

Question:	What are the benefits of short and long-term wellness interventions for individuals with MS?								
Author, Year	Sample(s)			Intervention(s)		Outcome measure(s)	Results	Applicability (relevance to your question and clinical practice)	Comments on evidence level / study quality
	Age, Gender	MS Hx	Severity/Other	Experimental	Control				
Hogan, 2014	Age (≥18) Mean age: 54.5 (9.6) males/females: 40/71	Time Since Dx (yrs): 15.0 (7.8) Time since Sx Onset (yrs): 20.3 (11.4)	Included lwMS needing bi. ADs for mobility (GNDRS 3 or 4); all types of MS included; relapse free for 12 wks	Group PT (n=48), indiv. PT (n=35), and yoga (n=13) groups exercised 1 hr/wk x 10 wks. Group & PT groups: 6 exercises performed strength & bal. exercise in varying freq./difficulty. Yoga intervention was vague but included relaxation, meditation, breathing, & stretching.	CG (n=14) asked not to change their exercise habits	Berg, 6MWT, MSIS (v.2), Modified Fatigue Impact Scale (MFIS) all measured at 10 wks (blind assessors)	High attendance (~80% over 10wks); sign. improv. for Berg (all exercise groups), 6MWT (indiv. PT), MSISv2 phys (group PT & indiv. PT), MSISv2 psych (group PT), MFIS (group PT & indiv. PT): Effect sizes calculated for Berg (w/in group ES 0.59, 0.35, & 0.43 for group PT, indiv. PT, & yoga), 6MWT (0.34 indiv. PT), MSIS phys (0.46 & 0.39 for group & indiv PT), MSIS psych (0.54 group PT) & Fatigue (0.32 & 0.5 for group & indiv. PT)	Most notable effects demonstrated in group therapy (moderate ES in balance, psych, & QOL) while indiv. PT resulted in gains in similar outcomes with better effects in fatigue and 6MWT; exercise protocol included; most exercises can be performed in a variety of settings without specialized equipment (step is only piece of necessary equipment)	No concealed allocation; dissimilar baseline chara. (cntrl group sign. younger; yoga had sign. less MFIS); high attrition (22.3%); protocols not consistent throughout groups (additional exercises given in indiv. PT group; no standard protocol for yoga groups); smaller sample size in yoga; "selection bias arose as several groups were not treated as randomised"; PEDro score 3/10
Stuifbergen 2003	mean age: 45.8 (10.1) (range 21-70y) 100% female	Pts had to have MS >6 mo. Mean duration = 10.76(6.92) (range 1-37 yrs)	55% reported relapsing-remitting MS (other types included in study); severity measured using Incapacity Status Scale. Mean severity = 15.4 (8.0) out of 64	n=56: 2 mo. behavioral/ educational intervention focused on improving goal-setting, barriers, stress, self-efficacy, and healthy maintenance; (90min sessions 1x/wk x 8 wks in groups of 8-14 pts); pts were also counseled during telephone follow-up (2x/mo. x 3 mo.)	Usual care (n=57). Pts were offered lifestyle change classes and telephone follow-up after the intervention	Health Promoting Lifestyle Profile II (HPLPII), Barriers to Health Promoting Activities for Disabled Persons Scale (BHPADP), The Personal Resource Questionnaire (PRQ), Self Rated Abilities for Health Practices (SRAHP) & SF-36 measured at 2mo., 5mo., & 8mo.	Sign. improv. in all subscales of HPLPII (health responsibility, activity, nutrition, spiritual, interpersonal, & stress management), SRAHP (exercise/nutrition/psyc self-efficacy), and bodily pain and mental health subscales of SF-36 (QOL); by the end of the intervention, women in the intervention group were more likely to be employed ($X^2 = 3.91$). Effect sizes calculated for total HPLPII score & SRAHP (0.55 & 0.74 respect.); SF-36 ES's were poor (<0.2).	This study demonstrates the effect of an behavioral intervention (12 hrs of educational sessions + 3mo of telephone follow-up) on promoting a variety of healthy behaviors & self-efficacy. The authors mentioned some intervention groups met for 4x3hrs instead of 8x1.5hrs. Difficult to replicate due to not having materials but good starting point for topics to build self efficacy. Content can be requested from lead author AKS.	High attrition (20.4%), selection bias (convenience sample), lack of blind subjects/therapists/ assessors; PEDro score 4/10
