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Original article

Physician referral improves adherence to the physical activity guidelines for adults with MS: A randomized controlled trial

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ABSTRACT

Background: Commitment and adherence to community-based physical activity can be a challenge for clinical populations. The aim of this study was to explore the effectiveness of physician referral on adherence to the Physical Activity Guidelines (PAGs) for adults with MS.

Methods: Ninety-one participants with MS (age: 47.9 ± 10.4 years, EDSS score: 3.5 ± 1.8) were randomized into a direct referral to PAGs from a physician (REF) or control (CON) group (given a print copy of PAGs). After 16 weeks participants were categorized as either PAG "Adherers" ($n = 30$) or "Non-Adherers" ($n = 49$), based on achieving an adherence rate of ≥ 75%.

Results: Adherence to the PAGs was significantly higher in REF (68.0 ± 28.6%) compared with CON (35.1 ± 35.0%) ($p < 0.05$). There were no differences in EDSS scores, time since diagnosis, fitness, fatigue, mobility or QOL between those who adhered or did not adhere to the PAGs ($p > 0.05$), but greater self-efficacy for exercise at baseline was associated with higher adherence ($p < 0.0001$).

Interpretation: Direct referral to physical activity from a physician is twice as effective as simply providing information about physical activity for adherence to the PAG in people with MS. As physical activity is recognized as an effective therapeutic option for adults with MS it is important that physicians play a role in prescribing it to their patients.

Trial registration: ClinicalTrials.gov Identifier: NCT02100020

1. Introduction

Physical activity is a powerful tool that can be utilized in the Multiple Sclerosis (MS) population for symptom management through modifying fitness, fatigue, mobility, depression and pain (Latimer-Cheung et al., 2013). Despite these benefits, at least two-thirds of people living with MS do not participate in regular physical activity (Motl et al., 2005). Commitment and adherence to community-based physical activity can be a challenge for people living with MS as they have to overcome numerous barriers on a daily basis (with respect to disease symptoms, transportation issues, fatigue) (Becker and Stuifbergen, 2004). In other clinical populations (e.g. cardiac patients), there is evidence to suggest that direct referral to community-based exercise from a physician can be a strong predictor for physical activity adherence (Jackson et al., 2005; Dunn et al., 2017). Therefore, there is potential for physical activity participation rates in the MS population to improve if physicians took a more active role in referring their patients to appropriate physical activity programs.

Characterizing or defining what constitutes physical activity adherence across exercise studies is variable, although most studies calculate adherence rates as the number of sessions attended over the total number of sessions for the duration of the study (Heesen et al., 2015). Currently there is no gold standard defining what constitutes physical activity adherence, nor do we know the number of training sessions required to incur significant benefits from physical activity. Studies evaluating adherence to physical activity in other populations have defined successful adherence as attending between 66–100% ($\bar{x} = 75\%$) of prescribed sessions (Deka et al., 2017; Geraedts et al., 2014; Hicks et al., 2013; Kampshoff et al., 2016; Kronish et al., 2017; Shumway-cook et al., 2007; Sjosten et al., 2007); this average of 75% was used to define adherence in the current study.

In 2012, the first evidence-informed physical activity guidelines (PAGs) specific to the MS population were released to the general public (mssociety.ca. [Internet] 2018). These guidelines provide minimum thresholds of aerobic and strength exercises that are predicted to induce improvements in both fitness and function in adults with MS, and the effectiveness of the PAGs has recently been published Canning and Hicks, 2019. The objectives of this study were to

