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Physical Therapy Faculty Research and Publications/College of Health Sciences

A Randomized Trial of a Motivational Interviewing Intervention to Increase Lifestyle Physical Activity and Improve Self-Reported Function in Adults with Arthritis

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Abstract

Background

Arthritis is a leading cause of chronic pain and functional limitations. Exercise is beneficial for improving strength and function and decreasing pain. We evaluated the effect of a motivational interviewing-based lifestyle physical activity intervention on self-reported physical function in adults with knee osteoarthritis (KOA) or rheumatoid arthritis (RA).

Methods

Participants were randomized to intervention or control. Control participants received a brief physician recommendation to increase physical activity to meet national guidelines. Intervention participants received the same brief baseline physician recommendation in addition to motivational interviewing sessions at baseline, 3, 6, and 12 months. These sessions focused on facilitating individualized lifestyle physical activity goal setting. The primary outcome was change in self-reported physical function. Secondary outcomes were self-reported pain and accelerometer-measured physical activity. Self-reported KOA outcomes were evaluated by the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) for KOA (WOMAC scores range from 0 to 68

for function and 0 to 20 for pain) and the Health Assessment Questionnaire (HAQ) for RA. Outcomes were measured at baseline, 3, 6, 12, and 24 months. Multiple regression accounting for repeated measures was used to evaluate the overall intervention effect on outcomes controlling for baseline values.

Results

Participants included 155 adults with KOA (76 intervention and 79 control) and 185 adults with RA (93 intervention and 92 control). Among KOA participants, WOMAC physical function improvement was greater in the intervention group compared to the control group [difference = 2.21 (95% CI: 0.01, 4.41)]. WOMAC pain improvement was greater in the intervention group compared to the control group [difference = 0.70 (95% CI: −0.004, 1.41)]. There were no significant changes in physical activity. Among RA participants, no significant intervention effects were found.

Conclusion

Participants with KOA receiving the lifestyle intervention experienced modest improvement in self-reported function and a trend toward improved pain compared to controls. There was no intervention effect for RA participants. Further refinement of this intervention is needed for more robust improvement in function, pain, and physical activity.

Keywords

Rheumatoid arthritis, Osteoarthritis, Clinical trial, otivational interviewing, Lifestyle physical activity, Accelerometer

Statement of clinical significance

Chronic arthritis is a leading cause of chronic pain and functional limitations. Clinical trials evaluating structured exercise programs in adults with knee osteoarthritis and rheumatoid arthritis demonstrate exercise is beneficial for improving strength and function and decreasing pain. Whether lifestyle physical activity interventions can lead to improved outcomes in these populations is unknown. We demonstrated that a motivational interviewing-based intervention to increase lifestyle physical activity led to a statistically significant improvement in self-reported function and a nonstatistically significant trend toward improved pain but no improvement in physical activity in participants with knee osteoarthritis. Motivational interviewing interventions focusing on lifestyle physical activity show promise in helping adults with knee osteoarthritis experience improved physical function and less pain. Further study is needed to refine this evaluated intervention before disseminating it more broadly.

Introduction

Chronic arthritis is a leading cause of chronic pain and functional limitations [1]. Of the more than 54 million Americans with arthritis, over 40% report arthritis-attributable activity limitation [1]. The most common joint diseases are knee osteoarthritis (KOA) and rheumatoid arthritis (RA) [2], [3]. Despite many health benefits from physical activity, insufficient physical activity is endemic in adults with KOA and RA [4], [5]. Observational studies have shown that individuals with KOA who increase physical activity have improved functional status and less disability [6]. Clinical trials evaluating exercise programs in adults with KOA and RA demonstrate exercise is beneficial for improving strength and function and decreasing pain; however, these studies focused on structured exercise interventions including walking programs, exercise classes, and physical therapy, which are difficult for many patients to initiate and sustain [7], [8], [9], [10], [11].

Two potential approaches to foster sustainable increases in physical activity are (1) to focus on lifestyle physical activity rather than structured exercise as a means to improve health and (2) to incorporate motivational

interviewing techniques into the intervention to foster a more durable behavior change. Lifestyle physical activity is defined as the daily accumulation of activities including leisure, occupational, and household activities that are part of everyday life; this is in contrast to exercise which is often structured, purposeful, and performed in bouts lasting at least 10 minutes [12]. Studies comparing lifestyle physical activity interventions to structured exercise have demonstrated more sustained changes for lifestyle physical activity following the end of an intervention [13], [14]. Engaging in lifestyle physical activity behavior, rather than structured exercise programs, might be more attainable throughout the intervention and more sustainable after the end of the intervention.

Motivational interviewing involves an interviewer eliciting personal motivation for change and identifying ambivalence and obstacles, followed by helping the participant create an individualized plan for change. Motivational interviewing has demonstrated effectiveness in helping individuals modify behaviors related to alcohol, drugs, and diet [15], [16]. It has also helped individuals with chronic disease increase physical activity [17].

The Improving Motivation for Physical Activity in Arthritis Clinical Trial (IMPAACT) examined the hypotheses that a motivational interviewing-based intervention promoting lifestyle physical activity added to brief physician counseling would improve self-reported physical function (primary outcome) over 24 months in individuals with KOA and RA compared to a control group receiving only the brief physician counseling. Secondary outcomes were self-reported pain and increased objectively measured physical activity levels.

Methods

Study population

Participants with KOA were recruited from two faculty rheumatology practices, general medicine practices, and orthopedic surgery practices at a single academic medical center, as well as research registries and by advertisements placed in public transportation. KOA participants were required to have symptoms (knee pain, aching, or stiffness) on most days in the last month and to have radiographic KOA defined by Kellgren–Lawrence Class 2 or higher [18]. A screening procedure was created to determine eligibility of those responding to advertisements consisting of medical record review, phone interview, and knee x-rays if none were available from the prior 6 months. Patients with RA were recruited from the same two faculty rheumatology practices. RA participants fulfilled the 1988 ACR criteria for RA [19].

