Table H-5. Strength of evidence for Key Question 2: balance exercise for multiple sclerosis

| **Intervention****Category,****Intervention** | **Comparator** | **Outcome** | **Number of Studies (Participants)****Author Year****(See Appendix B for Full Citation)** | **Study Limitations** | **Consistency** | **Precision** | **Reporting Bias** | **Strength of Evidence** | **Findings, Direction and Magnitude of Effect** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Postural Control** Balance training |  *Usual care* | Quality of life  | 2 (N=106)Gandolfi, 2015Tollar, 2020 | Moderate | Consistent | Imprecise | Undetected | Insufficient | Mean between-group difference:MSQoL-54: 5.02, 95% CI -1.12 to 9.92EQ-5 Sum Score: -0.6 (1.15) vs. 0.0 (1.13), p=0.023 |
| **Postural Control** Balance training | *Usual care or waitlist/no intervention* | Function | 7 (N=369)Forsberg, 2016Callesen, 2019Carling, 2017Amiri, 2019Tollar, 2020Ozkul, 2020Arntzen, 2020 | Moderate | Consistent | Imprecise | Undetected | Low strength of evidence for benefit | Pooled MSWS (4 studies): -4.66, 95% CI -6.65 to -2.67Pooled TUG (3 studies): 0.45, 95% CI -1.92 to 2.822MWT: MD 16.7, 95% CI 8.15 to 25.2510MWT: MD 0.48, 95% CI 0.11 to 0.8525FWT (m/s): MD 0.10, 95% CI 0.00 to 0.20, p=0.04FGA: 2.1, 95% CI 0.6 to 3.6, p=0.00792MWT: -3.24 (3.37), p=0.34Sit-to-Stand: 0.24 (2.12), p=0.1710MWT: 1.49 (3.84), p=0.70Significant interaction between time and group according to baseline EDSS score for core muscle endurance and strength, p<0.05MSIS-29: -6.3 (4.23) vs. 1.0 (3.46), p=0.008 |
| **Postural Control** Balance training | *Usual care or Waitlist* | BalanceBBS | 10 (N=553)Afrasiabifar, 2018Brichetto, 2015Gandolfi, 2015Carling, 2017Callesen, 2019Arntzen, 2019Forsberg, 2016Amiri, 2019Tollar, 2020Ozkul, 2020 | Moderate | Consistent | Imprecise | Undetected | Moderate for benefit | Pooled BBS (7 studies): MD -4.314 95% CI -5.57 to -2.70Pooled MiniBEST) 2 studies: 2.40, 95% CI 1.10 to 3.701 study: Significant interaction between time and group according to baseline EDSS score for static and dynamic stability p<0.05 |
| **Postural Control** Balance training | *Usual care or Waitlist* | FallsNear falls | 2 (128)Carling, 2017Gandolfi, 2015 | Moderate | Consistent | Imprecise | Undetected | Low for benefit | Falls: -1.24 (1.66), p<0.001Near Falls: -8.24 (14.78), p=0.002# of Falls: 0.59 (0.99) to 0.03 (0.16) vs. 0.37 (0.54) to 0.29 (0.34), p=0.005 (post-intervention); 0.59 (0.99) to 0.08 (0.27) vs. 0.37 (0.54) to 0.27 (0.55), p=0.53 (1 month post treatment) |
| **Postural Control** Balance training | *Attention control* | Sleep | 1 (45)Sadeghi Bahmani, 2019b | Moderate | Unknown | Imprecise | Undetected | Insufficient | ISI: 13.46 (5.81) to 10.13 (4.92) vs. 1.71 (5.43) to 11.14 (5.39), p>0.05 |
