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Effects of dance therapy on cognitive and mood symptoms in people with Parkinson's disease: A systematic review and meta-analysis

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ABSTRACT

Objective: To investigate whether the dance therapy was more beneficial than non-dance therapy on cognitive and mood symptoms in patients with Parkinson's disease (PD).
Methods: MEDLINE, CINAHL, Embase and the Cochrane Central Register of Controlled Trials were searched from inception to December 11, 2018. Risk of bias for the included trials was assessed using criteria in the Cochrane Handbook for Systematic Reviews of Interventions.
Results: Seven randomized controlled trials were identified on cognitive and mood symptoms in patients with PD. There were significant differences in favor of dance in executive function (WMD = 1.17, 95% CI:0.39 to 1.95, P = 0.003; I^2 = 0%, P = 0.45), but not in outcomes of global cognitive function, depression and apathy.
Conclusions: Dance therapy is beneficial in improving executive function for adults with PD. However, there are no positive effects were founded on global cognitive function, depression and apathy for PD.

1. Introduction

The prevalence of Parkinson's disease (PD) has steadily increased with the increasing life expectancy and aging population. Nowadays, PD is approximately 5 million in the 10 most populated countries. By 2030, these figures are projected to increase to 9.3 million [1]. PD is a chronic, progressive and multisystem neurodegenerative disease. It is characterized by progressive decline in not only motor functions but also non-motor symptoms such as, cognitive and emotional impairments, which can be as debilitating as motor symptoms [2]. Of the non-motor symptoms, cognitive and mental symptoms are the core features of PD [3,4]. The estimates of major depression prevalence at the onset of the PD ranged from 20% to 40%, and clinically significant anxiety is approximately 40% [5–7]. Cognitive deficits are frequently observed in patients with PD, and approximately 25%–30% of the PD patients show mild cognitive impairment, which is evident at the time of diagnosis in 10%–20% of patients [8,9]. Moreover, being affected by these non-motor symptoms may lead to decreased quality of life among sufferers, often to a greater extent than the motor symptoms [10,11]. Currently, the conventional treatment of PD is medical treatments based on the dopamine replacement therapies [12]. However, medical treatment is with side-effects and inadequate in the preservation of body functions, daily activities and mobility, as the disease progresses [12,13]. Furthermore, long-term medical treatment may be associated with treatment-resistant symptoms and motor complications including dyskinesia, fluctuations, and choreoathetosis [14,15]. Consequently, researchers gradually turn their attentions to nonpharmacological therapies of these non-motor symptoms [16].

There is accumulating evidence that physical exercise is associated with lower risk of developing PD suggesting potential slowing of PD progression without worsening the primary motor disorder [17,18]. However, regular exercise is either too intense or too monotonous, which makes it difficult for PD patients to maintain long-term adherence and effective exercising. Dance therapy (DT) was an enjoyable, motivating, and engaging form of exercise for rehabilitation of PD patients, through which people can engage creatively in a process to further their emotional, cognitive, physical and social integration [20]. Certain trials have demonstrated that PD patients have a high rate of compliance with a low dropout rate when they attended dance classes compared with other physical exercise alternatives [21]. In addition, DT combines physical and cognitive movements in a stimulating and pleasant environment, which positively affect cognition and brain

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structure by enhancing neuroplasticity [22]. DT is also a music-based movement therapy which can improve psychological state of PD patients by modulating emotional processes [17,23]. This is in accordance with Shanahan's claiming that dance can improve mood of PD after having shared the dance experience with others, which could improve emotional well-being and quality of life [24].

The use of DT for the management of motor and non-motor symptoms in individuals with PD has been documented previously [25]. However, previous systematic reviews on DT in PD patients are only focus on motor symptoms but did not cover important non-motor symptoms, and no meta-analyses to date have examined key issues such as psychological and cognitive outcomes, which have been shown to be strongly linked to quality of life for PD patients. To address these issues, a systematic review is needed to accurately gauge the effect of DT on cognitive and mood symptoms among adults with PD.

2. Methods

2.1. Study eligibility

1. **Types of studies.** The RCTs were included without restriction of publication language. Master theses and conference papers were not included.
2. **Types of participants.** Subjects of any age or gender with a diagnosis of definite PD as determined by movement disorders experts. Subjects were included regardless of their Hoehn - Yahr stage or disease severity.
3. **Types of interventions.** Patients in the intervention groups had to receive DT (either as a sole therapy or combined with other treatment). Intervention format (individual/group), setting (community/hospital), type, duration, frequency were not restricted. Comparison groups included those who received non-dance interventions, usual care or no intervention.
4. **Types of outcome measures.** The primary outcomes of interest were global cognition function and domain-specific cognition (e.g. memory, executive function). Secondary outcomes were PD-related distress, anxiety, depression, apathy and so on. All outcomes were measured using validated scales.

