



Original Article

## Effects of Resistance Exercise with Instability on Concerns about Falling and Depressive Symptoms in Cognitively Impaired Older Adults

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### SUMMARY

**Objective:** To explore the effects of 12-weeks of resistance exercise with instability (REI) and traditional resistance exercise (RE) as compared to a health education control (CON) on concerns about falling and depressive symptoms in older adults with self-reported cognitive complaints.

**Methods:** In this secondary analysis, 67 participants (aged between 65–88 years; 77% women) were randomized to either 12-weeks of thrice-weekly REI (n = 22) or RE (n = 23), or a once-weekly CON (n = 22) group. At each training session, RE and REI participants performed three sets and repetitions ranging between 10–15. REI group performed each exercise using instability devices. We measured falls self-efficacy index (FESI) and geriatric depression scale (GDS-15) at baseline and 12 weeks.

**Results:** Participants showed moderate levels of concerns about falling (mean = 26.3 ± 2.2) and no signs of depressive symptoms (mean = 2.6 ± 8.4) at baseline. At completion of trial, REI participants had fewer concerns about falls (-3.19, 95% CI: [-6.33; -0.05]). There were no changes in FESI for RE participants compared to CON (-0.89, 95% CI: [-3.99; 2.21]). Non-significant between-group differences were observed for mood after traditional RE and REI relative to the CON.

**Conclusion:** In older adults with cognitive complaints, 12-weeks of REI reduced concerns about falling but did not change depressive symptoms.

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## 1. Introduction

Cognitively impaired older adults are 74% more likely to have concerns of falling,<sup>1</sup> 70% more likely to have a fall each year,<sup>2</sup> and are 32% more likely to experience mood issues such as depression.<sup>3</sup> Falls represent a serious problem for older adults and are associated with frailty phenotype, disability, and a higher financial burden to the healthcare system.<sup>4</sup> Concerns about falling are also associated with being a faller.<sup>5</sup> Approximately 60% of fallers report some level of concern about falling, and half of older adults who have no falls history are still concerned about falling.<sup>1,6</sup> Yet, older individuals who have mild cognitive impairment (MCI) and depression symptoms are 28% more prone to dementia progression which may potentially have negative influence on overall health and quality of life.<sup>7</sup>

Falling and mood issues are markedly related among older adults.<sup>8</sup> For instance, among older adults who fall, approximately half develop concerns about falling and one quarter will potentially restrict their daily living activities.<sup>9</sup> Consequently, those with more

concerns of falling are more likely to experience functional decline, social isolation, and symptoms and diagnosis of depression and other psychiatric disorders which promote a negative impact on health-related quality of life.<sup>6,10</sup> Therefore, preventive interventions aiming to reduce psychological factors associated with falls risk and depressive symptoms are need for cognitively impaired individuals.

One strategy for reducing concerns about falling and promoting mood is exercise training.<sup>11,12</sup> The literature has provided evidence regarding exercise training as an adjuvant therapy to reduce fall risk (including mitigate concerns about falls),<sup>13</sup> decrease the risk of being an injurious faller.<sup>14</sup> Exercise is also consistently recommended as an effective therapy for treat mood disorders.<sup>15</sup> Resistance exercise (RE) is characterized by lifted weights using machine-based and/or free-weights aiming to promote strengthening muscles and bones – which can improve these outcomes.<sup>16</sup> RE training can reduce falls risk by 57% and improve balance in older adults.<sup>17</sup> A systematic review<sup>18</sup> found a significant association between RE training and reduction of depressive symptoms in individuals with and without established chronic diseases.