All participants also met the following additional criteria: (1) age 18 or greater, (2) no comorbidities that would limit potential functional improvement through physical activity (e.g., residual deficits from a stroke), (3) able to ambulate at least 50 ft, (4) body mass index (BMI) <35 kg/m^2, (5) no evidence of cognitive impairment or inability to speak and understand English, (6) no medical contraindications to physical activity (e.g., recent myocardial infarction or unstable angina), (7) no primary diagnosis of fibromyalgia, (8) no total joint replacement surgery within the past 12 months and no plans for total joint replacement in the next 24 months, and (9) no plans to relocate from the metropolitan area in the next 24 months.

The IMPAACT trial received approval from the Institutional Review Board and all participants provided written informed consent. This study was registered with clinicaltrials.gov NCT00248105. Enrollment occurred from May 2006 until January 2010 and follow-up assessments ended in September 2010 due to funding constraints. Further details of the study design and procedures have been published by Chang et al. [20].

Study procedures

Participants attended an initial visit at a centralized treatment site for baseline assessment followed by randomization. Participants were randomized 1:1 to 1 of 2 conditions: (1) IMPAACT intervention consisting of brief physician counseling and motivational interviewing intervention or (2) brief physician counseling only. KOA

and RA subjects had separate randomization schemes. A senior statistician provided a computer-generated list of random numbers for allocation of participants. Block randomization was stratified by diagnosis (KOA vs. RA), site of recruitment (each practice site, registry recruitment, and community recruitment), and self-reported functional status (high vs. low). KOA participants were classified as high function if their baseline Western Ontario and McMaster Universities Osteoarthritis Index Physical Function Scale (WOMAC function) was greater than 20, the median of participants enrolled in the Mechanical Factors in Arthritis of the Knee (MAK) study conducted at our institution [21]. RA participants were classified as high functional status if their baseline Health Assessment Questionnaire-Disability Index (HAQ function) was greater than 0, the median of subjects enrolled in a study on RA remission conducted at our institution [22]. The randomization scheme was only available to the primary statistician. The research assistant communicated the stratification data to the statistician (diagnosis, recruitment site, and self-reported functional status) who then provided the research assistant with an envelope including the treatment group for the participant.

All participants were scheduled for the Index Physician Visit at which time scripted physician physical activity counseling occurred. This visit took place at the centralized treatment site located in a clinic in an academic medical center. The physician physical activity counseling included determining whether the participant self-reported 30 minutes per day of moderate intensity physical activity on most days of the week. Participants were encouraged to work toward or maintain this level of physical activity. The physician also provided magnetic cards summarizing recommendations to remind participants of this goal. The physician providing the physical activity counseling was blinded to the group assignment of the participant. After this index physician visit, a research assistant opened an envelope and informed the participant of his or her group assignment.

Intervention

After the physician physical activity counseling session, participants randomized to the intervention group had their first motivational interviewing encounter with their physical activity advocate. This session, which has been described in detail elsewhere [23], included individual counseling based on motivational interviewing, individualized goal setting, and tailored strategies for increasing physical activity and monitoring progress. Counseling was completed by one of five health care professionals who were nurses and occupational therapists (physical activity advocate). In preparation for this trial the physical activity advocates completed training with a member of the Motivational Interviewing Network of Trainers. The intervention began with an in-person meeting to (1) establish a relationship and rapport; (2) complete a structured interview; and (3) establish an individual action plan. The structured interview identified individual-specific facilitators and barriers to increased physical activity participation including disease status, functional status, lifestyle, and motivation. This was used to identify key targets for a tailored physical activity intervention. The participant then set personal short-term goals and established an action plan to achieve these self-identified goals. The initial session lasted approximately 45–60 minutes.

Subsequent motivational interviewing sessions with the physical activity advocate occurred in-person or by telephone at a minimum of three sessions in the first year at 3, 6, and 12 months and at least two sessions (every 6 months) in the second year. These sessions focused on identifying individual supports and barriers to physical activity, an assessment of achievement of short-term goals, and revision of short-term goals as needed. Participants were encouraged to contact their physical activity advocate via telephone, e-mail, or other means if they desired contact between scheduled sessions. All sessions were individually tailored and the length of each session varied as determined by the participant and the physical activity advocate. It was expected that the sessions would last 10–15 minutes.

Sample descriptors

Upon enrollment, telephone interviews were conducted to collect demographic information (age, gender, race, education, and employment), disease characteristics (mobility-limiting comorbidities and disease duration), and baseline self-reported outcomes. Medical records were reviewed for current and past medical conditions, treatment, and duration of disease. BMI was calculated at the baseline visit using measured height and weight (kg/m^2). BMI was classified into under/normal weight (BMI < 25 kg/m^2), overweight (BMI 25–30 kg/m^2) and obese (BMI ≥ 30 kg/m^2). Kellgren–Lawrence rating of baseline knee x-ray was used to classify KOA severity with scores ranging from grade 0 to grade 4 (the most severe) [18]. All knee x-rays were rated by a single reader. Clinical Disease Activity Index (CDAI) score was calculated for RA participants based on tender and swollen joint count with scores ranging from 0 (no disease) to 76 (most severe disease activity) [24]. Assessors were blinded to participants' assignment to control or intervention group.

Outcomes

The primary outcome was change in self-reported physical function as assessed by WOMAC for KOA and HAQ for RA analyzed separately for KOA and RA over 24 months. Secondary outcomes were self-reported pain, physical activity assessed by accelerometer-measured average daily activity minutes and daily moderate-vigorous physical activity minutes, and self-reported health status using the Short Form-36 Physical and Mental Component Scores (SF-36 PCS and MCS). Self-reported outcomes were assessed via phone interviews with a research assistant at baseline with repeat assessments at 3, 6, 12, and 24 months. The research assistant was blinded to participants' assignment to control or intervention group. Participants enrolled after August 2009 (60 KOA and 85 RA) entered the study less than 12 months before the study end date and did not have 12- and 24-month assessments.