2.2. Search methods

Two independent reviewers to search potential citations in the databases MEDLINE, CINAHL, Embase and the Cochrane Central Register of Controlled Trials (CENTRAL), from inception to Dec 11, 2018, without language restrictions. The following search terms were employed: “Dance Therapy”, “Dancing”, “movement therapy”, “Parkinson Disease” or " Parkinson*". The reference lists of eligible trials were also searched extensively for potential trials.

2.3. Data extraction and study quality

Two investigators independently extracted data for the included trials using a standardized data extraction sheet, which included year, author, country, sample size, baseline characteristics of patients, duration of treatment, duration of disease, interventions and outcomes. Any discrepancies were resolved by discussion.

Two investigators independently assessed the methodological quality of trials using the Cochrane Collaboration Risk of Bias Tool, through the items: sequence generation; allocation concealment; participant, therapist, and outcome assessor blinding; incomplete outcome data; selective outcome reporting; and other sources of bias [26,27]. Each bias domain was rated as low, high, or unclear. Disagreements were also resolved through discussion with a third researcher.

2.4. Data synthesis

All statistical analyses were performed with Reviewer Manager Software, version 5.3. Given that all variables in the included trials were continuous data, weighted mean differences (WMD) with 95% confidence interval (CI) were used as the summary statistics. Standardized mean difference (SMD) with 95% CI will be used if different scales were used to measure a same outcome variable. Statistical heterogeneity of the treatment effects was assessed using Chi-square test and the calculating Higgins I^2 values. The values over 25 and 50% were defined to moderate and high heterogeneity, respectively [28]. If $I^2 > 50\%$, we planned to investigate studies for possible explanations and a random effects model was carried out. Otherwise, a fixed effects model was carried out.

Subgroup analyses will be performed to interpret the heterogeneity if possible. Publication bias will be assessed by visual inspection of funnel plots, if more than 10 trials are included. Sensitivity analyses will be conducted to verify the robustness of the review conclusions by exclusion of each trial one by one.

3. Results

3.1. Search results

The detailed screening process was shown in the PRISMA flow diagram (Fig. 1). A total of 1303 relevant trials were yielded through database. Basing on the title/abstract searching mode, 39 trials satisfied the eligibility criteria of this research. After reviewing the full content of the papers, a total of 7 trials meet the inclusion criteria and left in the final analysis.

3.2. Study characteristics

The characteristics of the included trials are summarized in Table 1. 7 included trials were published between 2013 and 2018. The sample size ranged from 13 to 41 with a total size of 185. The countries of publication were mainly Korea (n = 2), the United States (n = 1), Japan (n = 1), Italy (n = 1), Canada (n = 1) and the United Kingdom (n = 1). All publications are in English. Among these trials, four trials [29–32] compared the DT group to the control group that performed only conventional therapy or health education, and two trials compared the DT group to the control group that performed traditional rehabilitation [33] and self-directed exercise [34], respectively. Another one trial [35] evaluated the effect of DT combined with neurodevelopment treatment (NDT) and functional electrical stimulation (FES) versus the combination of NDT and FES. The length of dance programs ranged between 6 and 12 weeks. DT was performed 1 to 5 times per week and the duration per times varied between 30 and 90 min.

The most commonly assessed outcomes were: global cognitive function (n = 3)[31,32,34], executive function (n = 4)[29,31,33,34], depression (n = 5)[29,30,32,34,35] and apathy (n = 2)[29,34]. Tools used to assess cognitive functions included the Montreal Cognitive Assessment (MoCA) [31,32,34] and Frontal Assessment Battery (FAB) [29,33]. Self-rating Depression Scale (SDS) [29] and Beck Depression Inventory (BDI) [30,32,34,35] were used to assess the level of depression. Apathy Scale (AS) [29,34] was used to assess the apathy symptom of PD patients.

