THERAPEUTIC DANCE INSTRUCTION FOR ENHANCING EXERCISE ADHERENCE AND IMPROVING MOBILITY IN PERSONS WITH MS

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Why dance?

• How can we develop the habit of regular exercise for cardiopulmonary and neurological health
• Physical inactivity contributes to sedentary lifestyle that can increase risk of morbidity and all-cause mortality
• Low fitness is a better predictor of mortality than obesity or hypertension
• People with MS are at even greater risk
• Symptoms related to MS make participation in physical activity (PA) difficult (fatigue, difficulty with gait, balance issues)
• 64% of people with MS did not meet international guidelines for regular physical activity vs 40% of adults in US
Exercise as an disease course modifying intervention with generalized effects

- Adequate PA is one of the few non-pharmacological interventions available that can effectively reduce MS symptoms & improve quality of life, and is well-tolerated in people with MS

- Physiological, psychological, neurological effects:
  - Increase lower limb strength, step rate, walking speed
  - Decrease fatigue
  - Improving mood and balance
  - Improves cognition, relapse rate

- Benefits remain only if PA is maintained over time

Critical elements to increase habitual exercise?

- Experience with treadmill training suggests poor long term adherence
- Furthermore, although treadmills satisfies exercise needs, does not provide functional mobility training

- Theories for self-motivation & behavior change:
  - competence/self-efficacy
  - autonomy
  - meaningfulness to life goals
  - Enjoyment, group or social activity
Dance as Intervention

• Meets criteria for behavioral change
• Literature from other populations (elderly, PD, stroke, TBI) suggested high adherence
• May also have greater effects on mobility than just forward walking
• Dance as a “non-exercise” may make it more enjoyable

Neurological complexities of dance

• Motor learning, spatial integration, executive processing, appropriate response to external physical cues and social cues
• Tango, Waltz and Salsa are based on a set of structured steps which then can be arranged (choreographed) sequenced based on “real-time” needs
• Control of balance is dynamically applied
  • Forward, back, lateral, and turns
  • While responding to external perturbations
• Requires cognitive engagement and mastery of a motor skill, even more so than traditional gait training
Why Salsa?

- Wanted a dance form that could be performed **partnered** or **single**
- Dance style that is current, making actual use accessible
- Desired some potential choreography and mind-body planning
- Combination of structured steps, torso, and UE movements, requiring integration of attention and rehearsal of physical movement
- Step count happened to be nearly identical to the highest speed on the Lokomat

<table>
<thead>
<tr>
<th>ID#</th>
<th>Salsa Steps (# Steps/Min)</th>
<th>HR (Beats/Min)</th>
<th>Walk Steps at 3.5 km/hr (#Steps/Min)</th>
<th>HR (Beats/Min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>106</td>
<td>120</td>
<td>107</td>
<td>90</td>
</tr>
<tr>
<td>P2</td>
<td>112</td>
<td>77</td>
<td>110</td>
<td>77</td>
</tr>
<tr>
<td>P3</td>
<td>170</td>
<td>95</td>
<td>110</td>
<td>84</td>
</tr>
</tbody>
</table>

Why Salsa for MS?

- Limited studies looking at therapeutic effects of salsa in different pop.
- **Abreu et al. 2013**: case study on 83 y.o. with Alzheimer’s
  - 24 one-hour salsa sessions over 12 weeks
  - Improved strength, balance, gait and functional activity
- **Granacher et al. 2012**: RCT with 28 older adults
  - 16 one-hour salsa sessions over 8 week vs no treatment
  - Conclusion: Salsa is a safe, feasible, and highly enjoyable PA program with high adherence rate

Changes in BBS. Abreu et al. 2013
Changes in TUG Test (time in seconds). Abreu et al. 2013
Dance in MS

- Almost nothing is known about dance intervention in MS, except for one Brazilian case study by Salgado & de P Vasconcelos 2010.
- 1hr and 40-min session of salsa, twice a week for 5 month