Sandroff, 2014	Age 18-64 Mean age: 49.6 (8.6) males/females: 19/57	Mean duration: 12.1 (8.5)	Individuals with mild-moderate MS (amb. w/ or w/out AD) consistent with scores of 0-6 on the patient-determined disease steps (PDDS); relapse free for 30 days	n=37: 6 mo internet behav. intervention based off Social Cog. Theory. Pts wore pedometer, kept physical activity (PA) log, accessed online edu modules to inc. PA, and were coached 1-1 via skype. Modules included self-monitoring, goal setting, outcome expectations, self-efficacy, and facilitators/ barriers for PA	Waitlist control group would receive materials upon completion of the intervention (n=39)	Oral Symbol Digits Modalities Test (SDMT), International Physical Activity Questionnaire (IPAQ), 6MWT at assessed at 6mo. follow-up. The researchers compared outcomes across groups and outcomes across levels of disability (mild vs. mod.)	Sign. improv. in PA (within group ES = 1.63 in mild tx group & 0.24 in mod. tx group) and SDMT (ES 0.41 in mild tx); small improv. in 6MWT for Tx group. Changes in IPAQ scores were associated with changes in SDMT (mild MS only) and 6MWT; changes in avg. steps/day was assoc. with SDMT changes (mild MS only) and 6MWT times	Behavioral interventions based off SCT produced gains in cognitive processing speed (mild MS), 6MWT (mild & moderate MS), and physical activity. Changes in physical activity were associated with changes in processing speed (mild MS) and 6MWT (mild and moderate MS)	Good retention (93%) & compliance with online modules (88.6%); lack of blind subjects/ therapists/ assessors; PEDro score 6/10
Straudi, 2014	Age 18-75 Mean age: 52.58 (11.2) males/females: 7/17	Mean duration: 15.21 (8.68)	Avg EDSS: 4.89 (0.54) Individuals with all types of MS (amb. w/ or w/out AD) consistent with EDSS 4-5.5; individuals had to walk 100m without AD; relapse free for 3mo.; MMSE>24	n=12: 5x/wk x 2 wks of task-oriented circuit training followed by 3mo. HEP with similar exercises (recommended 60min 3x/wk). Pts rotated between 6 stations (3min @ each station + 2min of rest) twice for a total of 60min + 30min of TM walking with rests (total 120min /session). Exercises included dynamic balance/ gait activities like steps and tandem walking. HEP inten. & dur. recorde via diary, and telephone coaching provided during 3mo.	Control group did not receive any tx for gait or mobility improvement (n=12)	10m Walk, 6MWT, TUG, DGI, Fatigue Severity Scale, MSWS12, MSIS29 measured at 2wk and 3mo.	Tx group showed sign. in-group & between-group improv. in 6MWT, MSWS12, & MSIS29 physical and psyc subdomains after 2wk supervised sessions (w/in group ES's 0.14, 0.36, 0.26, & 0.23 respect). Between-group differences persisted for 3mo for MSIS29 psyc (w/in group ES 0.23). 58% completed exercise diary. Minor losses in 6MWT were observed in Tx group after 3mo HEP. Authors did not reference how often the telephone coaching was utilized	This study demonstrates modest benefits following a 2wk (5x/wk) & 3 mo. HEP involving gait & dyn. balance. Small gains in walking and 6MWT times were observed, though these were not maintained after 3mo. HEP. Perhaps giving pts a diary, exercise brochure, and access to coaching is not enough to result in functional gains. PA not measured. Pts felt they got the most out of TM walking, and rated slalom & tandem walking as enjoyable.	This was a feasibility study, so power was limited due to decreased sample size. Good retention: 85%; lack of blind subjects/ therapists/ assessors. PEDro score 7/10.

