

The potential benefits of Zumba Gold® in people with mild-to-moderate Parkinson's: feasibility and effects of dance styles and number of sessions

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Highlights Zumba Parkinson's paper CTM

- Zumba Gold[®] is a cheap, safe and enjoyable workout for people with PD.
- Two participants spent more than 75% of the time in the vigorous to maximal HR zone.
- Two participants spent more than 25% of the time in the moderate HR zone.
- Significant decreases in HR were observed when including backwards steps.
- Activity levels increased between the first and last sessions.

Abstract

Objectives: to assess the feasibility of Zumba Gold[®] in people with PD, and to investigate the effects of dance styles and number of sessions on activity levels and physiological load.

Design: repeated measure uncontrolled (single group) feasibility study.

Setting: Eleven participants (age: 64.0±8.1 years) with mild-to-moderate idiopathic PD (Hoehn & Yahr stage < 3.0) took part in a screening session, followed by six Zumba Gold[®] workouts each separated by one week, and a follow-up interview six months later.

Main outcome measures: The main feasibility parameters measured were retention, compliance, and adverse events. Furthermore, during each Zumba Gold[®] session, physical activity levels were measured using tri-axial accelerometers, while physiological load was assessed by average heart rate (HR_{mean}). A two-way ANOVA with repeated measures assessed the effects of dance styles and session number on activity level and HR.

Results: 73% retention and 81% compliance were achieved, and no adverse events were recorded. Participants' enjoyment was high and 38% started Zumba Gold[®] classes in the community after intervention. HR values were similar between dance styles and within the American College of Sports Medicine (ACSM)'s recommendations in 50% of participants. Backwards steps reduced physiological load but improvements in activity levels between the first and last sessions show that steps could be learnt with time.

Conclusions: Zumba Gold[®] is safe and enjoyable for people with PD. The excellent compliance and positive participants' feedback suggest the need for a larger-scale trial.

Introduction

Parkinson's (PD) is characterised by a variety of motor and non-motor symptoms.¹ Although physical exercise has been advocated in the management of PD,² PD is often associated with increased sedentariness.³ Amongst the main barriers to exercise, the lack of access to local sports facilities is commonly reported in people with PD.⁴

Dance classes are generally widely available in the community, and the positive effects of various styles of dance on PD symptoms have been reported in several recent systematic reviews and meta-analyses.⁵⁻⁸ In particular, significant improvements following dance programmes were identified on static and dynamic balance,⁹⁻¹¹ motor capacity (UPDRS motor scale),¹²⁻¹³ walking speed¹³⁻¹⁴ and quality of life.¹⁵⁻¹⁶ In addition, dance has greater benefits than other types of exercise on static and dynamic balance and quality of life, and promoted increased participation in physical activity and more complex tasks,^{12,17} partly because it incorporates external cues, transfer and functional balance, and adjustment to the environment and social network.^{7,18-21} In particular, dance styles that induce frequent movement cessation and initiation and backwards steps, such as tango seem to induce greater improvements in motor outcomes in PD.²²⁻²³ This is particularly important since backwards walking is challenging for people with PD because it disturbs balance and could trigger freezing events.²⁴ Several studies have shown altered biomechanical responses during compensatory backward stepping in people with PD compared to healthy controls.²⁵⁻²⁶

Zumba[®] is a dance-based aerobic activity based on a variety of Latin dance styles (salsa, reggaeton, cumbia, etc...) and including steps in multiple directions. Numerous physiological

and psychological benefits of Zumba[®] have been identified in healthy populations, including improvements in dynamic balance, quality of life, lower pain perception, less interference with daily activities, higher self-perception of physical strength, and greater autonomy and purpose in life.²⁷⁻³⁰ Since many of these aspects are affected in PD, it can be hypothesized that Zumba[®] could benefit this population. However, to date there is no study on this type of exercise in neurological populations. Zumba Gold[®] is adapted Zumba for older adults, with many classes available worldwide (www.zumba.com/gold). Three recent studies investigated the feasibility and potential benefits of Zumba[®] or Zumba Gold[®] in other clinical populations (hemodialysis patients, metabolic syndrome, obesity),³¹⁻³³ showing safety, good feasibility, retention, compliance and greater intrinsic motivation to exercise after intervention. However there is no study on the feasibility of Zumba Gold[®] in PD. Due to the various types of steps involved in Zumba Gold[®] and the gait alterations previously mentioned in PD,²⁵⁻²⁶ it is crucial to assess physiological and biomechanical responses to each dance style separately, to find out if they are all suitable for this population.