WOMAC function scores range from 0 (best) to 68 (worst) [25]. WOMAC pain scores range from 0 (no pain) to 20 (severe pain). HAQ function assesses the extent of the participant's functional ability and ranges from 0 (best function) to 3 (worst function) [25]. HAQ pain measures arthritis pain on a scale between 0 (no pain) and 10 (worst pain). SF-36 PCS and MCS scores were calculated for each participant from the SF-36 [26] with range from 0 (poor) to 100 (best quality of life), where general population mean is 50 (SD = 10).

Physical activity was monitored using a GT1M ActiGraph accelerometer, a small uniaxial accelerometer that measures vertical acceleration and deceleration [27]. Participants were given uniform scripted instructions to wear the unit on a belt at the natural waistline on the right hip in line with the right axilla during waking hours, except during water activities, for 7 consecutive days prior to their baseline clinic visit as well as at each follow-up assessment. Participants were instructed to "do what they would normally do in a typical week." Accelerometer data were analytically filtered using validated methodology to identify nonwear periods (a period the monitor was potentially removed during the day) and days with sufficient wear time for valid analysis [28]. To provide reliable estimates, we restricted analyses to participants with at least 4 valid days of accelerometer monitoring [29]. Nonwear periods were defined as more than 90 minutes with zero activity counts (allowing for 2 consecutive interrupted minutes with counts <100). A valid day of monitoring was defined as 10 or more wear hours in a 24-hour period, which was verified from accelerometer output. Accelerometers output an activity count, which is the weighted sum of the number of accelerations measured over 1 minute with the magnitude of the measured acceleration proportional to the weight. Physical activity measures were summarized as average daily minutes of nonsedentary activity (counts of ≥100 per minute that includes light, moderate, and vigorous intensity activity), and average daily minutes of moderate-vigorous physical activity (counts of ≥2020 counts per minute) [29].

Sample size

As described previously [20], a sample size of 172 KOA and 172 RA participants was estimated to provide 80% power to detect an improvement of effect sizes equaling 0.4 in WOMAC function for KOA participants and 0.4 for HAQ function for RA participants between intervention and control groups. We assumed the standard deviation of change in WOMAC function to be 9.3 and the standard deviation of change in HAQ function to be 0.7 [30], [31], [32], [33]. Given expected attrition, we attempted to recruit 189 RA and 189 KOA participants. We successfully recruited 82% (155/189) of the targeted number of participants with KOA and 98% (185/189) of the targeted number of participants with RA.

Statistical analysis

All analyses were performed separately for KOA and RA participants after the trial was completed with no interim analyses. Longitudinal multiple regression analyses with generalized estimating equations (GEE) were used to compare primary and secondary outcomes at follow-up assessment between the intervention group and the control group accounting for potential differences in baseline values. Our primary analysis evaluates all changes over the 24-month follow-up period using GEE to account for repeated observations across time on the same individual. This approach included all available follow-up data to mitigate the potential bias related to participants who terminated prior to their final 24-month follow-up assessment visit. Binary indicators were included for each follow-up assessment (3, 6, 12, or 24 months) and for the intervention status (intervention or physician advice only), and their interaction terms were included in the model. Data were analyzed from all participants who had any outcome data at 3, 6, 12, and/or 24 months follow-up. Overall mean outcome at follow-up assessment were compared between intervention and control groups adjusting for baseline outcome values.

In order to get robust estimates for HAQ function and average daily moderate-vigorous minutes which demonstrated a skewed distribution, these outcomes were assessed by quantile regression with clustered standard error to account for repeated observations across time (3, 6, 12, and/or 24 months follow-up) on the same individuals [34], [35]. All statistical analyses were conducted using SAS software version 9.4 (SAS Institute, Cary, NC) and Stata/SE 13.1 (StataCorp LP, College Station, TX).