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DeBolt, 2004	Mean age: 48.8 (8.9) males/females: 29/8	Mean duration: 14.1 (11.6)	EDSS inclusion 1-6.5; mean EDSS 3.74 (1.68); able to amb 20m w/ or w/out AD; relapse free for 3mo	n=19: Pts initially instructed on exercises during 6 sessions (3x/wk x 2wks), then given a video detailing the exercises. Home exercises included warmup, 25-30min strengthening, 5-10min of stretching 3x/wk x 8wks. Exercises: chair raises, forward lunges, step-ups, heel-toe raises, and leg curls. Periodization also incorporated with weighted vests/ankle weights (which increased in weight each wk) while increasing, then dec the # of sets. bi-weekly in-person coaching visits provided	Pts were given the opportunity for the 2 wk instructional sessions along with the home video (n=17)	MAS, Sway via AccuSwayplus, leg power via Leg Extensor Power Rig, TUG measured at 8 weeks	95% adherence to HEPs: pts completed an avg 22.9 (0.43) out of 24 home sessions. Improvements observed in sway and TUG but these were not sign. Sign. improvements in power (~30%) were observed b/t groups with reported ES=0.22.	Demonstrates benefits in power following an 8-wk HEP with in-person & video instruction with biweekly coaching sessions. Exercises included in protocol. All exercises could be performed at home, though weighted vests & ankle weights needed.	Good retention (97%); the authors acknowledged that their study was underpowered; lack of blinding and intent to tx; PEDro score 6/10
Romberg, 2004	Age 30-55 mean age: 43.9 (6.8) males/females: 34/61	Time since Dx: 5.7 (6.6) Time since 1st Sx: 9.6 (7.9)	EDSS inclusion 1-5.5; median EDSS =2.5; relapse free for 30 days; could not be engaged in regular exercise (>4x/wk) for the past 3 mo.; did not specify type of MS	n=47: 3wks of inpatient rehab instruction (10 supervised sessions) followed by 23wks of HEP (circuit strength 3x/wk & aerobic 1x/wk). An additional strength training session was added during last 5 wks. Coaching/encouragement via telephone wks 5, 8, 14, & 20. Exercises included 10 UE/LE strength training exercises with tband, aquatic therapy, and preferred aerobic exercise; adherence measured via diary. Progressed intensity & reps during program	n=48: individuals were advised not to increase their physical activity; individuals contacted 3x before 6mo. followup	25ft walk & 500m walk were primary outcomes. Secondary outcomes included EDSS, max isometric knee flexion and ext (MIKF & MIKE) measured via dynamometer, dexterity via the Box and block, UE endurance via lifting 7lb (female) or 10lb (male) weights (specific motion and postural position not clarified), VO2max via incremental exercise test on cycle ergometer, static balance via Equiscale. Measured at 6mo FU	High adherences: 95(46)%. Sign. within and b/t group improvements in 25ftW & 500mW (reported in-group ES 0.5 & 0.26 respec.); sign. improv. in MIKF (in-group), UE endurance (b/t group), an dexterity (in-group). Sign. improv. also found in the CG in dexterity and 25ftW. Age and EDSS were covariates; avg. adherence 93%	Long-term HEP with intermittent feedback produces benefits in various walking speeds, UE endurance, and LE flexor strength in individuals with mild-moderate MS. Pts preferred aerobic exercise (185% adherence) compared to strength training (59% adherence). Applicability is limited due to authors not listing exercise routine. Without specific exercises, it is difficult to draw solid conclusions.	Good retention (96%); no blinding or concealed allocation; PEDro score 6/10
Briken, 2014	Mean age: 49.8 (8.7) males/females: 18/24	Mean duration: 15.6 (14.5)	Mean EDSS 5.0 (0.8) EDSS inclusion 4-6; both relapse-remitting & primary progress included; immunomodulatory within 6mo or steroid tx within 4wks excluded; screened with Physical Activity Readiness Questionnaire; relapse free for 1 year	8-10wks of supervised aerobic exercise 2-3x/wk for ~20 sessions. 