<table>
<thead>
<tr>
<th>Scale</th>
<th>Initial score</th>
<th>Meaning</th>
<th>Final score</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>EDSS (Expanded Disability Status)</td>
<td>3</td>
<td>Medium incapacity of 1 FS (1 FS score 3 or little incapacity of 3 or 4 FS (1 FS score 2, others score 0 or 1) FS): Functional Systems</td>
<td>2</td>
<td>Little incapacity of 1 FS (1 FS score 2, others 0 or 1)</td>
</tr>
<tr>
<td>MRD (Minimal Record Disability)</td>
<td>6</td>
<td>Two supports are necessary during walking tests. The patient can walk 25 feet in 20 s</td>
<td>5</td>
<td>One support is necessary during walking tests. The patient can walk 25 feet in more than 20 s or bilateral supports are necessary and patient can walk 25 feet in 20 s at least</td>
</tr>
<tr>
<td>NRS (Scripps Neurologic Rating Scale)</td>
<td>Max Score 100</td>
<td></td>
<td>71</td>
<td>Max Score 100</td>
</tr>
</tbody>
</table>

Pilot study of Salsa for MS : Method

- Pilot structured salsa dance intervention for people with MS
- 8 persons with MS
- 2.5 hours, 2x week for 4 weeks
  - Two 60-min classes + 30 min practice at home
- Reproducible dance protocol
- Outcomes measured:
  - Longitudinal effects on PA
  - Gait, balance, self-efficacy & tolerability
Participant Demographics

<table>
<thead>
<tr>
<th>Subject</th>
<th>Age</th>
<th>Gender</th>
<th>MS Subtype</th>
<th>Disease Duration (yrs.)</th>
<th>PDDS(^a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>02</td>
<td>56</td>
<td>F</td>
<td>RRMS(^b)</td>
<td>22</td>
<td>1</td>
</tr>
<tr>
<td>03</td>
<td>32</td>
<td>F</td>
<td>RRMS</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>04</td>
<td>57</td>
<td>M</td>
<td>RRMS</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>06</td>
<td>63</td>
<td>F</td>
<td>RRMS</td>
<td>20</td>
<td>1</td>
</tr>
<tr>
<td>07</td>
<td>29</td>
<td>M</td>
<td>RRMS</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>08</td>
<td>51</td>
<td>F</td>
<td>RRMS</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>09</td>
<td>60</td>
<td>F</td>
<td>SPMS(^c)</td>
<td>13</td>
<td>3</td>
</tr>
<tr>
<td>10</td>
<td>48</td>
<td>M</td>
<td>RRMS</td>
<td>2</td>
<td>0</td>
</tr>
</tbody>
</table>

\(^a\) Patient Determined Disease Steps  
\(^b\) Relapsing-remitting multiple sclerosis  
\(^c\) Secondary-progressive multiple sclerosis

Dance Protocol

- **1\(^{st}\) lesson of each week:**
  - Introduced a new step
  - Initially learned without music & without partner
  - Randomly paired and rotated between partners every few minutes

- **2\(^{nd}\) lesson of each week:**
  - reviewed and practiced steps learned cumulatively in prior lessons

- Some movements were slightly adapted or customized to participants' limitation
- Two mandatory breaks
  - # of breaks as indicator of intolerability
Progression of Dance Steps, 8 Classes over 4 Weeks

<table>
<thead>
<tr>
<th>Classes</th>
<th>Bronze Level Syllabus</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-2</td>
<td>Frame-Posture-Balance, Leader/Follower Roles, Basic Step Forward and Side</td>
</tr>
<tr>
<td>3-4</td>
<td>Basic with Follower's Underarm Turn</td>
</tr>
<tr>
<td>5-6</td>
<td>Cross Over Breaks</td>
</tr>
<tr>
<td>7-8</td>
<td>Cross Body Lead</td>
</tr>
</tbody>
</table>

Outcomes measured

- Pre-post intervention, 3-, 6- month follow-up
- **Dance Tolerability:**
  - # of individual breaks per session
- **Gait:**
  - Timed 25-FT Walk Test
  - MS Walking Scale-12
- **Balance:**
  - Timed Up and Go
  - Dynamic Gait Index
  - Berg Balance Scale