Results

Knee osteoarthritis participants

A total of 617 individuals with KOA were screened to enroll 155 participants, of whom 76 were randomized to receive the intervention (Fig. 1). Due to late enrollment, 23 participants did not have 12-month follow-up assessment and an additional 60 participants did not have 24-month follow-up assessment. Of the 64 intervention participants and 68 control participants eligible for 12-month follow-up, 50 (78%) and 54 (79%), respectively provided data. Of the 46 intervention participants and 49 control participants eligible for 24-month follow-up, 35 (76%) intervention and 40 (82%) control participants provided data. The longitudinal analyses include the 141 with KOA who attended at least one follow-up assessment (3, 6, 12, and/or 24 months) following enrollment.
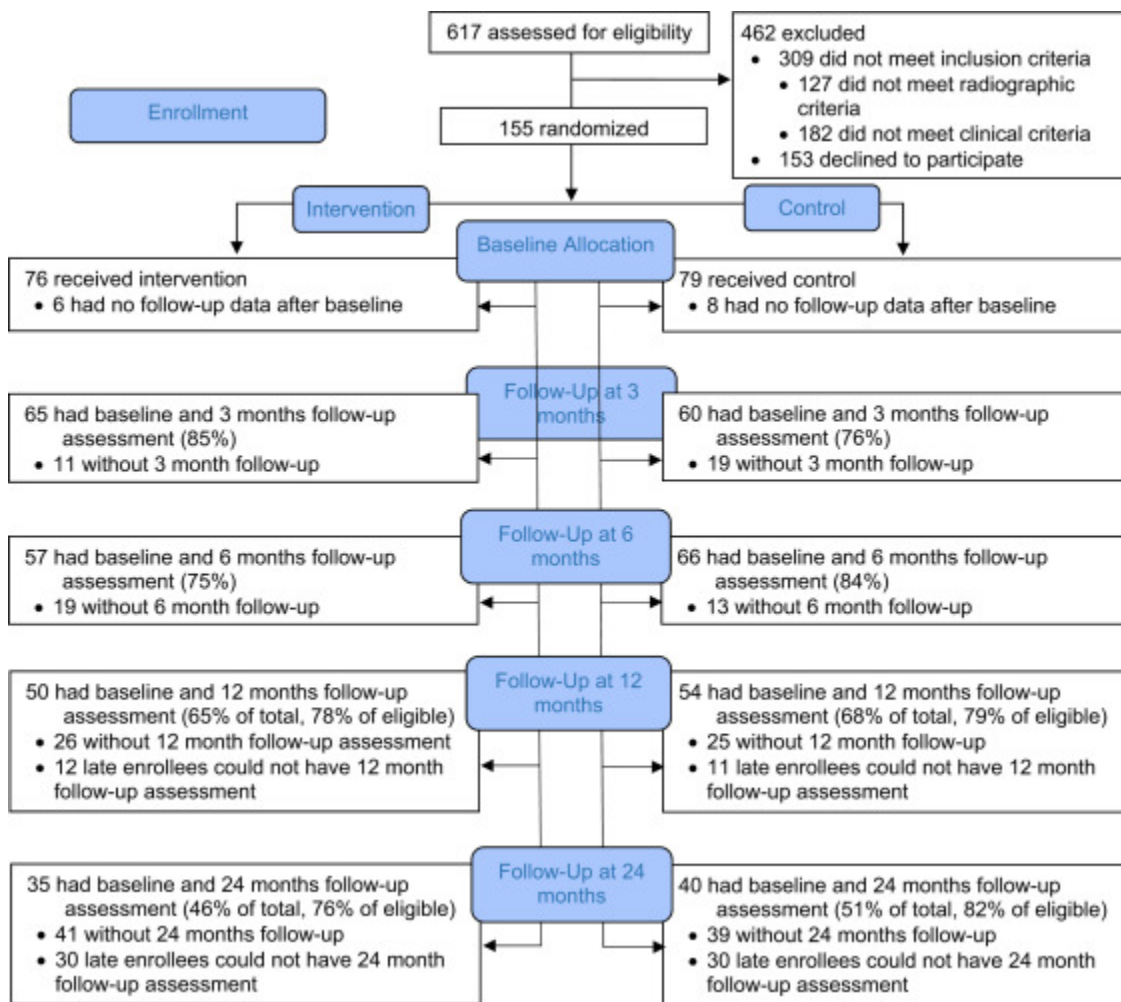
Fig. 1. Flow diagram of knee osteoarthritis study sample. Analysis sample includes participants with baseline outcome data and any data from 3-, 6-, 12-, or 24-month follow-up assessment.

The mean age of IMPAACT participants with KOA was 63.1 years, 60% were female, and 52% identified as white. As shown in Table 1, there were no significant differences between intervention and control groups in baseline characteristics. Outcomes at baseline were balanced between groups with the exception of daily activity minutes. On average KOA participants in the intervention group spent 30 more minutes in any intensity activity than the controls at baseline (p = 0.03). To account for baseline differences in daily activity minutes, outcomes were adjusted for baseline values.

Table 1. Baseline characteristics of IMPAACT participants

	Knee osteoarthritis		Rheumatoid arthritis	
	Intervention	Control	Intervention	Control
	(*n* = 76)	(*n* = 79)	(*n* = 93)	(*n* = 92)
Sociodemographics				
Age in years	61.41 (13.31)	64.78 (12.36)	54.97 (13.79)	54.70 (13.65)
Gender: % female	57.89	62.03	82.80	84.78
Race/ethnicity: % White	44.74	59.49	74.19	70.65
% College degree	72.37	79.74	88.17	82.61

% Employed	48.68	39.24	62.37	66.3
Health factors				
Body mass index (kg/m²)				
Mean	31.09 (5.51)	31.52 (6.94)	28.08 (6.36)	27.66 (6.84)
<25	10.53	17.72	36.56	39.13
25–29.9	36.84	27.85	29.03	34.78
≥30	52.63	54.43	34.41	26.09
% Mobility-limiting comorbidity	26.32	27.85	39.78	34.78
% Current smoker	18.42	17.72	7.53	2.17
Disease duration in years	9.57 (8.28)	12.18 (11.76)	13.40 (10.06)	13.03 (10.02)
OA severity (worst knee)				
KL grade 2	50.00	58.23	–	–
KL grade 3	27.63	26.58	–	–
KL grade 4	22.37	15.19	–	–
RA CDAI[a]	–	–	11.59 (10.98)	11.84 (10.66)
Outcomes				
WOMAC function[b]	18.04 (12.41)	17.42 (11.40)	–	–
WOMAC pain[b]	5.88 (3.64)	5.49 (3.42)	–	–
HAQ function[c]	–	–	0.73 (0.72)	0.67 (0.69)
HAQ pain[c]	–	–	3.32 (2.28)	3.31 (2.13)
PCS[d]	44.96 (8.19)	44.51 (8.13)	44.09 (9.96)	43.52 (9.63)
MCS[e]	53.83 (7.94)	54.40 (6.84)	51.21 (8.76)	50.83 (48.86)
Average daily activity mins	507.30 (105.30)	470.50 (99.24)	506.00 (104.90)	487.60 (105.60)
Average daily MV mins	22.73 (18.51)	17.34 (21.28)	17.63 (17.63)	21.37 (19.65)

% or mean (standard deviation).

KL, Kellgren–Lawrence grade ranges from 0 (no KOA) to 4 (most severe KOA).