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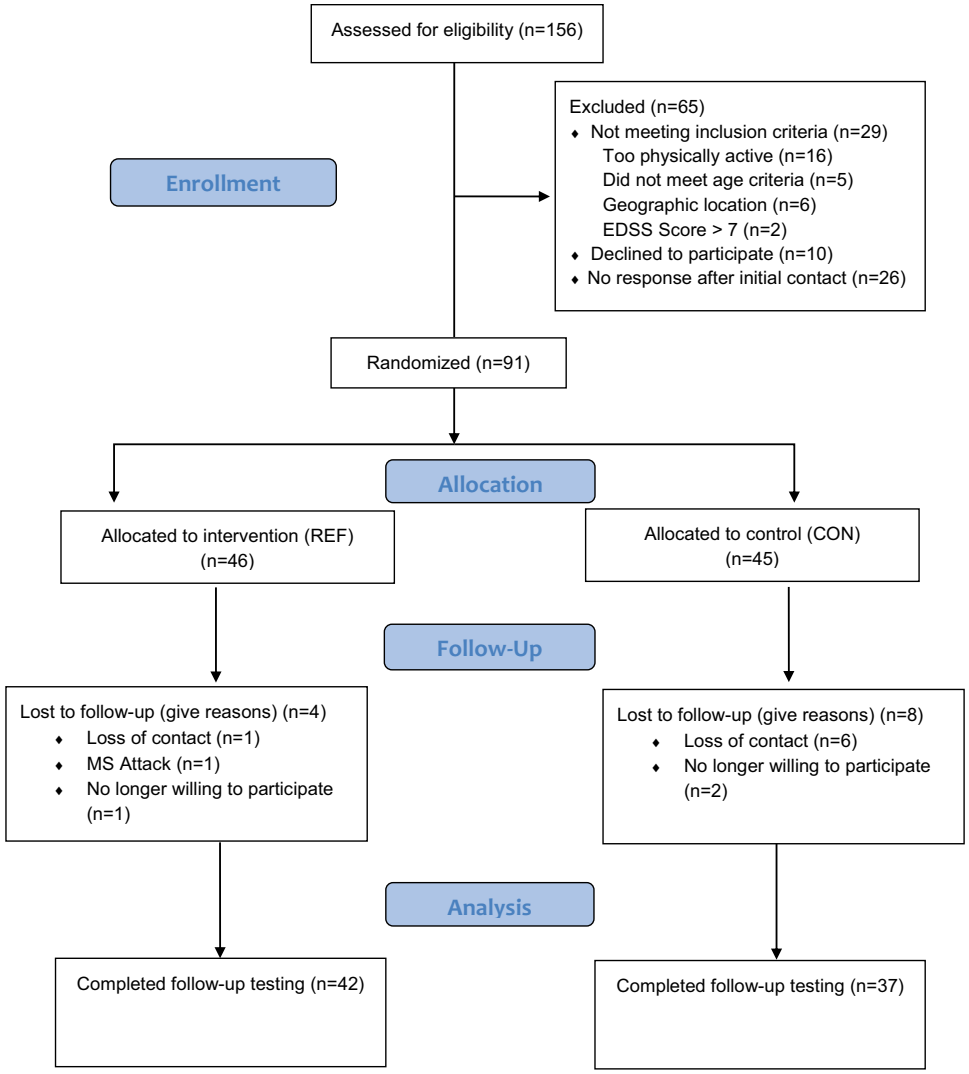

Fig. 1. CONSORT Flow diagram of participant recruitment and enrollment.

determine the effect of direct physician referral on adherence to the PAGs for people living with MS in a community setting and to identify what other factors may also be related to PAG adherence.

2. Methods

2.1. Participants

Detailed recruitment and enrollment information is provided in the flow diagram (**Fig. 1**). Ninety-one participants with diagnosis of MS volunteered to participate in a 16wk randomized controlled trial (RCT) at McMaster University in Hamilton, ON from July 2014 - March 2017. Inclusion criteria consisted of; i) EDSS score between 1 and 7, ii) aged 18 to 64 years and iii) medical clearance to participate in exercise. Exclusion criteria included; i) current participation in physical activity (≥ twice weekly) and ii) other serious medical condition that would impair ability to participate in strength or aerobic training. All participants provided written informed consent and all procedures were approved and conducted in accordance with the ethical guidelines of the Hamilton Integrated Research Ethics Board. Participants were randomized to a direct referral group (REF) or a control group (CON) after baseline testing was completed and randomization allocation was blinded to testers. Participants randomized to the REF group received a written prescription for exercise by a physician based on the PAG recommendations and referred to a community-based exercise program at McMaster University. Participants randomized to the CON group were given a print copy of the PAGs and an online link for information about physical activity and MS. CON participants had to use their own initiative to seek out community based exercise opportunities. Twelve participants (4 from REF, 8 from CON) were lost to follow-up; statistics were performed on the 79 participants who completed follow-up testing after the 16 week study period.

