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Critically Appraised Paper for "Adaptive vs. non-adaptive cognitive training by means of a personalized App: A randomized trial in people with multiple sclerosis."

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AOTA Critically Appraised Papers Series

Evidence Exchange

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CRITICALLY APPRAISED PAPER (CAP)

Sandroff, B., Klaren, R., Pilutti, L., Dlugonski, D., Benedict, R., & Motl, R. (2014). Randomized controlled trial of physical activity, cognition, and walking in multiple sclerosis. *Journal of Neurology, 261*(2), 363–372. https://doi.org/10.1007/s00415-013-7204-8

CLINICAL BOTTOM LINE

Multiple sclerosis (MS) is a condition that causes cognitive and physical fatigue, which can-slow cognitive processing speed (CPS). Slow CPS affects occupational engagement. Evidence suggests that physical activity can be used as an intervention to address and manage slowed CPS in MS. This Level I randomized controlled trial (RCT) examined the impact of a physical-activity behavioral intervention on CPS and walking performance among people with mild to moderate MS.

Seventy-six participants with mild to moderate MS participated in the study for 6 months. The participants were split into two groups, the intervention group and the wait-list control group. In the intervention group, participants were provided a social–cognitive theory (SCT) program for increasing physical activity through a website and one-on-one video behavioral-coaching sessions. The main intention of this SCT program was to increase ambulatory physical activity by teaching the behavioral strategies of self-monitoring, goal setting, and goal attainment.

The findings demonstrate that participants in the intervention group with mild MS showed significant improvement in CPS, as measured by the Symbol Digit Modalities Test. There was not a significant difference for those with moderate MS in the intervention or wait-list control group, however, regardless of disability status. In conjunction with an improvement in CPS, the study also supports the effectiveness of physical activity for improving overall walking performance.

This study contributes to clinical evidence supporting the use of a theory-based physical-activity intervention as a therapeutic tool for managing cognitive impairment and impaired walking performance for clients with mild MS. This study also suggests that physical activity can have direct effects on cognition. The results indicate that the intervention might not be appropriate for clients

with moderate MS, however. Hence, occupational therapists may consider using the SCT approach to aid in compliance with a physical-activity intervention, which may be able to improve CPS for clients with mild MS. Moreover, occupational therapists can implement the SCT program as a behavioral coach for clients with MS by reinforcing goal-setting strategies and supporting occupational engagement through physical activity.

RESEARCH OBJECTIVE(S)

Examine the impact of a physical-activity behavioral intervention on CPS and walking performance among people diagnosed with mild to moderate MS

DESIGN TYPE AND LEVEL OF EVIDENCE

Level 1: Randomized controlled trial

PARTICIPANT SELECTION

How were participants recruited and selected to participate?

Participants were recruited through a flyer sent to patients on the registry of the North American Research Committee on Multiple Sclerosis. Flyers were also sent to previous research participants from the last 5 years on the registry.

Inclusion criteria:

Participants were included if they

- had a diagnosis of MS by physician verification
- were relapse free for the past 30 days
- were able to walk with or without an assistive device
- were between ages 18 and 64
- were willing and able to complete in-person cognitive and functional assessments
- were physically inactive, defined as less than 60 minutes of physical activity per week
- were at low risk for contraindications of physical activity, as indicated by no more than one "yes" response on the Physical Activity Readiness Questionnaire
- had their physician's approval for participation

Exclusion criteria:

Participants were excluded if they

- were too physically active
- were not willing or able to travel
- had a recent relapse of symptoms
- were nonambulatory

- had a heart condition
- did not meet age criteria
- were no longer interested in participation
- did not have Internet access
- had an injury
- were pregnant
- died

PARTICIPANT CHARACTERISTICS

N=	82 were recruited, 76 completed data analyses

#/ % Male:	19/25%	**#/ % Female:**	57/75%

Ethnicity:	NR

Disease/disability diagnosis:	MS; mild or moderate disability status

INTERVENTION AND CONTROL GROUPS

Group 1: Intervention group

Brief description of the intervention	The intervention program was based on an SCT that focused on increasing physical-activity behavior through a website and one-on-one video sessions with a behavioral coach. Participants used a dedicated website that provided information on behavioral strategies of self-monitoring and goal setting. New social–cognitive strategies were posted on the website regularly. Using the website, participants also recorded daily steps from a Yamax SW-401 Digiwalker pedometer that they wore. The Goal Tracker software was used to track progress.
How many participants in the group?	41 participants; 37 participants completed the intervention (90.2%)
Where did the intervention take place?	NR
Who delivered?	A behavioral-change coach implemented the one-on-one session by Skype.
How often?	Behavioral-intervention sessions were held weekly through Skype. A total of

	15 sessions were scheduled. Seven sessions were scheduled in the first 2 months, six sessions in second 2 months, and two sessions in the last 2 months.
For how long?	6 months

Group 2: Wait-list control group

Brief description of the intervention	This study used a wait-list control group.
How many participants in the group?	41 participants; 39 participants completed the intervention (95.1%)
Where did the intervention take place?	NR
Who delivered?	NR
How often?	NR
For how long?	6 months

INTERVENTION BIASES

Contamination:

YES ☐ NO ☒	The wait-list control group received the intervention after the wait-list period.