MV, moderate-vigorous physical activity minutes.

aRA CDAI: Clinical Disease Activity Index score ranges from 1 (remission) to 76 (high disease activity).

bWOMAC: Western Ontario and McMaster Universities Osteoarthritis Index Function (0–68) and Pain (0–20). Pain scale ranges for 0 (no pain) to 20. Function ranges from 0 (best) to 68 (worst). Baseline WOMAC function for KOA participants ranged from 0 to 43, and baseline WOMAC pain ranged from 0 to 14.

cHAQ Health Assessment Questionnaire Pain (0–10) and Function (0–3): HAQ pain scale ranges from 0 (no pain) and 10 (worst pain). HAQ Function ranges from 0 (best function) to 3 (worst function). Baseline HAQ function for RA participants ranged from 0 to 3, and baseline HAQ pain ranged from 0 to 9.

dPCS: Short Form-36 Physical Component Score. Score ranges from 0 (poor) to 100 (best quality of life), where general population mean is 50 (SD = 10).

eMCS: Short Form-36 Mental Component Score. Score ranges from 0 (poor) to 100 (best quality of life), where general population mean is 50 (SD = 10).

Fourteen individuals with KOA (6 intervention and 8 controls) provided baseline data but did not complete any follow-up assessments. Compared to KOA participants who contributed follow-up data by participating in one or more follow-up assessment, the 14 individuals with KOA who did not contribute follow-up data were less likely to have college education and had fewer moderate-vigorous minutes at baseline (not shown).

Adjusted outcomes at 3-, 6-, 12-, and 24-month follow-up visits controlling for differences in baseline outcomes are reported in Table 2 for participants with KOA. Among KOA participants, the intervention group had significant improvement in WOMAC function scores at follow-up visits compared to improvement in controls [overall adjusted mean: intervention 14.39 vs. control 16.60; difference: 2.21 (95% CI: 0.01, 4.41)]. A trend toward improved WOMAC pain scores in the intervention group compared to the controls [overall adjusted mean: intervention 4.80 vs. control 5.50; difference = 0.70 (95% CI: −0.004, 1.41)] was not significant. Increases in accelerometer-measured physical activity were not statistically significant between intervention and control over follow-up assessment. There were no significant differences in PCS or MCS between intervention and control over follow-up assessment. No harms or unintended effects were detected by systematic monitoring at follow-up visits.

Table 2. Outcomes at 3-, 6-, 12- and 24-month follow-up assessment adjusted for baseline values for participants with knee osteoarthritis (*n* = 141)

Follow-up time	Treatment			Control			Difference between treatment and control[d]			
	Mean	95%	CI	Mean	95%	CI	Mean	95%	CI	*p* Value
***WOMAC function*[a]**										
3 mo	**16.51**	**14.66**	**18.36**	**17.80**	**16.25**	**19.36**	**1.29**	**−1.11**	**3.70**	**–**
6 mo	**15.13**	**13.07**	**17.18**	**16.69**	**15.07**	**18.31**	**1.56**	**−1.04**	**4.16**	**–**
12 mo	**13.41**	**11.12**	**15.70**	**16.60**	**14.57**	**18.63**	**3.19**	**0.14**	**6.24**	**–**
24 mo	**12.53**	**10.11**	**14.94**	**15.33**	**12.57**	**18.09**	**2.80**	**−0.83**	**6.43**	**–**
Overall[c]	**14.39**	**12.75**	**16.03**	**16.60**	**15.11**	**18.10**	**2.21**	**0.01**	**4.41**	**0.049**
***WOMAC pain*[a]**										
3 mo	5.17	4.57	5.78	6.14	5.58	6.70	0.97	0.15	1.79	–
6 mo	5.31	4.62	5.99	5.49	4.93	6.04	0.18	−0.70	1.06	–
12 mo	4.76	4.03	5.50	5.66	4.96	6.35	0.89	−0.11	1.90	–
24 mo	3.96	3.20	4.72	4.71	3.77	5.65	0.75	−0.44	1.95	–
Overall[c]	4.80	4.29	5.31	5.50	5.00	6.00	0.70	−0.004	1.41	0.051
Average daily activity minutes										
3 mo	495.31	476.66	513.97	489.94	472.80	507.09	5.37	−19.45	30.19	–
6 mo	524.17	483.45	564.90	472.27	454.24	490.30	51.91	8.27	95.54	–
12 mo	484.91	464.61	505.22	474.10	451.22	496.97	10.82	−19.70	41.33	–
24 mo	472.06	442.79	501.32	484.14	455.65	512.63	−12.09	−53.31	29.14	–
Overall[c]	494.11	474.03	514.20	480.11	463.14	497.08	14.00	−11.80	39.80	0.288
Average daily MV minutes										

3 mo	15.63	13.54	17.71	16.18	13.98	18.38	−0.55	−3.44	2.34	–
6 mo	18.51	14.69	22.32	15.95	13.21	18.68	3.26	−1.12	7.65	–
12 mo	15.03	11.76	18.30	17.74	14.92	20.56	−2.71	−6.85	1.43	–
24 mo	11.41	6.56	16.25	15.88	12.76	19.00	−4.48	−10.02	1.07	–
Overall[c]	15.85	13.62	18.09	16.41	14.10	18.72	−0.56	−3.21	2.10	0.680
PCS[b]										
3 mo	46.03	44.72	47.34	44.67	43.16	46.18	1.36	−0.63	3.35	–
6 mo	45.04	43.58	46.50	44.81	43.45	46.18	0.23	−1.76	2.21	–
12 mo	46.03	44.60	47.46	44.32	42.64	46.01	1.71	−0.50	3.91	–
24 mo	45.44	43.39	47.50	44.66	42.32	47.00	0.78	−2.28	3.85	–
Overall[c]	45.64	44.54	46.73	44.62	43.38	45.85	1.02	−0.61	2.65	0.220
MCS[b]										
3 mo	53.96	52.29	55.63	54.59	52.78	56.41	−0.63	−3.08	1.82	–
6 mo	54.32	52.54	56.10	54.05	52.19	55.90	0.28	−2.28	2.84	–
12 mo	54.06	51.92	56.19	54.68	52.91	56.44	−0.62	−3.37	2.13	–
24 mo	54.18	52.01	56.34	52.84	50.04	55.64	1.34	−2.16	4.84	–
Overall[c]	54.13	52.74	55.52	54.04	52.52	55.56	0.09	−1.94	2.12	0.929

Mean or mean change (95% confidence limits).

