76] = 2.70, $P < 0.02$). The GMCB intervention resulted in superior increases in SWF at 3 months ($d = .31$) and 12 months ($d = .58$) relative to the TRAD intervention.

Correlation analyses

Partial correlation analyses controlling for age were used to examine the relationships between change in the social cognitive outcomes and trial's primary outcomes of physical activity and mobility revealed that change in SRSE was significantly correlated with improvements in weekly minutes of moderate to vigorous physical activity (r = .38; $P < 0.01$) and mobility (r = −.23; $P < 0.05$) at 3 months. SRSE was also significantly correlated with change in mobility at 12 months (r = −.23; $P < 0.05$). MRSE was significantly correlated with change in mobility at 3 (r = −.43; $P < 0.01$) and 12 months (r = −.27; $P < 0.01$). Change in SWF was significantly correlated with change in moderate to vigorous physical activity at 12 months (r = .27; $P < 0.05$) and change in mobility at 3 (r = −.25; $P < 0.05$) and 12 months (r = −.24; $P < 0.05$). Collectively, the correlation analyses suggest that improvements in these social cognitive outcomes were associated with more favorable change in physical activity and mobility performance in the IMPACT-P trial.

Discussion

Exercise interventions have consistently resulted in meaningful improvements in clinical and patient reported outcomes among knee OA patients (Deyle et al., 2000; Ettinger et al., 1997; Focht, 2006; O'Reilly et al., 1999; Sullivan et al., 1998; van Baar et al., 2001). However, challenges in successfully promoting post-treatment adherence detract from the efficacy of implementing exercise in the treatment of knee OA and underscore the importance of investigating change in theory-based correlates of physical activity behavior among knee OA patients (Focht, 2006; Focht et al., 2005). Findings from this pilot, comparative efficacy trial demonstrated that the GMCB physical activity intervention resulted in superior improvements in important social cognitive outcomes relative to a TRAD exercise intervention focusing upon 12 weeks of center-based, supervised exercise. Additionally, change in these social cognitive outcomes were also significantly correlated with change in physical activity and mobility observed across the trial's 12 month follow-up period. Findings from the IMPACT-P trial are consistent with those of other recent randomized lifestyle intervention trials demonstrating the favorable effects of the GMCB intervention upon social cognitive outcomes among older adults (Rejeski et al., 2003, 2005, 2011) and post-natal women (Cramp & Brawley, 2006). The present findings extend the benefits of the GMCB approach to sedentary knee OA patients.

Findings from the present study revealed unique trajectories of change in the multiple self-efficacy measures between the GMCB and TRAD interventions. Given that the development of behavioral self-regulatory skills is a primary emphasis of the GMCB intervention, it is noteworthy that the present results revealed statistically significant treatment main effects for SRSE and SWF and the most pronounced improvement following the GMCB was observed for change in SRSE. These finding reinforce the utility of targeting the development,

practice, and mastery of self-regulatory skills in enhancing beliefs regarding the ability to self-regulate physical activity behavior. Furthermore, the significant associations observed among change in SRSE with change in physical activity and mobility also provide support for the position that enhancing self-regulatory self-efficacy beliefs may be related to maintaining physical activity and mobility among older knee OA patients.

Although not reaching conventional levels of statistical significance ($P < 0.07$), the effect sizes accompanying change in MRSE suggest the GMCB intervention yielded meaningful improvements in knee OA patients walking self-efficacy. In light of the deleterious impact that limitations in mobility have on quality of life and daily functioning of knee OA patients, the favorable change in MRSE represents an important social cognitive outcome for older adults burdened with knee OA that is related to the preservation of physical activity and mobility.

In addition to the favorable changes in self-efficacy outcomes, the GMCB intervention yielded statistically significant, superior improvement in SWF. Satisfaction with function has been conceptualized as a key proximal outcome expectation associated with physical activity among older adults (Brawley et al., Brawley et al. 2012) which has also previously been shown to mediate change in quality of life and physical function accompanying lifestyle interventions targeting knee OA patients (Rejeski et al., 2002). From a conceptual perspective (Brawley et al., 2012; Cramp & Brawley, 2006; Doerksen & McAuley, 2014), improvements in self-efficacy beliefs and behaviorally-relevant outcome expectations are proposed to have a combined effect that may contribute to favorable behavior change including enhanced physical activity participation. Consistent with prior research (Cramp & Brawley, 2006), the present findings support the utility of the GMCB intervention for eliciting favorable changes in these key social cognitive outcomes.

Although results from the IMPACT-P trial are promising, there are several limitations that should be acknowledged. For example, the sample size did not provide optimal power to test for significant differences for all outcomes or conduct mediation analyses to explore if the social cognitive theory variables mediated the intervention effects upon changes in physical activity or mobility. Accordingly, the present findings should be interpreted cautiously and an optimally powered randomized controlled trial is required to determine the efficacy of implementing the GMCB intervention and the potential mediating effects of social cognitive variables on study outcomes among older knee OA patients. Similarly, although an intention to treat analysis was conducted, the limitations associated with the last value carried forward approach must be acknowledged. Future large scale randomized trials implementing more sophisticated mixed model analyses and maximum likelihood imputation methods to account for missing data are warranted. Finally, women constituted a large percentage of the study sample, precluding the ability to explore potential gender differences and limiting the extent to which the findings can be generalized to men with knee OA.