| **Postural Control** Balance training | *Other active interventions (lumbar stabilization and task-oriented training)* | Function2-Minute Walk Test | 1 (N=42)Salci, 2017 | Moderate | Unknown | Imprecise | Undetected | Insufficient | Mean change from baseline: 10.75 m vs. 25.55 m vs. 18.69 m; p>0.05 |
| **Postural Control** Balance training | *Other active interventions (lumbar stabilization and task-oriented training)* | BalanceBBS | 1 (N=42)Salci, 2017 | Moderate | Unknown | Imprecise | Undetected | Insufficient | Mean change from baseline: 3.57 vs. 5.78 vs. 5.57; p=0.16 |
| **Postural Control** Hippotherapy | *Usual care, previous activity level or attention control* | Quality of life MSQoL-54 | 1 (N=70)Vermohlen, 2018 | Moderate | Unknown | Imprecise | Undetected | Insufficient | Mental health score: mean difference 12.0, 95% CI 6.2 to 17.7 Physical health score: 14.4, 95% CI 7.5 to 21.3 |
| **Postural Control** Hippotherapy | *Usual care, previous activity level or attention control* | BalanceBBS | 1 (N=70)Vermohlen, 2018 | Moderate | Unknown | Imprecise | Undetected | Insufficient | Mean difference 3.07, 95% CI 1.00 to 5.14 |
| **Postural Control** Hippotherapy | *Usual care, previous activity level or attention control* | SpasticityNSR | 1 (N=70)Vermohlen, 2018 | Moderate | Unknown | Imprecise | Undetected | Insufficient | Mean difference -0.9, 95% CI -1.9 to -0.1 |
| **Postural Control** Hippotherapy | *Usual care, previous activity level or attention control* | Walking | 1 (N=33)Moraes, 2020 | Moderate | Unknown | Imprecise | Undetected | Insufficient | 6MWT: 459.06 (118.34) to 503.59 (126.38) vs. 513.00 (101.97) to 497.13 (88.88), p<0.00125FWT: 6.37 (1.70) to 5.36 (1.43) vs. 5.82 (1.29) to 5.84 (1.08), p<0.001 |
| **Postural Control** Tai Chi | *Usual care* | Depression*Immediately Post-treatment* | 1 QENR (N=32)Burschka, 2014  | High | Unknown | Imprecise | Undetected | Insufficient | CES-D mean score 7.67 (5.12), p=0.007 vs. 16.13 (11.99), p=0.951; favors Tai Chi, interaction p=<0.05 |
| **Postural Control** Tai Chi | *Usual care* | Quality of life*Immediately Post-treatment* | 1QENR (N=32)Burschka, 2014  | High  | Unknown | Imprecise | Undetected | Insufficient | QLS mean score 232.57 (25.62), p=0.012 vs. 193.81 (36.2), p=0.290, Interaction p<0.01 |
| **Postural Control** Tai Chi | *Usual care* | Balance*Immediately Post-treatment* | 1 QENR(N=32)Burschka, 2014 | High | Unknown | Imprecise | Undetected | Insufficient | 14-task balance test: 9.33 (2.26), p=0.031, for the intervention vs. 6.53 (4.49), p=0.439; interaction p<0.05  |
| **Postural Control** Tai Chi | *Psychological classes and physical therapy)* | BalanceBBS*Immediate-ly Post-treatment* | 1 (N=34)Azimzadeh, 2015 | High | Unknown | Imprecise | Undetected | Insufficient | BBS: 52.25 (3.39) to 53.94 (2.23) vs. 53.22 (2.23) to 53.61 (2.14), p>0.05 |