MV, moderate-vigorous physical activity.

aWestern Ontario and McMaster Universities Osteoarthritis Index (WOMAC). WOMAC Physical Function scale ranges from 0 (best function) to 68. WOMAC Pain scale ranges from 0 (no pain) to 20.

bShort Form-36 Physical Component Score (PCS). Short Form-36 Mental Component Score (MCS). Range from 0 (poor) to 100 (best quality of life).

cOverall averaged over 3, 6, 12, and 24 months adjusting for baseline values.

dPositive values indicate improvement favoring intervention group.

Rheumatoid arthritis participants

Figure 2 shows the 272 individuals with RA who were screened for the trial. A total of 185 adults with RA were enrolled, 93 of whom received the intervention. Due to late enrollment, 30 participants were not eligible for 12-month follow-up assessment and 55 additional participants were not eligible for 24-month follow-up assessment. Of the 78 intervention participants and 77 control participants eligible for 12-month follow-up, 54 (69%) intervention participants and 49 (64%) control participants provided 12-month follow-up data. Of the 50 intervention and 50 control participants eligible for 24-month follow-up, 39 (78%) intervention and 37 (74%) control provided 24-month follow-up data. The longitudinal analyses include the 178 participants with RA who attended at least one follow-up assessment (3, 6, 12, and/or 24 months) following enrollment.
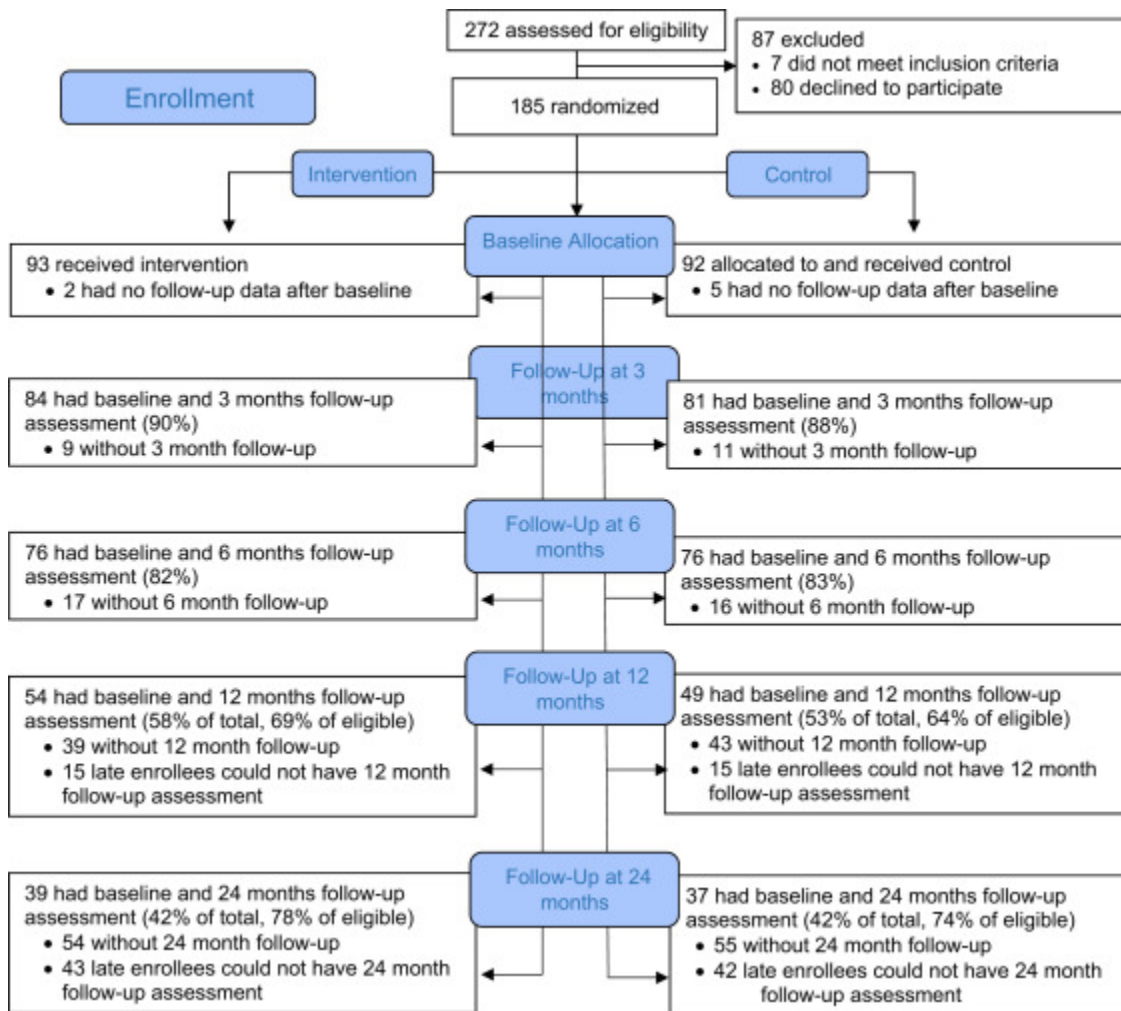
Fig. 2. Flow diagram of rheumatoid arthritis study sample. Analysis sample includes participants with baseline outcome data and any data from 3-, 6-, 12-, or 24-month follow-up assessment.