Therefore this study is the first exploration of the feasibility of Zumba Gold[®] in people with PD. Its primary aim is to characterise recruitment, compliance, retention, safety and participants' enjoyment. A secondary aim is to investigate the effects of dance styles and session number on activity levels and physiological load during the sessions.

Methods

Participants

Eleven participants with idiopathic PD (six females and five males) volunteered to take part in the study. This sample size is representative of Zumba Gold[®] class sizes, and similar to

previous feasibility studies.³¹⁻³³ Inclusion criteria were diagnosis of idiopathic PD by a medical practitioner,³⁴ and below stage 3.0 on the Hoehn and Yahr Staging Scale of Parkinson Disease.³⁵ Participants were excluded from the study if they had dementia, history of additional prior neurological condition, severe depression or psychosis or a mental state that would preclude consistent active involvement with the study, cardiovascular or musculoskeletal contraindications to exercise. All participants gave written informed consent before taking part in testing, in accordance with the declaration of Helsinki. The study was approved by the local ethical committee.

Overview

The study was divided in two main parts: a screening testing session to characterise participants' demographics as well as motor and non-motor symptoms, and The Zumba Gold[®] intervention period, consisting of six workouts, each separated by one week. Six months after the intervention, a follow-up session evaluating any change in participants' exercise practice was undertaken. During the entire duration of the study, drugs taken by participants were precisely recorded and they were requested to take them as they would normally do and notify the research team of any change in doses or types of medication taken. All testing sessions took place in a dance studio at the same time of day to reduce any medication-related fluctuation on performance.

Screening session

Participants' height (cm) and body mass (kg) were measured to the nearest 1 mm and 0.1 kg. Following questions related to general health, including other neurological condition,

musculoskeletal problems and treatment or counselling for depression, participants were required to fill-in a screening questionnaire for coronary artery disease risk factors, signs and symptoms and the physical activity readiness questionnaire (PAR-Q).³⁶

Disease severity was assessed by parts III and IV of the Movement Disorder Society Unified Parkinson's Disease Rating Scale (MDS-UPDRS).³⁷ In addition, disease severity was assessed by the Hoehn and Yahr scale,³⁵ and the Schwab and England scale was used to characterise participants' activities of daily living.³⁷ In addition, independence of daily living was evaluated using the Barthel Index.³⁹⁻⁴⁰

Any impairment in cognitive function was evaluated by the Mini Mental State Examination (MMSE),⁴¹ with a result inferior to 23 leading to exclusion from the study.⁴²

The Physical Activity Scale for the Elderly (PASE) is a self-reported questionnaire used to characterise participants' activity levels during leisure time, household and work-related activities. It is based on a recall of activities over the previous 7 days.⁴³

Two walking tests were undertaken and participants used their regular footwear during these tests. The 10-m walk test consisted in walking at a comfortable (preferred) speed in a straight line for 10 m. Time to complete the 10-m (i.e. between the command „Go“ and when participants passed the 10-m mark) was recorded. Two trials were performed and the average was calculated.⁴⁴ The 2-min walk test (2MWT)⁴⁵⁻⁴⁶ requires participants to walk at a comfortable speed on a flat level surface for 2 min between two cones placed 16-m apart. One trial was performed and the total distance covered recorded.