- **Self-efficacy & motivation:**
  - MS Self-Efficacy Scale
  - Activities-specific Balance Confidence Scale
  - Motives for Physical Activity Measure-Revised
- **Physical Activity:**
  - Godin Leisure Time Exercise Questionnaire
  - Home journal
- **MS-related clinical symptoms**
  - MS Symptom Checklist
- **Patient Determined Disease Steps (walking disability)**
<table>
<thead>
<tr>
<th>Outcome Measure</th>
<th>Pre-Intervention Median (IQR)</th>
<th>Post-Intervention Median (IQR)</th>
<th>3-Month Follow-Up Median (IQR)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gait Outcome Measures</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Timed 25 Foot Walk (sec)^b</td>
<td>4.6 (4.3, 5.0)</td>
<td>4.8 (4.3, 4.9)</td>
<td>4.8 (4.1, 5.1)</td>
</tr>
<tr>
<td>MS Walking Scale-12^b</td>
<td>29.2 (1.0, 59.9)</td>
<td>29.2 (1.6, 46.4)</td>
<td>17.7 (1.6, 41.7)</td>
</tr>
<tr>
<td><strong>Balance Outcome Measures</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Timed Up &amp; Go (sec)^b</td>
<td>9.5 (8.6, 10.0)</td>
<td>8.5 (8.1, 8.9) **</td>
<td>8.3 (8.0, 8.9) **</td>
</tr>
<tr>
<td>Dynamic Gait Index^c</td>
<td>22.5 (20.3, 23.8)</td>
<td>23.0 (23.0, 23.8) *</td>
<td>24.0 (22.3, 24.0) *</td>
</tr>
<tr>
<td>Berg Balance Scale^c</td>
<td>55.0 (53.3, 56.0)</td>
<td>56.0 (56.0, 56.0)</td>
<td>55.0 (54.0, 55.8)</td>
</tr>
<tr>
<td><strong>Self-Efficacy and Motivation Outcome Measures</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MS Self Efficacy Scale^c</td>
<td>56.5 (46.8, 71.5)</td>
<td>63.8 (47.3, 70.1)</td>
<td>62.3 (48.1, 64.8)</td>
</tr>
<tr>
<td>Activities-specific Balance Confidence Scale^c</td>
<td>85.5 (68.0, 97.0)</td>
<td>88.8 (70.5, 97.2) *</td>
<td>87.8 (63.9, 98.4)</td>
</tr>
<tr>
<td>Motives for Physical Activity Measure-Revised^c:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Competence Domain</td>
<td>6.2 (4.7, 6.7)</td>
<td>6.4 (5.7, 6.9)</td>
<td>5.9 (5.2, 6.7)</td>
</tr>
<tr>
<td>Interest/Enjoyment Domain</td>
<td>5.6 (4.8, 6.6)</td>
<td>6.1 (5.7, 6.5)</td>
<td>5.8 (5.1, 6.1)</td>
</tr>
<tr>
<td><strong>Physical Activity Outcome Measures</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total minutes/week</td>
<td>250.0 (25.0, 447.5)</td>
<td>450.0 (305.0, 731.3)</td>
<td>267.5 (25.0, 807.5) *</td>
</tr>
<tr>
<td>Vigorous Exercise (min)</td>
<td>0.0 (0.0, 0.0)</td>
<td>0.0 (0.0, 33.8)</td>
<td>20.0 (0, 126.3) *</td>
</tr>
<tr>
<td>Moderate Exercise (min)</td>
<td>70.0 (0.0, 338.8)</td>
<td>325.0 (240.0, 492.5)**</td>
<td>45.0 (0, 195.0)</td>
</tr>
<tr>
<td>Mild Exercise (min)</td>
<td>75.0 (0.0, 201.3)</td>
<td>75.0 (0.0, 246.3)</td>
<td>177.5 (0, 326.3)</td>
</tr>
<tr>
<td>Total Leisure Activity (METs^d)</td>
<td>28.0 (4.5, 50.8)</td>
<td>43.0 (30.0, 67.5) **</td>
<td>20.5 (3.8, 66.5)</td>
</tr>
<tr>
<td><strong>MS Symptoms/Disability</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patient Determined Disease Steps^b</td>
<td>1.0 (0.0, 2.5)</td>
<td>1.0 (0.0, 2.5)</td>
<td>1.0 (0.0, 2.5)</td>
</tr>
<tr>
<td>MS Symptom Checklist^b</td>
<td>5.0 (2.0, 6.8)</td>
<td>5.5 (2.3, 8.5) **</td>
<td>2.0 (1.3, 9.0)</td>
</tr>
</tbody>
</table>