Mean age for RA participants was 54.8 years, and participants were predominantly female (84%) and white (72%). As shown in Table 2, there were no significant differences in baseline characteristics and outcomes between intervention and control RA groups.

Seven individuals with RA (2 intervention and 5 controls) provided baseline data but did not complete any follow-up evaluations. Compared to RA participants who contributed follow-up data by participating in one or more follow-up assessment, the 7 individuals with RA who did not provide follow-up data were similar in baseline characteristics and baseline outcomes (not shown).

Table 3 summarizes adjusted outcomes at 3-, 6-, 12-, and 24-month follow-up assessment controlling for differences in baseline outcome for individuals with RA. The intervention group had significantly worse MCS scores at follow-up assessment compared to controls [intervention 50.92 vs. control 52.74; difference −1.82 (95% CI: −3.34, −0.29)]. This did not exceed the reported MCS MCID of 3.1 [36]. There was no significant overall mean difference in HAQ function or pain scores, physical activity, or PCS for those who received the IMPAACT intervention compared to those who received only physician advice. No harms or unintended effects were detected by systematic monitoring at follow-up visits.

Table 3. Outcomes at 3-, 6-, 12- and 24-month follow-up assessment adjusted for baseline values for participants with rheumatoid arthritis (n = 178)

	Treatment	Control	Difference between treatment and control[a]							
Follow-up time	Median	95%	CI	Median	95%	CI	Mean	95%	CI	p Value
HAQ function[b]										
3 mo	**0.38**	**0.30**	**0.45**	**0.38**	**0.28**	**0.47**	**0**	**−0.10**	**0.10**	**–**
6 mo	**0.38**	**0.28**	**0.47**	**0.38**	**0.27**	**0.48**	**0**	**−0.12**	**0.12**	**–**
12 mo	**0.38**	**0.28**	**0.47**	**0.38**	**0.23**	**0.52**	**0**	**−0.14**	**0.14**	**–**
24 mo	**0.38**	**0.22**	**0.53**	**0.38**	**0.24**	**0.51**	**0**	**−0.19**	**0.19**	**–**
Overall[c]	**0.38**	**0.30**	**0.45**	**0.38**	**0.28**	**0.47**	**0**	**−0.10**	**0.10**	**0.999**
HAQ pain[b]										
3 M	3.58	3.14	4.03	3.20	2.83	3.57	−0.38	−0.96	0.20	–
6 M	3.52	3.1	3.94	3.71	3.21	4.21	0.19	−0.46	0.85	–
12 M	3.31	2.82	3.8	3.47	2.89	4.05	0.16	−0.60	0.92	–
24 M	3.73	3.08	4.38	3.08	2.4	3.77	−0.64	−1.59	0.30	–
Overall[c]	3.54	3.19	3.88	3.37	3.01	3.72	−0.17	−0.66	0.32	0.502
Average daily activity minutes										
3 mo	486.18	469.95	502.42	484.46	469.86	499.07	1.72	−20.07	23.51	–
6 mo	483.06	466.74	499.37	489.25	473.25	505.26	−6.2	−29.01	16.61	–
12 mo	482.02	466.69	497.35	481.61	463.07	500.16	0.41	−23.6	24.42	–
24 mo	477.14	455.59	498.69	480.62	454.65	506.58	−3.48	−37.11	30.14	–
Overall[c]	482.10	470.52	493.68	483.99	470.83	497.14	−1.89	−19.32	15.54	0.832
Average daily MV minutes										
3 mo	13.62	12.12	15.12	11.94	10.32	13.55	1.68	−0.52	3.88	–
6 mo	14.81	12.29	17.33	13.00	10.27	15.73	1.84	−1.6	5.29	–
12 mo	14.16	11.52	16.8	12.89	10.9	14.87	1.27	−2.03	4.57	–
24 mo	15.82	13.46	18.18	10.26	6.79	13.73	5.56	1.33	9.79	–
Overall[c]	14.16	11.72	16.60	12.25	9.78	14.71	1.91	−0.13	3.95	0.067
PCS[d]										
3 mo	43.61	42.24	44.99	44.57	43.46	45.69	−0.96	−2.73	0.81	–
6 mo	44.06	42.56	45.55	42.82	41.39	44.25	1.24	−0.83	3.31	–
12 mo	43.57	41.99	45.15	44.81	43.29	46.34	−1.24	−3.43	0.96	–
24 mo	42.98	41.27	44.68	44.33	42.48	46.17	−1.35	−3.86	1.17	–
Overall[c]	43.56	42.49	44.62	44.13	43.18	45.08	−0.58	−2.00	0.85	0.429
MCS[d]										
3 mo	51.98	50.86	53.11	52.01	50.54	53.48	−0.03	−1.88	1.82	–
6 mo	51.04	49.34	52.75	52.49	51.03	53.96	−1.45	−3.70	0.80	–
12 mo	50.08	48.09	52.06	53.27	51.55	55.00	−3.20	−5.83	−0.57	–

24 mo	50.59	48.64	52.53	53.19	51.32	55.06	−2.60	−5.30	0.10	−
Overall[c]	50.92	49.83	52.02	52.74	51.69	53.79	−1.82	−3.34	−0.29	0.020

Mean/mean change or median/median change (95% confidence interval).

aPositive values indicate improvement favoring intervention group.

bHAQ Health Assessment Questionnaire (HAQ): HAQ Function scale ranges from 0 (best function) to 3 (worst function). HAQ Pain scale ranges from 0 (no pain) to 10.

cOverall averaged over 3, 6, 12, and 24 months adjusting for baseline values.

dShort Form-36 Physical Component Score (PCS): Short Form-36 Mental Component Score (MCS). Range from 0 (poor) to 100 (best quality of life).