Procedures: Zumba Gold® workouts

Participants were requested to take part in six Zumba Gold[®] workouts separated by a week. They were led by a qualified instructor and performed as a class in a dance studio. Before each song, the instructor demonstrated the steps slowly, giving time to participants to learn them. In addition, three members of the research team participated in the class and were placed strategically for safety reasons. Each session included a warm-up song, cool-down song and the main body was based on steps from the following six dance styles commonly used in Zumba: merengue, cumbia, reggaeton, salsa, belly dancing and pop. The progression between sessions included an increase in duration from 45-min (eight songs, each style represented once only) to 60-min (11 songs, with merengue, salsa and reggaeton represented twice). While most of these dance styles required forward and side steps, another salsa choreography was included from week 3, based on backwards steps, rather than side-steps in the first salsa choreography. This second salsa choreography was introduced because it is well established that backwards walking is challenging for people with PD because it disturbs balance and could trigger freezing events,²⁴ and that dance styles that challenge these aspects are more successful than others.²²

Recruitment, retention and compliance

Participants retention was calculated as the ratio of the number who completed the study to the number who started it, while compliance was calculated as the percentage of all sessions attended by participants.

Safety

Assessment of safety included taking into account any adverse event occurring during the class (example: fall, dizziness, pain) and measuring participants' blood pressure (DINAMAP ProCare monitor, GE Medical Systems, Freiburg, Germany) before and after each session. It was expressed as Mean Arterial Pressure (MAP, mmHg), calculated as:

$$\text{Formula (1): } \text{MAP} = [(2 \times \text{diastolic}) + \text{systolic}] / 3$$

In addition, participants were requested to stay with the investigators for 60-min after each workout to monitor any post-exercise symptoms, and asked to report any other symptoms developing during the rest of the week at the start of the next class.

Enjoyment, perceived effort, and change in physical activity

To evaluate participants' perceptions and enjoyment during the sessions, their rated perceived exertion (RPE)⁴⁷ was assessed immediately on completion of each workout. In addition, immediately upon completion of each session, they were asked to give their opinion about the workout, by stating at least one positive and one negative point about the session. Finally, 6 months after the end of the study each participant was asked if they were currently or had participated in any Zumba Gold[®] or dance-based workouts since the end of the intervention.

Exercise intensity

In order to describe exercise intensity during the sessions, two measures were obtained. The first one was a measurement of activity level based on accelerometry. Each participant was fitted with a wrist-worn triaxial accelerometer (GENEActiv, Original, UK). Three-dimensional acceleration was measured during the session at 100Hz. Epochs of 10s were taken, after which a gravity corrected single vector magnitude (SVM_g) was derived by using

formula 2, in order to extract the dynamic rather than static acceleration used as a level of activity.

$$\text{Formula (2): } SVM_g = (\sqrt{x^2 + y^2 + z^2}) - g$$

Activity level classification was assigned according to the method published by Esliger et al.⁴⁸ whereby the following cutoff levels for the SVM_g were used: Sedentary ($SVM_g < 270$), Light ($270 < SVM_g < 806$), Moderate ($806 < SVM_g < 2263$) and Vigorous ($SVM_g > 2263$). The second measurement of exercise intensity was based on heart rate (HR, $\text{beat}\cdot\text{min}^{-1}$). It was continuously measured at 5-s intervals during the workouts (Polar team system 2, Kempele, Finland). Subsequently, HR_{mean} was calculated as the average of HR values from the start of the warm-up to the start of the cool-down, excluding rest periods. A HR_{mean} per song was also calculated. The cool-down was excluded because it was mostly static stretching exercises (very low intensity), while the warm-up was a dance routine similarly to the main body of the class. Values were expressed in absolute ($\text{beat}\cdot\text{min}^{-1}$) and relative (% of maximal HR (HR_{max})), according to the Tanaka⁴⁹ equation. Finally, the time spent in the following HR zones was calculated.³⁶

-Zone 1 (very light-to-light): $HR < 64\%$ of HR_{max}

-Zone 2 (moderate) 64% of $HR_{\text{max}} \leq HR \leq 76\%$ of HR_{max}

-Zone 3 (vigorous to maximal): 76% of $HR_{\text{max}} \leq HR \leq 95\%$ of HR_{max}

Statistical analyses

All variables were expressed as mean (SD). The Shapiro-Wilks test showed the normality of the data, and therefore a two-way ANOVA with repeated measures assessed the effects of

dance styles (warm-up, merengue, cumbia, salsa, belly dance, reggaeton, and pop) and session number (last session vs. first session) on activity level and HR data. Only the first and last sessions completed by each participant were compared, because of limited attendance to the six sessions amongst participants. Where significant differences were identified, multiple Student T-tests for paired samples were used to compare the first and last session for each dance style. In addition, differences in activity levels and HR_{mean} between the two salsa styles (side steps vs. backwards steps) were evaluated by Student T-tests for paired samples. Estimates are shown as 95% confidence limits (CLs) with corresponding p values. An alpha level of 0.05 was considered statistically significant. Effect sizes were calculated using partial eta squared (η_p^2) and Cohen's d and interpreted as small (<0.1), medium (<0.3) and large (>0.5), respectively.⁵⁰