In summary, the results of the IMPACT-P trial demonstrate the utility of the GMCB intervention for producing meaningful improvements in relevant social cognitive outcomes among older knee OA patients and underscore the promise of integrating this approach to physical activity promotion in the medical management of knee OA. The GMCB

intervention to promoting physical activity and preserving mobility shows promise for improving relevant patient reported and functional outcomes among older adults burdened with knee OA and should be explored further in future large scale efficacy trials.

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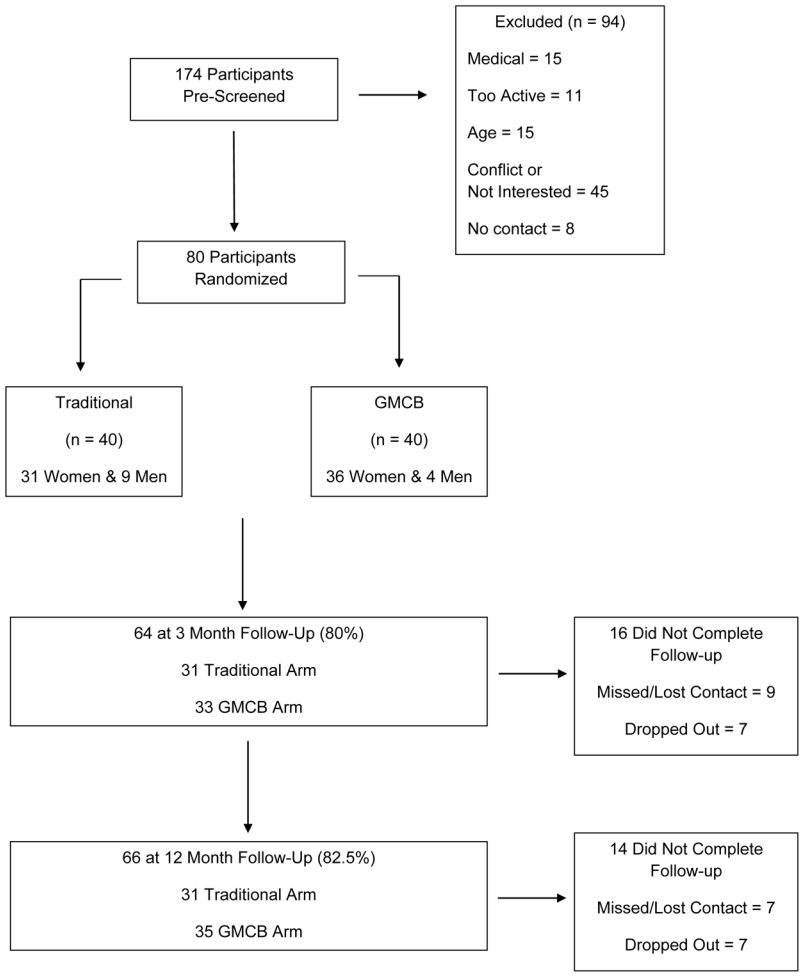

Fig. 1.

Consolidated Standards of Reporting Trials (CONSORT) diagram for the IMPACT-pilot trial

Table 1

Contact sequencing and content in the GMCB and Traditional interventions

Intervention criteria	GMCB	Traditional
Supervised center-based exercise sessions	60 min of exercise (walking and lower body strength training) + 20 min of GMCB counseling	60 min of exercise (walking and lower body strength training)
Supervised exercise Month 1	2 sessions/week	3 sessions/week
Supervised exercise Month 2–3	1 session/week	3 sessions/week
Supervised exercise Month 4	1 session/week	No sessions
Supervised exercise Month 5–6	2 sessions/month	No sessions
Supervised exercise Months 7–9	1 session/month	No sessions

Table 2

Unadjusted mean values (M/SD) of the social cognitive outcomes at baseline and follow-up

	Intervention arms	
	GMCB	**Traditional**
Variable		
Self-regulatory self-efficacy		
Baseline	54.25 (18.13)	54.50 (20.19)
3 month	63.50 (18.77)	52.50 (19.98)
12 month	62.25 (16.09)	46.94 (22.50)
Mobility-related self-efficacy		
Baseline	73.00 (27.64)	70.42 (27.62)
3 month	81.42 (26.28)	74.17 (27.05)
12 month	81.54 (27.10)	71.63 (28.25)
Satisfaction with physical function		
Baseline	0.80 (1.24)	1.10 (1.07)
3 month	1.33 (1.25)	1.38 (1.02)
12 month	1.22 (1.11)	0.80 (1.37)