Co-intervention:

YES ☐ NO ☒	Cointervention was not discussed. The researchers excluded participants who had a recent relapse or who were physically active, however, to minimize cointervention. Participants who had health concerns or relapsed dropped out before baseline.

Timing of intervention:

YES ☐ NO ☒	Six months was long enough to demonstrate a change in cognition and physical activity.

Site of intervention:

YES ☒ NO ☐	The intervention group accessed the intervention from a location with a computer that had access to the Internet. The researchers had no control over the environment that participants were in when they accessed the website content. Participants could

	have been negatively affected by environmental factors, such as distractions or interruptions.

Use of different therapists to provide intervention:

YES ☐ NO ☐ NR ☒	The researchers did not state whether the same coach interacted with the participants in each session.

Baseline equality:

YES ☐ NO ☒	Participants were grouped on the basis of disability through a stratified randomization process.

MEASURES AND OUTCOMES

Measure 1: Symbol Digit Modalities Test

Name/type of measure used:	Oral version of the Symbol Digit Modalities Test (SDMT)		
What outcome is measured?	Cognitive processing speed was measured with the SDMT. Participants were given a page showing symbols paired with single-digit numbers in a key. Their task was to voice the correct numbers for unpaired symbols as fast as possible for 90 seconds. The outcome measure was the number of correct responses in 90 seconds.		
Is the measure reliable (as reported in the article)?	YES ☐	NO ☐	Not Reported ☒
Is the measure valid (as reported in the article)?	YES ☐	NO ☐	Not Reported ☒
When is the measure used?	Prior to intervention and postintervention		

Measure 2: Patient-Determined Disease Steps Scale

Name/type of measure used:	Patient-Determined Disease Steps Scale		
What outcome is measured?	Physical disability status was measured through self-reporting on an ordinal scale.		
Is the measure	YES ☐	NO ☐	Not Reported ☒

reliable as reported in the article?	
Is the measure valid as reported in the article?	YES ☒ NO ☐ Not Reported ☐
When is the measure used?	Prior to intervention and postintervention

Measure 3: International Physical Activity Questionnaire

Name/type of measure used:	International Physical Activity Questionnaire (IPAQ)
What outcome is measured?	The IPAQ is a self-report measure of the frequency of vigorous, moderate, and walking physical activity throughout a 7-day period.
Is the measure reliable as reported in the article?	YES ☐ NO ☐ Not Reported ☒
Is the measure valid as reported in the article?	YES ☒ NO ☐ Not Reported ☐
When is the measure used?	Prior to intervention and postintervention

Measure 4: Six-Minute Walk

Name/type of measure used:	Six-Minute Walk (6MW)
What outcome is measured?	Endurance walking performance
Is the measure reliable as reported in the article?	YES ☐ NO ☐ Not Reported ☒
Is the measure valid as reported in the article?	YES ☐ NO ☐ Not Reported ☒
When is the measure used?	Prior to intervention and postintervention

MEASUREMENT BIASES

Were the evaluators blind to treatment status?

YES ☐ NO ☒	Evaluators were not blinded in the testing conditions because of limited funding. The researchers adopted a stratified randomization process to limit bias that might arise from the evaluators.

Was there recall or memory bias?

YES ☒ NO ☐	Because the IPAQ is a self-reported measure of a 7-day period, participants could have had recall bias when reporting accurate physical-activity measures within that time period.

Other measurement biases:

The technique used in the 6MW assessment as a measurement of distance was a potential bias factor. Researchers followed approximately 1 meter behind the participant with a distance-measuring wheel while measuring total distance traveled. Potential biases include the researchers lack of blinding to the condition and their presence as an influence on the participant's performance. This method was noted as well established in current research to measure ambulation, however.

RESULTS

List key findings based on study objectives:

At baseline, there were no significant effects between the condition and disability groups for any demographic or clinical variables. There were significant disability effects for age ($p = .02$) and Patient-Determined Disease Steps Scale score ($p < .01$), given a statistical significance ($p < .05$).

Compliance

Compliance with the behavioral interventions was listed at 88.6%.