| **Postural Control** Motion gaming | *Usual care* | Function | 4 N=(177)Nilsagard, 2013Ozkul, 2020Tollar, 2020Yazgan, 2020 | Moderate | Consistent | Imprecise | Undetected | Low for benefit | 6MWT pooled 2 studies: MD -30.90, 95% CI -49.55 to -12.25TUG pooled 3 studies: MD -1.06, 95% CI -1.43 to -0.6925footWT: -0.3 (1.1) vs. -0.1 (1.4), p=0.51DGI: 1.78 (2.3) vs. 1.0 (2.0), p=0.21MS Walking Scale: -5.9 (11.5) vs. -3.95 (18.1), p=0.76Four Square Step Test: ‑1.6(2.1) vs. -2.0 (6.6), p=0.64 |
| **Postural Control** Motion gaming | *Different type balance exercises*  | Function | 2 (N=62)Kalron, 2016Khalil, 2018 | Moderate | Consistent | Imprecise | Undetected | Insufficient | Four Square Step Test: 16.2 (7.0) to 12.7 (6.4) vs. 14.2 (7.1) to 11.7 (5.9), p=0.361TUG: 0.04, 95% CI –2.24 to 2.32, p=0.9710MWT: 8.48, 95% CI –5.16 to 22.12, p=0.213MinWT: –7.11, 95% CI –34.18 to 19.95, p=0.59 |
| **Postural Control** Motion gaming | *Different type balance exercises or usual care* | Quality of Life | 2 (N=58)Khalil, 2018Tollar, 2020 | Moderate | Consistent | Imprecise | Undetected | Insufficient | SF-36 PCS: -11.62, 95% CI -22.27 to -0.99, p=0.03SF-36 MCS: -13.60, 95% CI -23.66 to -3.55, p=0.01EQ-5 Sum Score: -2.3 (1.44) vs. 0.0 (1.13), p<0.001 |
| **Postural Control** Motion gaming | *Different type balance exercises*  | Balance | 2 (N=62)Khalil, 2018Kalron, 2016 | Moderate | Inconsistent | Imprecise | Undetected |  Insufficient | BBS: 46.8 (9.6) to 47.9 (6.4) vs. 43.3 (7.1) to 44.6 (4.9), p=0.56 BBS: -4.52, 95% CI -7.90 to -1.09, p=0.01Falls Efficacy Scale International: 36.4 (9/7) to 29.4 (7.8) vs. 32.9 (10.3) to 28.6 (5.8), p=0.021FES-I: 3.86, 95% CI -0.062 to 8.34, p=0.08 |
| **Postural Control** Motion gaming | *Usual care*  | Balance | 3 (94)Tollar, 2020Ozkul, 2020Yazgan, 2020 | Moderate | Consistent | Imprecise | Undetected | Low for benefit | BBS (pooled analysis 3 trials):MD -3.43, 95% CI -6.30 to -0.57 |
| **Postural Control** Whole body vibration | *Usual Care* | Function | 1 (N=47)Claerbout, 2012 | Moderate | Unknown | Imprecise | Undetected | Insufficient | 3MinWT: 45.0 (42.6) vs. 20.4 (27.95), p>0.05 TUG: 11.32 (5.21) to 11.16 (8.82) vs. 14.43 (3.20) to 14.57 (4.02), p=0.05, NS |
| **Postural Control** Whole body vibration | *Usual Care* | Balance | 1 (N=47)Claerbout, 2012 |  Moderate  |  Unknown  | Imprecise | Undetected | Insufficient | BBS: 3.9 (4.4) vs. 4.2 (6.1) vs. 0.2 (7.5), p>0.05 for all comparisons |
| **Postural Control** Whole body vibration | *No treatment* | QoL | 1 (46)Abbasi, 2019 | Moderate | Unknown | Imprecise | Undetected | Insufficient | QOL-54 (PCS): 4.20 (1.73, 8.40) vs. -1.26 (-3.28, 0), p<0.001QOL-54 (MCS): 5.96 (2.71, 11.89) vs. -0.17 (-2.20, 0.07), p<0.001 |