2.2. Physician referral

The physician referral form was filled out by the lead Neurologist at Hamilton Health Science's MS Clinic. The referral form replicated a physicians' prescription pad wherein participants were prescribed exercise in accordance with the PAGs for adults living with MS (Canadian Society for Exercise Physiology 2012). The form also included a referral to an appropriate exercise program at McMaster University. Participants who joined the exercise program participated in supervised, twice-weekly exercise sessions that involved both aerobic and resistance exercise. Each participant worked one-on-one with an exercise trainer who monitored each exercise session, recorded the details pertaining to all exercises completed and progressed the intensity of the prescription as appropriate. The membership fee for this program ($55/month + $20/month parking if required) was the responsibility of the study participant.

2.3. Demographics and questionnaires

Participants completed a variety of questionnaires assessing demographics, quality of life (QOL), fatigue symptoms and self-efficacy for exercise at baseline and post-testing. QOL was assessed using the MS Quality of Life 54 (MSQOL-54) (Vickrey et al., 1995), and fatigue was assessed using the Modified Fatigue Impact Scale (MFIS-5) (Fisk et al., 1994). A questionnaire previously used in the spinal cord injury population was used to determine self-efficacy for exercise (Latimer et al., 2006). Questionnaire items included items assessing participants' perceptions of the value of the PAGs, expectations about the benefits of meeting the guidelines and confidence to engage in the recommended amount of physical activity. The questionnaire assessed participants' confidence and intentions to follow the PAGs, addressing both the aerobic and muscle strengthening portions of the guidelines separately (Latimer et al., 2006). All self-efficacy items were rated on a 7 point Likert scale from 1 (strongly disagree/not at all confident) to 7 (strongly agree/completely confident). One total score was reported for outcome expectation and 4 total scores were reported for self-efficacy beliefs regarding strengthening and aerobic exercise.

2.4. Peak aerobic capacity

To measure peak oxygen consumption, a progressive VO_2 peak test to peak oxygen consumption or volitional exhaustion on an arm cycle ergometer (Lode B.V., Groningen, Netherlands) was completed by participants. The resistance started at 0 W and increased thereafter by 10 W every minute and participants were asked to keep their RPMs between 50–60 RPM. Heart rate (Polar Electro, Lachine, QC, Canada) and VO_2 (Moxus Metabolic System, AEI Technologies, Pittsburgh, PA, USA) were continuously measured. The test was terminated if a) the participant reached volitional exhaustion, b) the cycling rate dropped below 50 RPM c) a plateau in VO_2 was observed, or d) heart rate was greater than 90% of the participants' age predicted maximum heart rate.

2.5. Muscle strength

One repetition maximum (1RM) strength testing using established procedures (Kraemer et al., 2006) was completed on a multi-station (wheelchair accessible) weight training system (Equalizer Multi-Station, Equalizer Exercise Machines, Red Deer, AB, Canada), unilateral wall pulleys (Endorphin Pulleys, Patterson Medical Supply, Mississauga, ON, Canada) and using the HUR leg extension/flexion machine (HUR Health & Fitness Canada INC, Canada). 1RM was assessed in the back, chest, biceps, triceps, shoulder flexors, shoulder extensors, hamstrings and quadriceps muscles and a composite strength score was calculated.

2.6. Mobility

Mobility was assessed using established procedures for the 25 ft walk test (Fischer et al., 1999). Participants were instructed to walk 25 ft as quickly as possible but safely and in their usual manner and they repeated this twice. An average of the 2 attempts was calculated.