3 aerobic exercise groups: arm ergometry (n=12), rowing (n=12), and bicycle ergometry (n=12). Intensity determined by a ramp test. Intensity & duration progressed throughout study (15min -> 45min)	n=12: "waitlist control"	Aerobic fitness via VO2, 6MWT, processing speed via symbol digit modalities test, Verbal Learning & Memory Test (VLMT), attention via Test Battery of Attention (alertness and shift attention subtests), executive function via Achievement Testing System (subtest 3), verbal fluency via Regensburg Verbal Fluency Test (G-R subtests), depression via Inventory of Depressive Symptoms, & fatigue via MFIS measured at 8-10wks.	Mean # of sessions = 22; avg Borg during sessions 4.6. Sign. b/t group improvements observed in VO2 for the cycle group, 6MWT for arm & cycle groups, VLMT delayed recall for all exercise groups, alertness & attention for arm & cycle groups, depression for arm & cycle groups, and fatigue for arm group. Greater Borg ratings observed for rowing (mean 5.3 [0.3]) compared to arm or cycle exercise (4.3[0.5] & 4.3[0.1]).	Continuous aerobic exercise results in a variety of improvements following a 2mo aerobic intervention for individuals with moderate MS. Benefits observed in aerobic fitness, endurance (even for arm ergometry), cognitive domains (learning, memory and attention), depression, and fatigue. Greatest gains in cycle ergometry (which can be replicated in one's home with portable erometer), though modest gains observed in arm ergometer.	Good retention (89%); means not reported so ES could not be calculated; similar baseline comparisons not addressed; no blinding; endpoint not specifically designated (measured between 8-10wks); PEDro score 6/10

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Garrett, 2012	Age (≥18) Mean age: 49.3 (10.8) males/females: 78/235	Time since Dx: 10.6 (9) Time since 1st Sx: 14.1 (9)	0-2 on the Guys Neurological Disability Rating Scale, relapse or steroid tx in the past 12wks excluded; all types of MS included	3 group exercise groups: PT-led (n=80), Fitness Instructor/FI-led (n=86), & yoga/Y (n=77). Groups of 8 met for 1 hr/wk x 10wks. PT group consisted of 8 UE&LE circuit training exercises with 3 sets of ~12 of each exercise; self-paced; pts given HEP with aerobic & strength exercises for 30min 2x/wk @65% max HR/Borg 11-14. FI sessions were heterogeneous and mostly consisted of strength & aerobic training. Y sessions also heterogeneous but include breathing, ROM & body centering.	n=71; individuals told not to change their exercise habits; waitlisted for the exercise of their choice following the study	MSIS29 physical & psych, MFIS, 6MWT measured at 10wks. Baseline activity levels were also assessed.	Sign. in-group improv. in all outcomes for the 3 exercise groups except for 6MTW for the Y group. Sign. b/t group improv. in MSIS29 psych (all exercise groups), MFIS total and physical subscale (all exercise groups), 6MWT (PT & FI groups), & MSIS29 physical (PT & FI groups). <10% were meeting ACSM guidelines before intervention. Moderate ES (0.2<ES<0.8) were observed for MSIS29 physical (PT, FI, & Y), MSIS29 psych (all groups), MFIS total (PT, FI, & Y), MFIS physical (all groups), MFIS cognitive (PT), & 6MWT (PT)	8-10 weeks of various exercise routines results in gains in subjective outcomes (physical functioning, mood, & fatigue) and objective outcomes for PT & fitness instructor-led exercises via 6MWT, demonstrating the benefits of supervised exercise for individuals with moderate MS. PT exercises mentioned in study (p. 783) and can easily be replicated in the clinic or at home with some basic equipment	High attrition (23%); lack of pt/PT blinding & intent to tx; PEDro score 6/10. Very difficult to control for all the variables between groups (due to various protocols used)
Sosnoff, 2014	Age (50-75) mean age: 60(6.1) males/females: 6/21	Time Since Dx (yrs): 15.8 (9.1)	Self-reported EDSS 2.5-6.5 (median 5.0); 6 used a cane and 8 used a walker; able to walk 25ft w/ or w/out assistance; required to have a self-reported fall in last 12mo.; relapse free for 30 days	n=13: 3mo progressive HEP consisting of balance, LE strength, core m strength, & stretching 45-60min 3x/wk. Pts instructed exercises at orientation; pts returned at wks 2,4,& 8 to monitor form & intensity; compliance measured with dairies	n=14: waitlisted for the intervention after the study concluded	Physiological Profile Assessment (PPA) Scores (Falls Risk, Mobility, Balance, & Self-Reported Falls), Berg, 25ftW, 6MWT, TUG, MSWS12, ABC, falls during program	Sign. b/t group improv. in falls risk, postural sway (via PPA), 25ftW, & ABC; trend for sign. for Berg. Greater # of fallers reported in CG vs Tx group (94 vs 50%) though not sign. Sign. correlation between baseline PPA & falls during intervention. Exercise group completed avg 24.6 sessions (68% adherence); they also reported other types of exercise such as walking/biking. Moderate in-group ES for falls risk, postural sway, MSWS12, & Berg.	