3.3. Quality assessment

The details of the risk-of-bias assessment of the included trials were presented in Fig. 2. 5 of 7 trials [29,30,32,34,35] generated an adequate randomization sequence and shown the details of randomization. No trials provide detailed information on allocation concealment. It is not possible to blind therapist and participant to group allocation, therefore performance bias may be present in all trials. Furthermore 4 trials [29–31,33] reported blinding of outcome assessment. Three trials

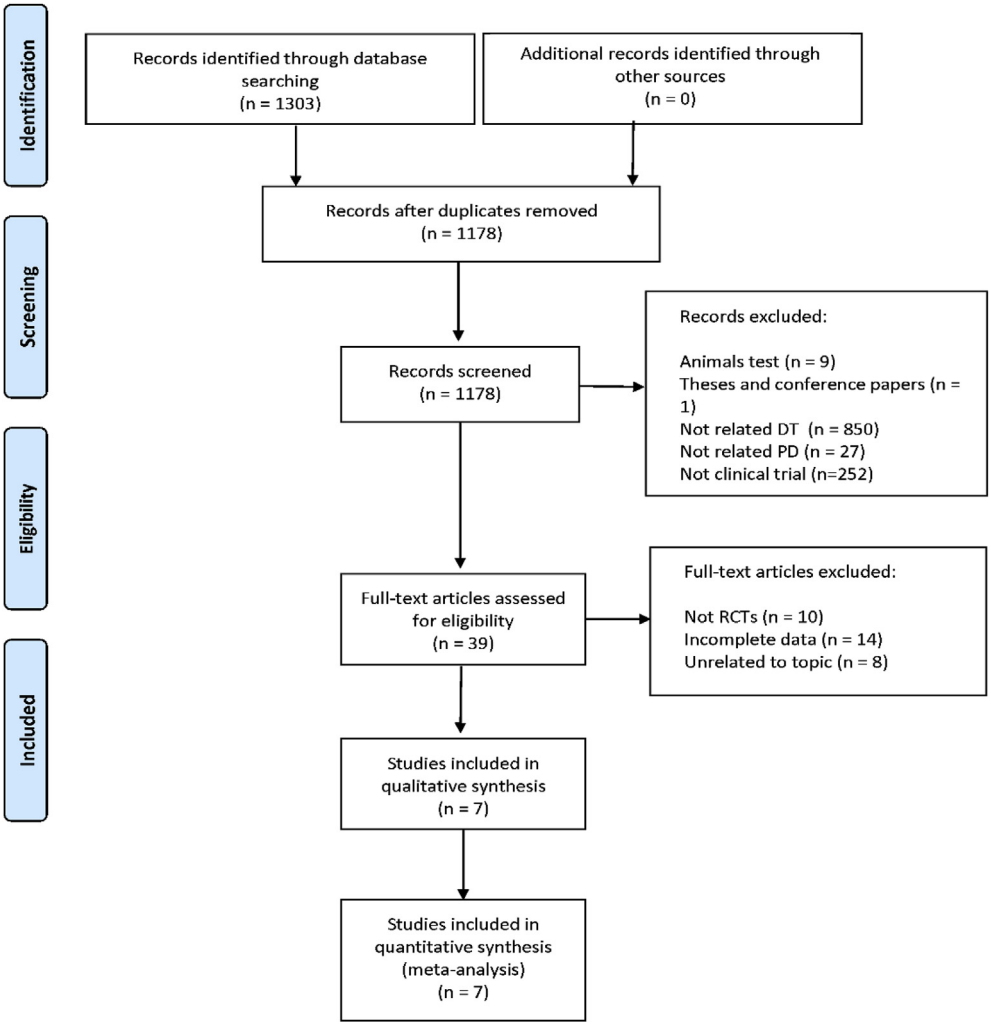

Fig. 1. Flow chart of study selection process.

[30,31,34] reported intention to treat approach. With regard to selective reporting bias, we judged that expected outcomes were stated in all trials.

4. Efficacy analysis

4.1. Global cognitive function

3 of 7 included RCTs with 79 patients measured the global cognitive function using MoCA [31–33]. Random-effect model was used as heterogeneity existed (P = 0.11, I^2 = 54%). Compared with the control group, meta-analysis showed that DT had no significance for improving global cognitive function (WMD = 1.30, 95% CI: −0.32 to 2.93, P = 0.12) (Fig. 3). A sensitivity analysis was conducted by removing individual article one by one. After removing one trial by Mckee [31], we found that DT was superior to the control on the global cognitive function (WMD = 2.02, 95% CI:0.65 to 3.38, P = 0.004), with heterogeneity of 7% (p = 0.30).