| **Postural Control** Yoga | *Usual care, previous activity level or attention control* |  Function | 4 (N=215)Garrett, 2013a/bHogan, 2014Young, 2019Ahmadi, 2013 | High | Consistent | Imprecise | Undetected | Low-strength evidence for no clear benefit | 6MWT: Median Difference (SIQR): 0 (82) vs. -10 (91), p=0.736MWT: Median Difference:-25 vs. 6.5, NS6MWT: Mean Difference:22.83, 95% CI -16.67 to 6.2, p=0.25TUG: MD:-1.20, 95% CI -2.58 to 0.18, p=0.095XSit to Stand: -0.70, 95% CI -2.17 to 0.77, p=0.3410MWT: 12.45 (4.54) to 6.45 (3.61) vs. 9.16 (1.88) to 9.47 (1.92), p=0.112MWT: 109 (17.44) to 120.36 (20.62) vs. 121.50 (27.73) to 119.05 (27.12), p=0.11 |
| **Postural Control** Yoga | *Usual care, previous activity level or attention control* | Quality of Life | 4 (N=241)Doulatabad, 2013Hasanpour-Dehkordi, 2014Garrett, 2013a/bHogan, 2014 | High | Inconsistent | Imprecise | Undetected |  Insufficient | Mean (SD) MSQoL-54:4.9±1.9 vs.6.9±1.5 (baseline); 7.4±2.16 vs. 6.8±1.9 (post-intervention), p=0.001Mean Difference SF-36:1106.41, p<0.001Median Difference MSIS-psychological: –3.7 (22.2) vs. 0 (16.7), p=0.04Median (SIQR) MSIS-psychological: 14 (2.2) baseline, 15 (4) post intervention vs. 17 (4) baseline, 15 (4.5) post-intervention, NSMean Difference MSIS-physical: –4.0, 95% CI –7.5 to –0.5 vs. 0.3, 95% CI -4.0 to 4.6, p=0.12Mean Difference MSIS-physical: 1.3, 95% CI -4.7 to 7.3 vs. -4.8, 95% CI -10.4 to -0.60, NS |
| **Postural Control** Yoga | *Usual care, previous activity level or attention control* | Balance | 2 (N=49)Hogan, 2014 | High | Unknown | Imprecise | Undetected | Insufficient | BBS: MD: 5.3, 95% CI -3.1 to 7.5 vs. -3.1, 95% CI -2.8 to 9.0, NSBBS: 47.72 (6.78) to 53.81 (3.40) vs. 44.50 (8.48) to 41.70 (8.48), p=0.07 |
| **Postural Control** Yoga | Movement to Music (Dance) | Function | 1 (N=53)Young, 2019 | Moderate | Unknown | Imprecise | Undetected | Insufficient | 6MWT: MD: -18.2, 95% CI -56.4 to 20.1, p=0.34TUG: MD 0.69, 95% CI -0.71 to 2.08, p=0.335XSit to Stand: MD 0.30, 95% CI -1.21 to 1.82, p=0.69 |
| **Postural Control** Yoga | Undescribed control | Quality of Life:Sexual Satisfaction | 1 RCTs (N=60)Najafidoul-atabad, 2014 | Moderate | Unknown | Imprecise | Undetected | Insufficient | Yoga baseline 1.8 (SD 2.0) to 1.4 (SD 1.5), p=0.001 versus women in the control group (baseline 2.1 (SD 1.2) to 2.1 (SD 1.2), p>0.05. |
| **Postural Control** Yoga | Aerobics |  QoL | 1 (N=40)Hasanpour-Dehkordi, 2014 | High | Unknown | Imprecise | Undetected | Insufficient | SF-36: MD between groups: 229.32, p=0.07 |
| **Postural Control**Yoga | Physiotherapist-led exercise | Function | 1 (N=126)Garrett, 2013a/b | High | Unknown | Imprecise | Undetected | Insufficient | 6MWT: Median Difference (SIQR): 0 (82) vs. 10 (52), NS |
| **Postural Control**Yoga | Physiotherapist-led exercise | Quality of Life | 1 (N=126)Garrett, 2013a/b | High | Unknown | Imprecise | Undetected | Insufficient | MSIS (psychological): Median Difference (SIQR): -3.7 (22.2) vs. -11.1 (25.9), NSMSIS (physical): : MD -4.0, 95% CI -7.5 to -0.5 vs. -6.9, 95% CI -10.8 to -2.9, NS |