Results

Screening session

Results from the screening session are presented in Table 1. At the time of the study participants were prescribed Levodopa and Monoamine oxidase inhibitors, common prescribed medications used in the treatment of PD. None of the participants reported being prescribed medication for blood pressure or heart rate issues.

Zumba Gold[®] workouts

Recruitment, retention and compliance

Participant retention was 73% (8 participants out of 11). Compliance to the six Zumba Gold[®] sessions was $81.3 \pm 13.7\%$, with a total of 38 classes attended for all participants from a total of 48 offered.

Safety

Taking into account all the sessions, MAP measured ranged from 85.3 to 96.7 mmHg pre-exercise and from 86.7 to 95.3 mmHg post-exercise. No adverse event was recorded either during or after the Zumba Gold[®] sessions.

Enjoyment, perceived effort, and change in exercise practice

RPE recorded immediately after all the sessions ranged from 9 to 12, with a significant increase between the first and last sessions undertaken ($p=0.09$, $d: 1.37$, 95%CI: -4.8 to -1.0). When asked about their experience after each session, a “friendly”, “comfortable” or “nice” atmosphere was reported by 87.5% of participants, while “motivation of exercising with other people with PD” was mentioned by 62.5%. Fifty percent of participants said that “meeting new people” was a positive of the sessions and 37.5% liked the “novelty of the Zumba Gold[®] workouts”. The main negative aspects mentioned were the “complexity of the steps” (87.5% of participants), “high speed of execution” (62.5% of participants), and “only one weekly session” (62.5% of participants). In addition, three of the eight participants (37.5%) started Zumba Gold[®] classes after the study completion and were still involved in these classes 6 months later.

Exercise intensity

The HR_{mean} averaged during the six Zumba Gold[®] sessions was $56.5 \pm 9.2\%$ of HR_{max} . Overall, time spent by participants in the various HR zones was $80.6 \pm 34.4\%$, $18.7 \pm 15.6\%$, and $4.8 \pm 10.9\%$, respectively for very light-to-light, moderate, and vigorous-to-maximal zones. In addition, SVM_g data showed that the mean time spent in the various activity zones was $77 \pm 30.6\%$, $32.6 \pm 29.2\%$ and $0.8 \pm 1.4\%$ of total time in sedentary, light and moderate zones.

The ANOVA showed a significant effect of dance style on SVM_g ($p=0.001$, $\eta_p^2=0.679$, Figure 2), with lower values observed in Cumbia compared to Salsa ($p=0.015$, 95%CI: -103.8 to -16.12). No significant effect of dance style was shown on HR_{mean} ($p=0.689$, $\eta_p^2=0.115$, Figure 3). Regarding step complexity, the comparison between the two salsa conditions showed no significant difference in SVM_g ($P>0.05$), but a significant greater HR_{mean} in the side-steps compared to the backwards step dance condition ($59.8 \pm 12.4\%$ of HR_{max} vs. $54.2 \pm 8.7\%$ of HR_{max} , $d=0.40$, 95% CI: -0.10 to +10.9).

The ANOVA showed a significant effect of session number ($p=0.021$, $\eta_p^2=0.773$) and a significant interaction between dance style and session number ($p=0.038$, $\eta_p^2=0.402$) on SVM_g data (Figure 2). Further analyses revealed significant increases in SVM_g between the first and last session for the warm-up ($p=0.007$, $d=1.08$, 95% CI: -226.9 to -58.1), cumbia ($p=0.020$, $d=0.32$, 95% CI: -51.6 to -7.0), belly dance ($p=0.030$, $d=0.27$, 95% CI: -61.5 to -4.4), salsa ($p=0.002$, $d=0.98$, 95% CI: -148.1 to -51.1), and pop ($p=0.029$, $d=0.39$, 95% CI: -87.5 to -6.7). Conversely, no significant difference between sessions were found for Merengue and Reggaeton ($p>0.05$). Finally, the ANOVA did not show any significant effect of session number ($p=0.421$, $\eta_p^2=0.133$) or interaction between session number and dance style on HR_{mean} ($p=0.624$, $\eta_p^2=0.128$, Figure 3).