4.2. Executive function

4 of 7 included RCTs with 111 patients measured executive function using FAB [29,33] and MoCA [31,34]. Data synthesis was performed according to the test being used. Two studies [29,33] were pooled for FAB with a statistically significant effect in favor of DT for improving executive function (WMD = 1.17, 95% CI:0.39 to 1.95, P = 0.003; I^2 = 0%, P = 0.45) (Fig. 4). Two studies [31,34] measured executive function using MoCA. However only one study by Romenets [34] reported the specific data on executive function and no significant improvements were observed between the DT and the control groups.

4.3. Depression

Depression was measured in 5 of 7 included RCTs with 136 patients using the SDS [29] and BDI [30,32,34,35]. Four studies [30,32,34,35] used BDI were pooled to evaluate the effects of DT with no significant improvements on depression in favor of group exposed to dance classes (WMD = −0.39, 95% CI: 4.10 to 3.31, P = 0.84; I^2 = 78%, P = 0.004) (Fig. 5). Sensitivity analyses were done to explore potential sources of heterogeneity. On exclusion of one study by Michels [32], a significant result was found between group in favor of DT compared with the control group (WMD = −2.24, 95% CI: 3.63 to −0.86, P = 0.002), with heterogeneity of 23% (p = 0.27). Hiroko [29] also reported the effect on depression using SDS and a significant trend towards improvements were also observed between the groups.

4.4. Apathy

2 of 7 included RCTs examined the effect of DT on apathy using AS [29,34]. WMD and a fixed- effect model were used in pooling the data due to a moderate heterogeneity (P = 0.16, I^2 = 50%). The overall results of meta-analyses with 62 individuals showed no significant

Table 1
Study Characteristics. T: treatment; C: control; M: male; F: female; NA: not available; MoCA: Montreal Cognitive Assessment; FAB: Frontal Assessment Battery; TMT A&B: Trail Making Test A &B; SDS: Self-rating Depression Scale; AS: Apathy Scale; DT: Dance Therapy; NDT: Neurodevelopment Treatment; FES: Functional Electrical Stimulation; BDI: Beck Depression Inventory.

Author/Year	Mean age,years	Duration of disease, years	Hoehn-Yahr	No. T/C	Sex M/F	Intervention	Frequency and duration of DT	Setting	Outcomes/Measure
De Natale ER/2017	T:66.0 ± 9.15 C:70.0 ± 3.16	T: 6.0 ± 2.07 C: 6.33 ± 2.25	T: 6.33 ± 2.25 C: 2.6 ± 0.6	9/7	T:7/2 C:4/3	T: Tango C: Traditional rehabilitation	60 min/day, 2 times/week, 10 weeks	Italy	Executive function: FAB; TMT A&B; Stroop Test
Hiroko H/2015	T:67.9 ± 7.0 C:69.7 ± 4.0	T: 6.3 ± 4.6 G: 6.9 ± 4.0	NA	15/14	T:3/12 C:7/7	T: Aerobic, jazz, tango and classical ballet C: Conventional therapy	60 min/day, 1 time/week, 12 weeks	Japan	Executive function: FAB; Depression: SDS Apathy: AS
Lee NY/2014	T:68.4 ± 2.9 C:70.1 ± 3.3	NA	NA	10/10	T:5/5 C:5/5	T: Virtual reality dance exercise + NDT + FES C: NDT + FES	30 min/day, 5 times/week, 6 weeks	Korea	Depression: BDI
Lee HJ/2017	T:65.8 ± 7.2 C:65.7 ± 6.4	NA	NA	25/16	T:10/15 C:7/9	T: Turo dance C: Conventional therapy	60 min/day, 2 times/week, 8 weeks	Korea	Depression: BDI
Mckee KE/2013	T:68.4 ± 7.5 C:74.4 ± 6.5	T: 7.0 ± 5.5 C: 7.2 ± 4.9	NA	24/9	T:12/12 C:8/1	T: Tango C: Health education	90 min/day, 2 times/week, 10 weeks	UK	Global cognitive function: MoCA Executive function: MoCA
Michels K /2018	T:66.4 C:75.5	NA	T: 2.11 ± 0.33 C:2.5 ± 1.00	9/4	NA	T: DT C: Health education	60 min/day, 2 time/week, 10 weeks	USA	Global cognitive function: MoCA Depression: BDI
Romenets SR/2015	T:63.2 ± 9.9 C:64.3 ± 8.1	T: 5.5 ± 4.4 C: 7.7 ± 4.6	NA	18/15	T:12/6 C:7/8	T: Tango C: Self-directed exercise	60 min/day, 2 times/week, 12 weeks	Canada	Global cognitive function: MoCA Executive function: MoCA Depression: BDI Apathy: AS

Fig. 2. Risk of bias summary.

improvements in AS scores (WMD = 0.07, 95% CI: 2.55 to 2.69, P = 0.96) (Fig. 6).