Physical-Activity Results

Mixed analysis of variance (ANOVA) indicated significance, $F(1, 69) = 5.28$, $p = .03$, for a Time × Treatment Condition × Disability Group interaction effect on IPAQ scores, given a statistical significance ($p < .05$). There was a large increase in self-reported physical activity ($d = 1.63$) in the mild-disability intervention group. There was a small increase in self-reported physical activity ($d = 0.24$) in the moderate-disability intervention group. There was a moderate decrease in self-reported physical activity in the mild-disability control group ($d = −0.52$). There was no significant change in self-reported physical activity ($d = 0.03$) in the moderate-disability control group.

CPS Results

A significant disability-group main effect ($p = .01$) was present for baseline SDMT. Mixed ANOVA

indicated a significant relationship (p = .02, partial η^2 = .08) among disability status, treatment condition, and time as a within-subject factor on CPS scores, given a statistical significance (p < .05).There was a moderate increase in SDMT scores in the mild-disability intervention group (d = 0.41, ~6-point increase). There was minimal change in the moderate-disability intervention group (d = −0.12, ~1-point decrease). There were minimal changes in SDMT scores for those with mild disability (d = 0.10, ~1-point increase) and moderate disability (d = 0.10, ~1-point increase) in the control group.

6MW Results

A significant disability-group main effect (p < .01) was present for the baseline 6MW distance. Mixed ANOVA indicated a significant relationship (p = .02, partial η^2 = .07) between time and treatment condition on 6MW scores, given a statistical significance (p < .05). Mixed ANOVA indicated no significance, $F(1, 71) = 0.01$, p = .93, partial η^2 < .01, for the Time × Treatment Condition × Disability Group interaction, given a statistical significance (p < .05). There was a small increase in 6MW distance in the intervention group (d = 0.08, ~12-m increase). There was a small decrease in 6MW distance in the control group (d = −0.06, ~10-m decrease).

Was this study adequately powered (large enough to show a difference)?

YES ☒ NO ☐	The final sample size of 82 participants was determined on the basis of a power analysis for detecting a differential pattern of change in physical activity as a function of disability status. Statistical power was inferred on the basis of the study's strength of using a large sample size of 82 for an RCT.

Were the analysis methods appropriate?

YES ☒ NO ☐	Two-way ANOVA was used to analyze baseline and follow-up differences in physical activity, cognition, and walking performance. ANOVA was used appropriately to analyze differences among the multiple independent groups presented in this study.

Were statistics appropriately reported (in written or table format)?

YES ☒ NO ☐	Statistics were reported in a table format and organized according to the entire group with MS and by varying disability of MS.

Was participant dropout less than 20% in total sample and balanced between groups?

YES ☒ NO ☐	The dropout rate for this study was 0.07%, with 6 participants lost (4 in the intervention condition and 2 in the wait-list control condition) due to death, pregnancy, injury, or unwillingness to follow up.

What are the overall study limitations?

The first noted limitation is that testing by laboratory personnel was not blinded to the intervention or control groups. A second limitation is the absence of an active control condition, so that it was impossible to determine whether significant changes were based on physical activity or time and

attention effects. A third limitation is the use of the IPAQ as a self-report measure for physical activity. Scores from the IPAQ could be altered depending on the nature of the intervention provided. A fourth limitation described is the use of the PDDS as a self-report measure for disability, instead of clinical evaluation by a neurologist. A fifth limitation described is the use of the SDMT as the only measure for CPS; rather, future research should include other areas of cognition to be measured.

CONCLUSIONS

State the authors' conclusions related to the research objectives.

Overall, this study determined the effectiveness of an SCT-based program incorporating physical activity over 6 months to improve CPS and walking performance for clients with MS. CPS was measured by the SDMT, and walking performance was measured by the 6MW. The researchers concluded that CPS improved for participants with mild disability who were in the intervention group. No significant improvement was measured for those with moderate disability, however.

The results indicate that physical activity may be a possible intervention strategy to manage slow CPS for individuals with mild MS disability. Walking performance also increased in the intervention condition for both mild and moderate disability. The increase in SDMT and 6MW scores suggests that the SCT-based program for increasing physical activity may have clinical potential to improve mobility and CPS among adults with mild MS disability.

To increase the strength of the study, the researchers suggested using a larger sample size of participants with MS, using a blind-assessors approach, and providing more attention to the control condition. Overall, this RCT study provides clinical evidence that supports the use of physical activity as a tool to help manage cognitive impairment and walking performance challenges for individuals with MS.

This work is based on the evidence-based literature review completed by Kevin Ng, OTS, Jeffrey Kou, OTS, Patricia Lyons, OTS, Yvonne Lam, OTS, America Ortega, OTS, and Kitsum Li, OTD, OTR/L, CSRS, faculty advisor, Dominion University.