Specific exercises referenced on p.257. 3mo. HEP with intermittent coaching provides improvements in falls risk, sway, walking speed, & balance confidence for older adults with moderate MS.	High attrition (18%) due to relapses and time commitments; lack of pt/PT blinding; no intent to tx; PEDro score 6/10. Study may have been underpowered to measure the change in Berg
Carter, 2013	Age (18-65) Mean age 40.2 (8.0) males/females: 4/26	Mean duration not listed	EDSS<5.5; mean EDSS 3.0(1.4); no changes in drug therapy or relapses the previous 3mo.; could not be exercising more than once/wk for the previous 3mo.	n=15: 10wk exercise program with 2 supervised and 1 home session/wk; behavioral intervention included utilizing Transtheoretical approach (consciousness raising, goal setting, & finding social support for exercise). Self-directed intensity, duration, and progression though recommendations were given including 11-13 on Borg/50-69% of max HR. Exercises included aerobic, balance, strength, core stability, flexibility. Training diary checked weekly.	n=13: waitlisted for 3 supervised studies once they had completed the study.	Assessed at 10wks & at 3mo FU: BMI, waist/hip circumference, Aerobic Capacity via continuous incremented sub-maximal cycle ergometer test, TUG, MSQOL54, PA via Godin Leisure-Time Exercise Questionnaire, visual analogue scale of five Transtheoretical stages of change, MS Functional Composite	Gains observed in exercise duration, intensity, and training load; walking/TM most popular activity. Sign. b/t group improv. observed for readiness to exercise (based of VAS of TT stages) at 3mo, physical subdomain of MSQOL54 at 10wks (in group ES 0.52). Trend for sign. for EDSS. Moderate-large in-group ES also observed for mod & vigorous PA at 3mo (0.69 & 0.89 respect.)	10wk behavioral intervention, supervised exercise, and HEP demonstrated modest benefits in readiness to exercise and QOL, which were inconsistent over 10wk & 3mo. FU assessments. Specific exercises not included which limits reproducibility	Good retention (93%); high quality study: PEDro score 8/10 (lacked only PT/pt blinding). Changes in PA might have been significant if the study had more power/larger sample size.

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Learmonth, 2011	Mean age: 51.6 (8.1) males/females: 9/23	Time since onset: 13.1 (7.4)	EDSS 5-6.5; mean EDSS 6.02 (0.38); stable drug therapy for previous 30 days; relapse free for the previous 3mo.; MMSE>24;	n=20: 12wk group exercise with supervised circuit training 60min 2x/wk. Exercises included 8-12 UE & LE aerobic, balance, & strength exercises with breaks	n=12: encouraged not to change their exercise habits for the 12wks of the study	Outcomes assessed at 8 & 12wk: 25ftW, BMI, 6MWT, Berg, TUG, quad strength of weaker LE via handheld dynamometer, PA via PhoneFITT, ABC, Fatigue Severity Scale, depression via Hospital Anxiety and Depression Scale, Leads QOL Scale, Goal Attainment Scale	Poor adherence (71%): 340 out of 480 tx sessions attended. Sign. in-group & b/t group differences in PA, which was the only outcome which improved. Notable ES observed in 25ftW (0.3 at 8wks & 0.23 at 12wks), PA (1.37/1.05 at 8/12wks), ABC (0.94 at 12wks), quad strength (1.33 at 12wks), Berg (0.8 at 12wks), 6MWT (0.68 at 12wks) & FSS (0.67 at 12wks).	12wk program incorporating a variety of gait & balance activities results in clinical gains in PA, walking speed, balance, balance confidence, endurance, and fatigue, though only PA statistically significant. Protocol included and includes different levels of exercise. Could easily be implemented in a variety of settings without specialized equipment.	Poor retention (69%); lack of PT/pt blinding; several outcomes demonstrated notable effect sizes and may have been stat. sign. if study had greater power; PEDro Score 7/10