5. Discussion

To the best of our knowledge, this is the first systematic review evaluating the effect of DT on cognitive and mood symptoms in individuals with PD. Seven trials that included 185 patients were identified. Evidence showed that dance can improve executive function but had no significant effects on global cognitive function, depression and apathy.

Prior systematic reviews have demonstrated that dance can induce better responses in motor symptoms and in functional mobility for individuals with PD [36,37]. There is also growing evidence that dance can also potentially improve non-motor symptoms, including cognitive and emotional deficits, in PD [38]. Cognitive deficits occur in the disease progresses of PD, and prevalence rates of mild cognitive impairment in PD range from 18.9% to 55% [39,40]. Dance have been considered as an alternative therapy and shown potential mechanisms by reducing the impact of neuroinflammation on cognition function improvements among PD patients [38]. Calvo-merino explained dance could stimulate the brain plasticity through neurotrophines, which could further facilitate changes in cognitive behavior [41]. Rochester thought dance with music rhythm provides an auditory cue to engage cortical control of movement, which might potentially improve cognitive defect [42]. However, the cognitive effect of DT was only found in executive function but not global cognitive function in our meta-analysis. One reason for this might be the limited number of trials were pooled to evaluate global cognitive function as an outcome. The combined effect sizes of global cognitive function were based on only three trials. Prior studies also have observed music with dancing may

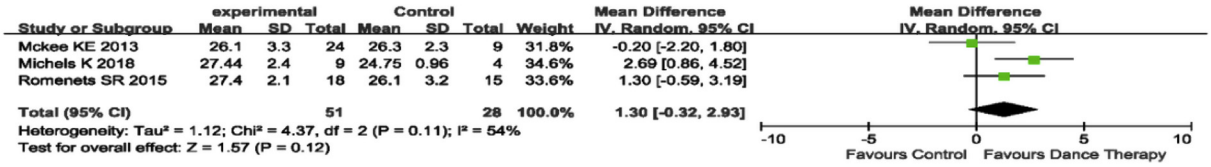

Fig. 3. Forest plot for dance therapy on global cognition function.

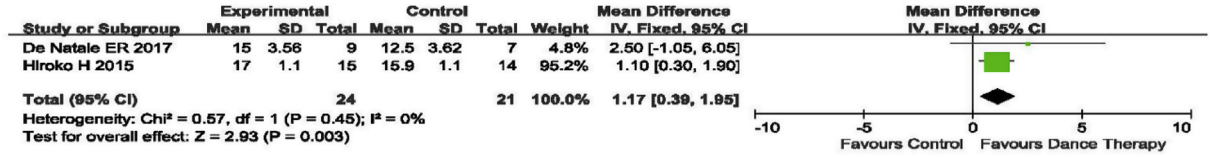

Fig. 4. Forest plot for dance therapy on executive function.

modulate emotional processes, reducing negative mood state after participation in group dance classes [43]. To our surprise, our results revealed that neither depression nor apathy levels were not significant improved in our meta-analysis, which differs from the results of Hashimoto who reported depressive symptoms of PD improved more with dance than with no intervention [44]. This may potentially be due to the difficulties related to controlling for some methodological and sampling biases and the short follow-up periods. The trials included in our meta-analysis all provided data for short-term interventions that did not exceed 12 weeks.

Significant heterogeneity was found on global cognitive function and depression outcomes. However, when we conducted sensitivity analysis by omitting each trial one by one, heterogeneity was significantly reduced and statistically significant differences were observed on these outcomes. It is indicated that the evidence of the effect of DT is not robust based on current meta-analysis and more high-quality RCTs is needed to draw definite conclusions.