2.7. Adherence to PAGs

Adherence was assessed over 16 weeks by weekly physical activity logs. Participants were emailed weekly logs for aerobic and strengthening exercises completed. If participants were unable to access internet, paper copies of 16 weeks of logs were provided at baseline testing and participants were instructed to return the physical activity logs at post-testing. Detailed information about type, duration and intensity of exercise was provided by participants in the logs for analysis of adherence. Adherence to the PAGs was calculated as the number of weeks (calculated as a percentage) participants achieved both the aerobic and resistance exercise recommendations over the 16 week period. At the end of the study, participants were classified as an "Adherer" if they met the PAGs recommendations for 12 out of 16 weeks, or had a calculated adherence rate of 75%.

2.8. Data analyses

Continuous variables are reported as means and standard deviations and categorical variables are presented as frequencies and prevalence values. Differences in baseline values were compared between randomized groups using independent samples t-tests. Differences in baseline values between Adherers and Non-Adherers were compared post-hoc using independent samples t-tests. Stepwise multiple regression analyses were used to determine what factors predict adherence. Pearson R correlational analyses were used to assess relationships between outcome variables and adherence. All statistical analyses were performed using IBM SPSS Statistics v24. Statistical significance was set at alpha < 0.05.

3. Results

3.1. Participant characteristics

Seventy-nine participants (age 47.9 ± 10.0 years, EDSS score 3.5 ± 1.8, 12.1 ± 10.0 years living with MS) completed follow-up; 42 had been randomized into the REF group and 37 were randomized into the CON group. Demographic characteristics are presented in **Table 1**; there were no significant differences between groups. The study sample had a wide range in baseline characteristics; age (range: 22–64 years), EDSS score (range: 1–7), time since diagnosis (range: 1 month-39 years), fatigue scores (range: 2–20) and mobility (range: 0.08–2.25 m/s).

3.2. Adherence

All participants who participated in follow-up testing successfully completed the weekly physical activity logs. The effect of direct referral on adherence is displayed in Fig. 2. Over the 16-wk study period, participants in the REF group had twice the adherence rate to the PAGs as those in the CON group ($p < 0.05$; 68.0 ± 28.6%, range: 0–100% versus 35.1 ± 35.0%, range: 0–100%). Thirty-seven people in the REF group joined either the community-based exercise program at McMaster University or another fitness center whereas only 15 people in the CON group joined a community-based program. Within each group there was a wide range of adherence to the PAGs (0–100%); 30 participants were subsequently classified as Adherers (22 from REF, 8 from CON) and 49 were classified as Non-Adherers (20 from REF, 29 from CON) (Canning and Hicks, 2019). Participants who adhered to the PAGs over the 16 week study period significantly improved aerobic

Table 1
Participant characteristics.

Characteristic	Mean ± SD	
	REF ($n = 42$)	CON ($n = 37$)
Age (y)	46.8 ± 10.5	48.9 ± 10.3
Female (N,%)	26 (63)	22 (63)
EDSS	3.5 ± 1.8	3.5 ± 1.8
Time Since Diagnosis (y)	10.9 ± 8.9	13.8 ± 11.1
RRMS (N,%)	27 (66)	23 (59)

REF, Referral Group.
CON, Control Group.
EDSS, Expanded Disability Status Score.
RRMS, Relapse-Remitting MS.

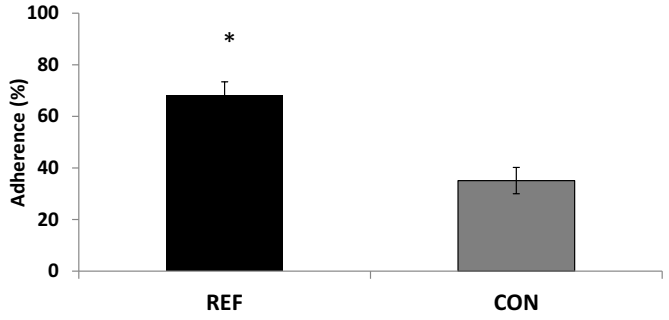

Fig. 2. The effect of direct referral on adherence.
* significant difference ($p < 0.05$).

fitness, strength in major muscle groups, mobility, fatigue symptoms and overall health-related QOL (Canning and Hicks, 2015; Canning and Hicks, 2019).