Discussion

This is the first trial of a motivational interviewing intervention to improve lifestyle physical activity in individuals with KOA or RA. Our results demonstrated that for persons with KOA, the IMPAACT intervention led to a modest improvement in self-reported function and a nonsignificant trend toward improvement in self-reported pain. We recognize the limited improvement and the possibility that these results may have resulted from selection bias due to missing data. There were no significant increases in physical activity compared to control group receiving only brief physician counseling. In individuals with RA there were no significant treatment effects. Given its lack of demonstrated effect on physical activity in those with KOA and RA, additional refinement of the IMPAACT intervention should be considered prior to dissemination.

Numerous studies have evaluated the benefits of structured exercise programs in adults with arthritis. These studies have shown that for both adults with KOA and RA, structured exercise programs improve physical function and reduce pain [7], [8], [37]. While there are many benefits from exercise programs, these are limited by low adherence and high recidivism [10], [11], [38]. The premise of the current study was that motivational interviewing targeting all types of physical activity rather than a specific exercise program would promote attainable and sustainable physical activity and lead to similar improved pain and function outcomes that exercise interventions had previously shown. Motivational interviewing interventions have been associated with modest improvements in physical activity for people with chronic health conditions [17]. In addition, motivational interviewing interventions have been associated with improved health behaviors in individuals with rheumatic conditions, e.g., improved dietary habits in individuals with systemic lupus erythematosus [39], [40].

For KOA participants, the IMPAACT intervention resulted in a small, but significant improvement in function and a small, nonsignificant improvement in pain. However, there was no significant effect on physical activity. Thus, the mechanism for the reported improvement in function is unclear given the intervention's lack of an effect on physical activity. The functional improvement might have been a result of participants consciously practicing more functional tasks (which tend not to contribute substantially to accelerometer counts) in an effort to be more active. We also recognize the modest positive results in the KOA part of the study that may be due to bias from the significant amount of missing data (approximately 25%) from follow-up assessments. For persons with RA, the IMPAACT intervention had no effect on self-reported function and pain outcomes or in objectively measured physical activity. As participants receiving the IMPAACT intervention did not increase physical activity, we conclude it was not the mechanism for improvements in function and pain outcomes.

It is possible that motivational interviewing may not be effective at improving self-reported physical function through increases in physical activity in individuals with KOA and RA. However, we think there are several potential reasons for the limited effects of the IMPAACT intervention and refining the intervention might lead to significant improvements. First, increases in physical activity from IMPAACT intervention may have been limited by low frequency of contact between the participants and the physical activity advocate especially early in the

intervention. Interventions involving lifestyle change successful in other populations have included more frequent contacts. For example, intensive lifestyle changes in the Diabetes Prevention Program included 16 face-to-face visits in the first 6 months [41]. In contrast, IMPAACT only had 3 scheduled encounters in the first 6 months. Future interventions should consider having more frequent contact especially at the start of the intervention to increase physical activity.

A second potential reason for the intervention's limited impact is that our participants had long-standing disease (average of 10.9 years for KOA participants and 13.2 years for RA participants). This long duration of disease likely contributed to more advanced disease and worse pain and symptoms as reflected by half of KOA participants with more advanced disease (KL grade 2 or 3) and RA participants with CDAI showing moderate disease activity. It is also likely that participants decreased physical activity closer to the onset of symptoms and these behavior habits are ingrained in the individual's daily lives. Interventions are likely to be more effective if they target individuals with earlier onset of symptoms, for example individuals with knee symptoms prior to developing radiographic KOA.

A third potential reason for the intervention's limited impact on outcomes may relate to the large percent of participants with obesity and overweight, which often coexists with chronic pain [42]. Obesity/overweight could also inhibit physical activity and thus have also limited improvement in function and pain. Fourth, participants had frequent interaction with research staff to collect self-reported outcomes during telephone interviews and study visits, so reported functional improvements may have been due to social desirability bias. Some control participants asked if they were in the intervention group due to this frequent contact by data collection staff. This issue could be mitigated by using computerized instruments to measure outcomes to minimize the effects of interactions between research staff and participants.

As mentioned earlier, a methodologic limitation to this study is partial follow-up on a number of participants. For example, 9% of individuals with KOA and 4% of individuals with RA provided baseline data but dropped out and did not participate in any follow-up assessments. Baseline data were generally similar to those who participated and unlikely to bias the results. The major factor contributing to incomplete follow-up was late recruitment of participants. Among KOA participants, 30 intervention and 30 control participants were recruited too late to participate in all follow-up evaluations. Among RA participants, 43 intervention and 42 control participants were enrolled late. Recruiting from a larger pool should allow more participants to enroll earlier in the study. Retention challenges also contributed to dropout. Among KOA participants who enrolled early enough to complete all follow-up assessments, 24% of intervention and 18% of control participants did not complete the final follow-up assessment. Among RA participants, 22% of intervention and 26% of control participants did not complete the final follow-up assessment. Engaging participants with more frequent motivational interviewing sessions would likely improve retention and participants would be more likely to participate in follow-up assessments. We used GEE to include information from participants who provided any follow-up visit data to make an overall assessment of efficacy over the 2-year follow-up period. Future studies can consider recruiting participants from a larger population to allow more participants to be enrolled earlier in the study. A final limitation is our participants were relatively well educated and results may not generalize to a population with lower education levels.

Conclusion

This is the first intervention to use motivational interviewing to focus on lifestyle physical activity in individuals with KOA or RA. The IMPAACT intervention, when added to brief physician counseling, resulted in a modest improvement in self-reported physical function and a trend toward improved self-reported pain, but no increases in physical activity in KOA participants. There were no significant changes in outcomes for RA participants receiving the IMPAACT intervention. The intervention needs refinement before it can be

recommended for dissemination to individuals with KOA and RA. While these findings and current literature show promise in helping patients with KOA experience improved outcomes, future physical activity trials should possibly include more frequent contact with participants early in the program, and consider a more frequent and multidimensional intervention to impact function and pain.

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