Discussion

This study was the first to explore the feasibility of Zumba Gold[®] in neurological populations. The main results of the present study showed excellent safety, retention and compliance of people with PD to the Zumba Gold[®] intervention. In addition, all participants reported enjoyment during the intervention. All dance styles showed similar intensity, and participants increased their activity levels as the sessions progressed, with four participants spending at least 25% of the time in the recommended exercise intensity zones.

This study explored the following feasibility issues: retention of participants, compliance to the programme, safety of the intervention and participants' enjoyment.⁵¹⁻⁵² The retention in the present study was 73%, which is within the range reported for Zumba intervention for other clinical populations (68-81%),^{31,33} as well as other dance-based interventions in PD participants (83%).¹¹ We reported a good compliance to the six Zumba Gold[®] classes, with 81.3±13.7% amongst participants. Several intervention studies on Zumba or other dance styles for PD and other clinical populations showed similar or lower compliance rates (71 to 79%).^{10-11,31,32} Despite the shorter intervention of our intervention compared to these studies that could partly explain this greater participation, our compliance rate suggests that Zumba Gold[®] seems like a suitable exercise workout for PD.

Another crucial feasibility criterion for clinical population is the safety of the exercise intervention.⁵² No fall occurred during any of the six sessions performed, and no injury was reported by participant following the classes, which suggest that Zumba Gold[®] is safe for this

population. Furthermore, monitoring of BP pre and post sessions demonstrated normal individualised BP parameters throughout the study.

Finally the last feasibility criterion evoked in the literature is participants' enjoyment. Our results provided evidence that participants enjoyed the workouts. In addition, although our Zumba classes stopped after the 6-week intervention, the eight participants who completed the study expressed an interest to take part in similar projects involving Zumba Gold[®], and three of them started Zumba Gold[®] classes in the community after the study completion. All together, these observations suggest a good feasibility of Zumba Gold[®] in people with PD, and are in support of implementing a larger randomised-controlled trial. Another feasibility aspect is the cost of interventions. Zumba Gold[®] classes are cheap (maximum of £6 or \$10 per class, with decreased cost with number of sessions purchased, www.zumbafitness.com), can be included in gym memberships, and hence could be used by people of various economical backgrounds.

Exercise intensity during the intervention

The HR_{mean} recorded during the Zumba Gold[®] sessions was $56.5 \pm 9.2\%$ of HR_{max}. This is lower than values reported in healthy older adults during Zumba Gold[®] (72.2% of HR_{max}),⁵³ however the wide range of HR reported in this latter study (absolute HR_{mean} ranging from 87 to 155) suggests a high inter-individual variability of older adults in their physiological responses to Zumba Gold[®]. Our results are also lower than values reported in PD during other exercise modes, including treadmill walking, cycling and various gym-based ergometers.⁵⁴⁻⁵⁵ These differences in exercise modes may be due to the less controlled environment and complexity of the steps involved in Zumba Gold[®] compared to gym-based workout, creating more apprehension by participants. Observation of individual responses

showed that two participants spent more than 75% of the time in the vigorous to maximal HR zone, and two participants spent more than 25% of the time in the moderate HR zone. Interestingly, these participants were characterised by a Hoehn & Yahr stage equal or lower than 1.5, suggesting that people in the early stages of PD who are more able to move reach the American College of Sports Medicine (ACSM)'s recommended target for aerobic exercise.^{36,56} When interpreting these results, it must be kept in mind that HR should be interpreted with caution, due to the hemodynamic responses commonly associated with PD.