Included trials in our meta-analysis are all RCTs, which are the gold standard of research on the effectiveness of interventions. Nevertheless, several important limitations of our meta-analysis should not be ignored. First, sample size of our meta-analysis was very small; the smallest sample size was only 13. Small total sample size between studies impacted the quality of the body of evidence. Studies with larger sample size are necessary to draw definite in the future. Second, the high heterogeneity identified between included studies (dance therapy programs, duration of disease, Hoehn-Yahr stage, sex and age etc.) made it impossible to reach a confirm evidence on the effects of DT. In addition, subgroup analysis was not performed due to the limited number of included studies. Third, most included studies showed poor methodological quality based on the Cochrane Collaboration Risk of Bias Tool. For example, two studies [31,33] did not reported the sequence generation in their experimental procedures. These studies stated only that “participants were randomized”, which may confound the final results. Moreover, only three studies [30,31,34] used intention-to-treat approach, which may affect the attrition bias in our review. Therefore, the finial effects should be carefully analyzed. Fourth, owing to insufficient number of trials included in each outcome, publication bias was not assessed. These limitations may have affected the relationship observed between the DT and improvements in the evaluated outcomes.

Global measures of cognition were all measured by MoCA in the included studies and it was originally developed as a screening tool for mild cognitive impairment. In Gill’ study [45], MoCA have also verified its good psychometric properties to measure the global cognitive function in PD patients. The instruments measured executive function in our review includes the FAB and MoCA. Bezdicek [46] have confirmed that FAB has high discriminative validity and proposed this instrument for its high classification accuracy as the new screening measure for PD patients. Additionally, two study used the MoCA to assess the executive function in PD. Depression levels were measured by SDS and BDI, which were both shown to be optimal instruments for screening depression in patients with PD [47,48]. Outcome on apathy of PD was measured with AS, which has been validated for use in PD patients [49]. We should note the fact that executive function and depression were not examined in an identical measure in the eligible studies. In addition, most studies measuring cognitive and mood outcomes employed a single cognitive test; a self-reported questionnaire or general measures of cognition. All of which made it challenging for comparing study outcomes. Hence, we recommend that future studies select a standard measure of outcomes and which will provide a broader and wider perspective to reflect meaningful clinical improvements of DT on cognitive and psychological outcomes in PD patients.

Although the effects of DT on global cognitive function, depression and apathy are still unclear, we believe it is rather obvious that DT is very promising as a replacement therapy for PD in clinical practice. In the future, RCTs of dance for PD patients should adhere to accepted standards of trial methodology and be larger than those already conducted. Investigations should explore the most appropriated type, time and number of sessions per week to reach the best therapeutical effect of dance and track outcomes for those with PD over the long term.

6. Conclusion

In conclusion, our results suggested that DT may not significant improve global cognitive function, depression and apathy outcomes of PD, while significant improvements in executive function were observed after dance. However, there was insufficient data to fully confirm the effect of DT on cognitive and mood symptoms, and the results should be interpreted with some caution. Well-designed studies with larger sample size and clear reporting standards are necessary to draw

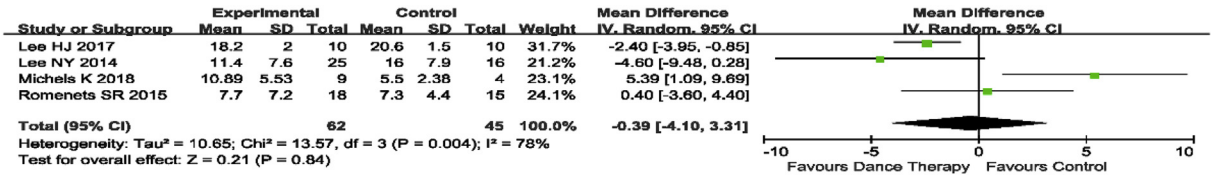

Fig. 5. Forest plot for dance therapy on depression.

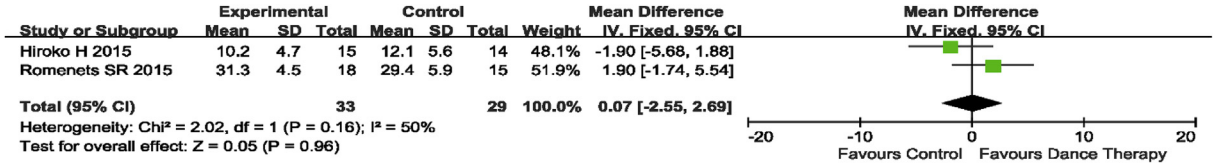

Fig. 6. Forest plot for dance therapy on apathy.

definite conclusions of dance on cognitive and mood symptoms in individuals with PD.

Potential conflict of interests

There is no conflict of interests regarding the publication of this paper.

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Disclosure statement

The authors have nothing to disclose.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ctcp.2019.04.005.

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