3.3. Baseline characteristics in adherers and non-adherers

There were no significant differences in demographics, fitness or functional outcomes at baseline between those who adhered or did not adhere to the PAGs ($p > 0.05$; Table 2). No significant correlations were observed between any of the baseline demographic, fitness or functional outcomes and adherence ($p > 0.05$).

3.4. Self-Efficacy

Table 3 indicates that participants classified as Adherers had greater self-efficacy for exercise at baseline compared to the Non-Adherers ($p < 0.0001$). Significant moderate correlations were observed between baseline self-efficacy scores for meeting the aerobic and strengthening portions of the PAGs and adherence ($r = = 0.473$, $p < 0.0001$; $r = = 0.484$, $p < 0.0001$, respectively). Higher self-efficacy scores at baseline were associated with greater adherence to the PAGs.

3.5. Significant predictors for adherence

From the step-wise regression analysis, Group (REF v. CON) and self-efficacy for completing the aerobic component of the PAGs significantly predicted adherence, accounting for 33% of variance in the model ($R = = 0.57$, $R^2 = = 0.33$, $p < 0.05$).

Table 2
Baseline demographic, fitness & functional characteristics of adherers and non-adherers.

Characteristic	Mean ± SD		p Value
	Adherers ($n = = 30$)	Non-Adherers ($n = = 49$)	
Age (y)	49.7 ± 8.1	46.6 ± 11.4	$p = = 0.179$
EDSS	3.6 ± 1.7	3.5 ± 1.9	$p = = 0.781$
Time Since Diagnosis (y)	12.6 ± 8.1	12.0 ± 11.1	$p = = 0.816$
VO_2 Peak (ml/kg/min)	13.8 ± 5.6	14.1 ± 4.2	$p = = 0.783$
Composite Strength (1RM, kg)	16.4 ± 5.0	17.0 ± 5.7	$p = = 0.626$
25FTW Speed (m/s)	1.4 ± 0.5	1.2 ± 0.5	$p = = 0.258$
MFIS-5	11.0 ± 4.5	11.0 ± 3.3	$p = = 0.964$
Physical Health QOL	53.5 ± 17.8	51.8 ± 16.7	$p = = 0.320$
Mental Health QOL	68.2 ± 15.3	61.5 ± 21.3	$p = = 0.681$

EDSS, Expanded Disability Status Score.
1RM, One Repetition Maximum.
25FTW, 25 Foot Walk Test.
MFIS-5, 5 item Modified Fatigue Impact Scale.
QOL, Quality of Life.

Table 3
Baseline self-efficacy for exercise constructs of adherers and non-adherers.

Characteristic	Mean ± SD		pvalue
	Adherers ($n = = 30$)	Non-Adherers ($n = = 49$)	
Total Score 1	64.5 ± 7.3	60.6 ± 8.4	$p = = 0.078$
Total Score 2	27.5 ± 1.6	24.0 ± 4.6	$p < 0.0001$
Total Score 3	13.7 ± 0.8	11.6 ± 2.4	$p < 0.0001$
Total Score 4	27.2 ± 2.1	22.9 ± 5.9	$p < 0.0001$
Total Score 5	34.1 ± 2.3	28.8 ± 6.7	$p < 0.0001$

Total Score 1, Overall Outcome Expectations.
Total Score 2, Self-Efficacy Beliefs for Completing Aerobic Exercise at Targeted Intensities & Durations.
Total Score 3, Self-Efficacy Beliefs for Completing Aerobic Exercise Sessions.
Total Score 4, Self-Efficacy Beliefs for Completing Resistance Exercise.
Total Score 5, Self-Efficacy Beliefs for Completing Exercise Program Over Time.