The results of the present study showed that Cumbia was characterised by a lower activity level than Salsa. To our knowledge, there is no study using accelerometers to compare these two dance styles. However, Otto et al.⁵⁷ compared the energy cost of several Zumba dance styles in young healthy women, and found lower HR, oxygen consumption (VO_2) and calorie expenditure during Cumbia compared to Salsa (150 vs. 146 $\text{beats}\cdot\text{min}^{-1}$, 25.9 vs 22.7 $\text{ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$, and 7.4 vs 6.6 $\text{kcal}\cdot\text{min}^{-1}$). These differences could be attributed to the high step frequency usually experienced in Salsa (about 120 $\text{steps}\cdot\text{min}^{-1}$),⁵⁸ and the different rhythmic structures of these dance styles, with salsa more complex (2/3 rhythmic structure) than Cumbia (simpler binary 2/4 structure). Despite the accelerometers being worn on the wrist in our study, it has been demonstrated that this method is valid to characterise activity levels during a variety of physical tasks involving both upper and lower limbs.⁵⁹ Our results showed a significantly lower HR_{mean} in the backwards step salsa condition compared to side-step condition. It could be assumed that participants' lower HR was due to their lower capacity to perform the backwards steps at a high enough intensity due to their fear of falling. However, the fact that no fall was recorded during this type of dance style suggests that backwards steps should be introduced in exercise prescription for PD. In favour of this hypothesis, several authors reported that Tango was more beneficial than other dance styles for walking speed and balance in PD due to the prominence of backwards steps in this dance style.^{8-9,11}

Significant increases in activity levels between the first and last sessions completed by each participant were observed for all dance styles, except Merengue and Reggaeton. In addition, the overall session RPE increased significantly between the start and end of the intervention, despite no significant variation in HR_{mean} . This absence of variation in HR could be explained by dysautonomia commonly observed in PD.⁶⁰ Overall, the literature on dance prescription for PD recommends changes in movement speed and length, visual cueing, and alternative shifts in the centre of mass.⁶¹

The main limitations of this study were the relatively small sample size and the fact that only six Zumba Gold[®] sessions were undertaken. In addition, there was no control group and consequently no randomisation of participants into interventions.

In conclusion Zumba Gold[®] is a cheap, safe and enjoyable workout for people with PD, characterised by excellent compliance. The physiological load experienced is within the target zone set by the ACSM in the four participants with a low disease severity. Significant decreases in HR were observed when including backwards steps but improvements in activity levels between the first and last sessions show that steps could be learnt with time. These positive observations suggest that a larger-scale trial could be implemented to assess the feasibility of community-based Zumba Gold[®] classes for PD and evaluate the longer-term effects of this type of intervention on motor and non-motor symptoms.

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Figure legends

Figure 1. Flow diagram of participants through each stage of the study.

Figure 2. Average activity levels (SVM_g) for different dance styles during the first and last Zumba Gold[®] sessions of the intervention.

*: significantly different from first session, $p < 0.05$.

#: significantly different from Cumbia dance style, $p < 0.05$.

Figure 3. Mean heart rate (HR_{mean}) for different dance styles during the first and last Zumba Gold[®] sessions of the intervention.