Statistical significance: ^ * p < 0.10; ** p < 0.05.
^Interquartile Range
*Lower values indicate better performance.
**Higher values indicate better performance, the total number of minutes per week include dance sessions.
^Metabolic equivalent
Results of 4 weeks of progressive salsa dance

- Increased engagement in PA during the intervention period

- Improvements in gait and balance immediately post-intervention and at 3-month follow-up compared to baseline

- At 3-month:
  - Increases in vigorous and mild exercise, but not stat sig
  - Stat sig improvements in TUG, DGI, and MSWS-12 compared to baseline

Other literature on Dance

Parkinson's disease (PD)

- Hackney et al (2007): 2x/week, 10-week tango
  - Sig improvements on the BBS & TUG for tango group
  - No improvement for traditional exercise group

Berg Balance Scores for the tango and exercise groups before (gray) and after (black) intervention. Values plotted are means +/- SEM. The tango group demonstrated significant improvement while the exercise group did not.
Tolerability

- Well-tolerated (no one took an elective break during salsa sessions)
- Post-study interviews:
  - additional 30 min would be possible
  - a study longer than 4 weeks would be welcomed without fatigue

Limitations

- Small sample size (n=8)
- No control group
- Safety screening = people with motor deficits at milder range
- Some participants already engaged with regular exercise = less apparent to see pre-post difference in PA for some participants
- Short study duration = less likely to affect long-term behavioral changes
- Potential ceiling effects on clinical measures, especially the Berg Balance Scale
Summary and conclusions

• Safe and Tolerable
• No reported issues with fatigue
• Recruiting for a larger RCT (60-70)
• Tend to attract those already fairly active
• Intimidation factor for dance
• Participants like the “safety” of dancing with others with MS
• As with pharmacological agents, will not be for everyone

Thank you
What is salsa dance?

- A dance style that blended several Caribbean musical styles together.
  - The term "salsa" was created in New York City in the 1970s.

- Usually dance to music with a 4/4 beat per measure.
  - Basic dance rhythm consists of taking 3 steps every 4 beats of music
  - A standard salsa step sequence is danced in 8 beats, or 2 measures.

- Basic steps include front-to-back and side-to-side
- Dance tempo generally ranges from 140 bpm to 220 bpm
- Open and closed frames
Different styles of Salsa

- There are many different types of salsa dance styles that emphasizes accenting different beats and movements.

- **Los Angeles**: danced “on 1” (first beat), emphasizes theatricality such as salsa shines (solos), very “showy”

- **Colombian**: emphasizes side-to-center footsteps and back-to-center (instead of forward-and-backward)

- **Cuban**: emphasizes the 4th and 8th beats and circular movements as opposed to linear movements

- **New York**: dance “on 2” (second beat), emphasizes shines, very linear

- **Puerto Rican**: can be danced on 1st or 2nd beats, emphasizes solo footwork and incorporates lots of shoulder shimmies
Salsa styles examples

Our choice: structured “American” style

• Why did we choose our style? Is it more new york or LA style?
• Our bpm? Al told me that it’s around 114?
Videos of Rosalind teaching steps

- To be added

Salsa and other Dances

- Merengue
- Bachata

- Yen to add info for the dances above, but why didn’t we choose other dance styles? Is there a reason besides the fact that salsa is currently the most popular dance style for people in the age range of being diagnosed with MS?
Salsa vs Merengue vs Bachata

- Tango
- Waltz
- Yen to add
Yesenia Peralta

- Internationally-renown salsa instructor, performer, and dancer
- Diagnosed with MS in August 2010 and mostly retired from salsa due to symptoms
- Started dancing and teaching salsa again in 2013

Yesenia in Berlin, 2005