| **Postural Control**Yoga | Group exercise | Qol | 1 (N=61)Hogan, 2014 | High | Unknown | Imprecise | Undetected | Insufficient | MSIS-29 (psychological): 18 (5.38) to 17 (4.8) vs. 8 (5.5) to 15 (5.7), p>0.05MS-29 (physical): 54 (11.5) to 49.4 (12) vs. 50.5 (9.5) to 45.9 (10.5) vs, p=NR |
| **Postural Control**Yoga | Group exercise | Balance | 1 (N=61)Hogan, 2014 | High | Unknown | Imprecise | Undetected | Insufficient | BBS: 30.4 (11.6) to 34.2 (9.8) vs. 28.9 (9.5) to 34.5 (9.8), p<0.05 |
| **Postural Control**Yoga | Group exercise | Function | 1 (N=61)Hogan, 2014 | High | Unknown | Imprecise | Undetected | Insufficient | 6MWT: 83.9 (39.8) to 100 (55) vs. 101 (39.5) to 121.2 (47.4), p>0.05 |
| **Postural Control**Yoga | One-on-one exercise | Qol | 1 (N=48)Hogan, 2014 | High | Unknown | Imprecise | Undetected | Insufficient | MSIS-29 (psychological): 18 (5.38) to 17 (4.8) vs. 14 (2.2) to 15 (4), p>0.05MS-29 (physical): 54 (11.5) to 49.4 (12) vs. 48.3 (10.5) to 49.6 (11.6), p=NR |
| **Postural Control**Yoga | One-on-one exercise | Balance | 1 (N=48)Hogan, 2014 | High | Unknown | Imprecise | Undetected | Insufficient | BBS: 30.4 (11.6) to 34.2 (9.8) vs. 22.6 (12.6) to 27.9 (11.5), p<0.05 |
| **Postural Control**Yoga | One-on-one exercise | Function | 1 (N=48)Hogan, 2014 | High | Unknown | Imprecise | Undetected | Insufficient | 6MWT: 83.9 (39.8) to 100 (55) vs. 70 (30) to 45 (54.5), p>0.05 |
| **Postural Control**Yoga | Fitness instructor-led exercise | 6MWT | 1 (N=130)Garrett, 2013a/b | High | Unknown | Imprecise | Undetected | Insufficient | Median Difference (SIQR): 0 (82) vs. 20 (61), NS |
| **Postural Control**Yoga | Fitness instructor-led exercise | MSIS-psychological | 1 (N=130)Garrett, 2013a/b | High | Unknown | Imprecise | Undetected | Insufficient | MSIS (psychological): Median Difference (SIQR): -3.7 (22.2) vs. -3.7 (22.2), NSMSIS (physical): MD -4.0, 95% CI -7.5 to -0.5 vs. -5.7, 95% CI -9.1 to -2.4, NS |

**Abbreviations:** 2MWT = 2-Minute Walking Test; 3MinWT = 3-Minute Walking Test; 6MWT = 6-Minute Walking Test; 10MWT = 10-Meter Walking Test; 25-FWT=25-Foot Timed Walking Test; BBS=Berg Balance Scale; CES-D= Center for Epidemiological Studies Depression Scale, CI = confidence interval;ISI =Insomnia Severity Index; RCT=randomized controlled trial; MCS = Mental Component Summary; MD = mean difference; MS = multiple sclerosis; MSIS = Multiple Sclerosis Impact Scale; MSQOL= Multiple Sclerosis Quality of Life; NSR = nonsignificant risk; QENR=quasiexperimental nonrandomized study; QLS=Questionnaire of Life Satisfaction; QOL = Quality of Life; SD = Standard Deviation; SF 36-MCS = Short Form 36 Mental Health Scores; SF 36-PCS = Short Form 36 Physical Component Score; SIQR = Symptom Impact Questionnaire; TUG= Timed Up and Go Test; WT = Walking Time