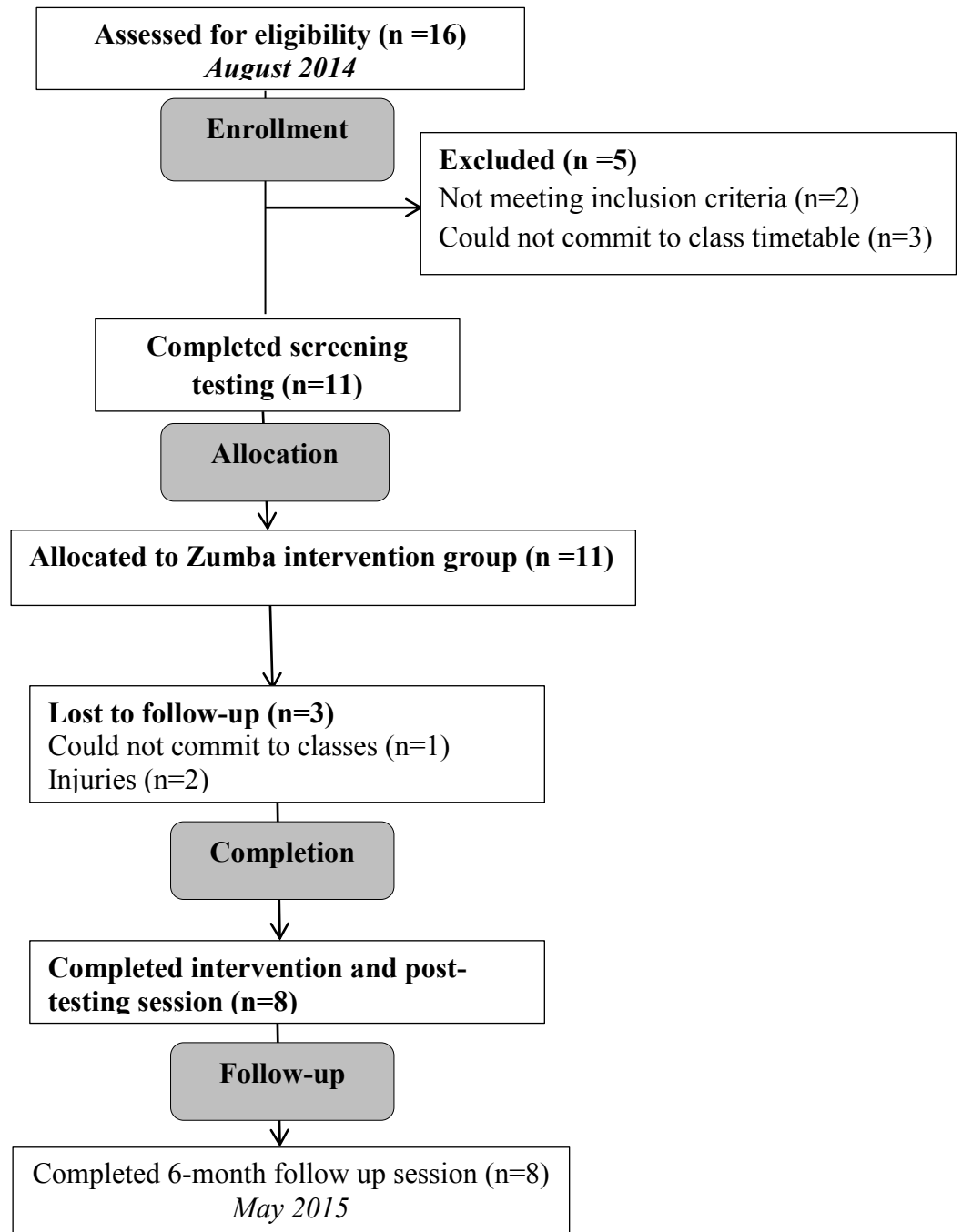
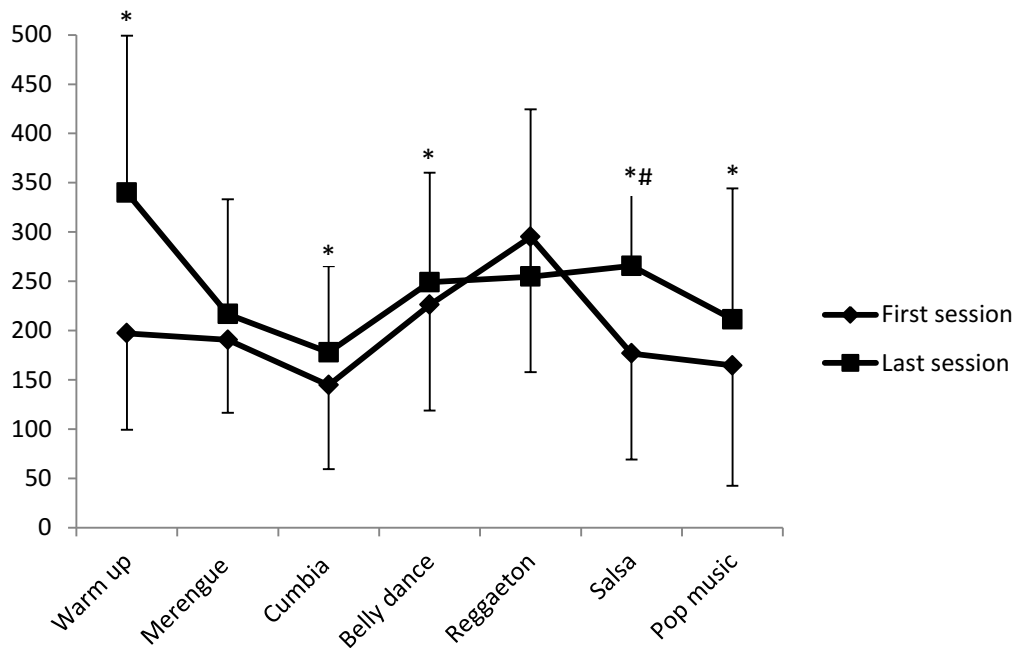
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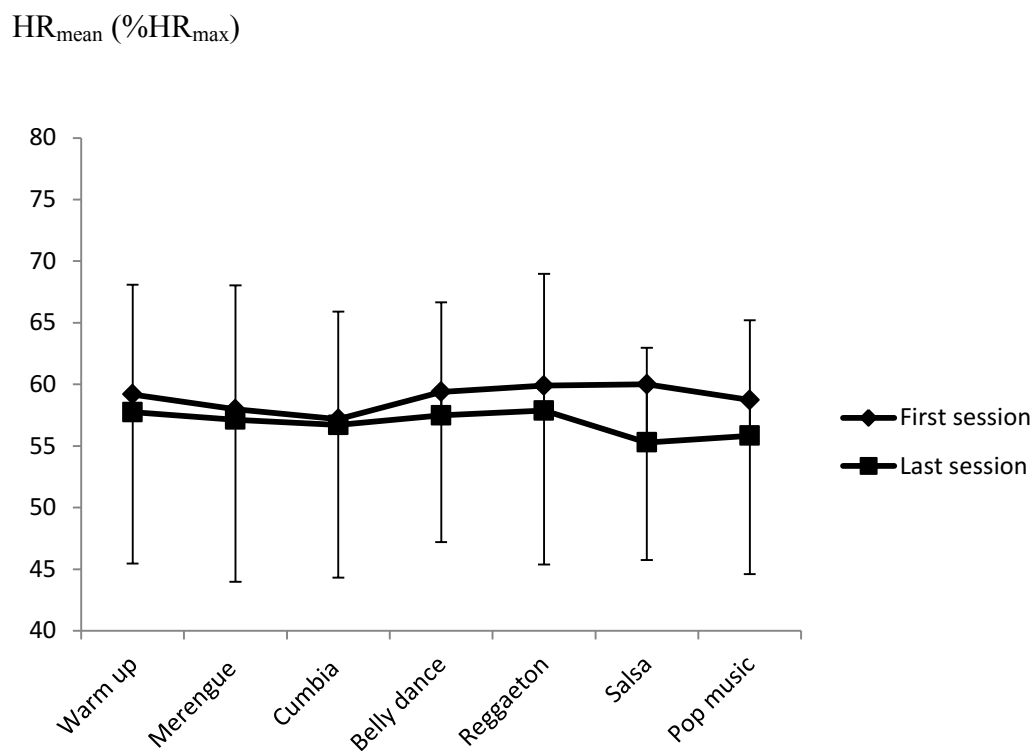
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Table

Table 1. Screening characteristics of participants (BMI: body mass index; MMSE: Mini Mental State Examination; PASE: Physical Activity Scale for the Elderly; UPDRS: Unified Parkinson's disease rating scale motor evaluation (UPDRS-3) and complications of therapy (UPDRS-4).

Variable	Mean (SD)	Median (Range)
Age (years)	64.0 (8.1)	
Height (cm)	169.2 (8.7)	
Weight (kg)	73.0 (10.4)	
BMI (kg/m ²)	25.6 (3.9)	
MMSE		30 (27-30)
Barthel Index		20 (18-20)
UPDRS-3		14.5 (9-21)
UPDRS-4		2 (1-7)
Hoehn and Yahr		1.5 (1-2.5)
Schwab and England daily activities (%)		90 (80-100)
PASE		78.9 (39.7-138.8)
10-m walk (m.s ⁻¹)	0.75 (0.07)	0.63-0.83

2-min walk (m)

139.0 (15.9)

120.5-167.0