4. Discussion

As physical activity is recognized as an effective therapeutic option to both manage symptoms and improve fitness and function in people living with MS, it is important to identify factors that could improve physical activity adherence in this population. The objective of this study was to determine the effect of physician referral on adherence to the PAGs in people with MS, and to identify other factors that may also predict PAG adherence. The findings suggest that physician referral to an exercise program is twice as effective as simply providing written information about the PAGs to adults living with MS. Further, we found that baseline self-efficacy for exercise is an additional predictor of adherence to the PAGs in this population. These results have clear implications for the important role physicians can play in promoting physical activity to their patients with MS.

Patients with MS identify physicians and allied healthcare professionals as the most credible source for physical activity information (Heesen et al., 2015), and the results from this RCT certainly support this observation. Our results highlight the importance of physician referral in improving physical activity adherence, and align with what has been observed in the cardiac rehabilitation setting (Jackson et al., 2005; Dunn et al., 2017). Having disease specific PAGs (Canadian Society for Exercise Physiology 2012) should make it much easier for physicians to talk about the importance of physical activity to their patients and to make baseline recommendations for the types, intensities and amounts of physical activity they should engage in.

One of the more interesting results from this current study was that there were no differences in EDSS score, time since diagnosis, fitness parameters, fatigue symptoms or overall health-related QOL between participants who ended up adhering or not adhering to the PAGs. The observation that MS-related symptoms do not seem to predict adherence to physical activity is noteworthy. There is evidence that individuals with MS who reported a greater number of symptoms during the past 30 days engaged in lower amounts of physical activity (Motl et al., 2006), but the results from this study suggest that physician referral might override any potential negative effect of symptomology on the decision to participate in physical activity. It is also important to highlight that participants in the current study had to take the initiative to join (and pay for) the exercise program, enhancing its ecological validity.

Apart from physician referral, a higher self-efficacy for exercise was the only additional predictor of PAG adherence in this randomized, community-based sample of adults living with MS. Social Cognitive Theory is a theoretical framework that describes behaviour by personal self-control and can be used to identify constructs (e.g. self-efficacy and outcome expectations) as targets for changing health behaviours (i.e.

physical activity) (Bandura, 2004). Research by Motl and colleagues has shown that these constructs from Social Cognitive Theory determine physical activity behaviour in adults with MS (Motl et al., 2013; Suh et al., 2011). Previous cross-sectional studies in the MS population have revealed self-efficacy for exercise to be a strong predictor of adherence to physical activity (Kayes et al., 2011; Nickel et al., 2014; Plow et al., 2009); we have now validated this association in this prospective study.

4.1. Limitations

This study included a wide range of individuals with MS, with varying types of MS, disability levels and times since diagnosis. This could be considered both a strength and a limitation, as we may have been able to identify additional factors that predicted PA adherence if our sample was more homogeneous. The fact that we had no published guideline from which to classify "adherence" was another potential limitation, but we chose to use the average percentage of sessions attended from existing studies in the literature (75%) to use as our benchmark. Finally, reliance on physical activity logs to assess PAG adherence could have resulted in inaccurate reporting, but care was taken to fully explain how to identify various types of physical activities (and their intensities) to each participant prior to study onset, and participants were extremely compliant in filling out their weekly logs.

5. Conclusions

Adherence to the PAGs for people living with MS is twice as high in people who receive a direct referral from a physician. Further, baseline self-efficacy for exercise is an additional predictor. Given the multiple benefits associated with regular physical activity, and the fact that there now are evidence-based PAGs for people living with MS, the results from this study send a strong message to the medical community regarding the importance of physical activity referral by a physician in this population.

Declaration of Competing Interest

Authors report no financial relationships with commercial interests of relevance to this study. A. Hicks received research grant support from the Multiple Sclerosis Society of Canada, and K. Canning received a studentship from the Multiple Sclerosis Society of Canada for the duration of the project.

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