Multimodal interventions may have additional benefits on promoting mood and reducing falls risk. Sherrington et al.<sup>19</sup> found that multicomponent strategies focusing on the arrangement of tradi-

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tional RE with balance exercise reduce falls by 30% in older people who live independently in the community. In fact, Liu-Ambrose et al.<sup>20</sup> demonstrated that a home-based strength and balance retraining exercise program significantly reduced the rate of subsequent falls compared with usual care. Exercise also reduces concerns about falling but in a limited extent (small-to-moderate effect) and, thus, further clinical trials are required.<sup>13</sup> Supervised and remotely administrated progressive RE with balance retraining has anti-depressive effects in older adults by upregulating biomarker and neurotransmitter release associated with processes of neurogenesis, angiogenesis, and neuroplasticity.<sup>21–23</sup> In light of these findings, a novel approach combining moderate-intensity resistance exercise training with instability devices or uneven surfaces (i.e., resistance exercise with instability [REI]) has been proposed to promote motor complexity and challenging dynamic balance of participants. REI is an effective modality to optimize physical function and neuropsychological outcomes in middle-aged and healthy older adults.<sup>24–26</sup>

Since cognitively impaired older adults are more likely to have negative psychological outcomes, we hypothesized that REI will reduce concerns about falling and improve mood.<sup>27,28</sup> Therefore, we performed a secondary analysis wherein the aim was to explore the effects of 12-weeks of REI and traditional RE compared with a health education control on concerns about falling and depressive symptoms in older adults with subjective cognitive complaints.

## 2. Material and methods

### 2.1. Study design, ethics, randomization, and sample size calculation

The randomized controlled trial was registered (RBR-4KQS22) and approved by the Research Ethics Committee. All participants provided written informed consent prior baseline assessment. A randomization list stratified by sex and age was generated remotely by an independent researcher. Sampling procedures has been described previously.<sup>29</sup> Briefly, the number of participants was calculated based on an 80% probability of detecting an effect size (Cohen's *d*) of 0.40,<sup>30</sup> an alpha of 5%. A sample of 66 participants was determined. Considering a dropout rate of 15%, the final sample was 75 participants.

### 2.2. Participants and eligibility criteria

We recruited community-dwelling older adults with subjective cognitive complaints (self-reported) and/or a Montreal Cognitive Assessment (MoCA) score lower than 26 points (out of 30) – a well-established cut-point used to classify participants with probable mild cognitive impairment.<sup>31</sup> Participants were eligible if they met the following criteria: a) aged 65 or older; b) were not engaged in structure exercise classes over the last three months; c) did not present clinical conditions or unstable disease (e.g., uncontrolled hypertension, angina pectoris signs) that contraindicates resistance exercise training; d) did not have previously diagnosed cardiovascular, neurological or psychiatric disease and e) had enough visual and hearing function to complete cognitive measures.

### 2.3. Interventions

#### 2.3.1. Traditional resistance exercise (RE) and RE with instability (REI)

Participants allocated in RE trained thrice-weekly for 12-weeks

on alternate days. The training program consisted of seven exercises performed at the same time of day (morning). Each exercise was performed for three sets and repetitions ranging from 10–15 repetition maximum (RM); abdominal exercises were performed for either 15–30 RM or 10–30 seconds of isometric contractions. The rest interval between the sets, in each exercise, ranged from 60 to 90 seconds, and between exercises from two to three minutes.

The REI group performed the same training program as the RE group, however, instability devices (e.g., balance discs) were introduced over the weekly training progression. The degree of postural instability in the exercises were augmented as the individual improved their balance and/or muscle strength quickly.<sup>32</sup>

In both exercise groups, the first week of training was characterized by minimal load in free-weight and machines; during this period the focus was on exercise learning and safety (familiarization). The training progression and load adjustment of exercise groups followed the ACSM<sup>33</sup> recommendations and both exercise sessions were supervised and delivered by trained therapists.

#### 2.3.2. Health education control group (CON)

Participants in the CON group received weekly health education seminars including lectures on prevention and treatment of health-related issues, maintenance of healthy behaviors (e.g., physical activity), or stretching and relaxation classes.

### 2.4. Descriptive measures

The general characteristics of participants including age, sex, education level, and clinical history were obtained. We measured body mass (kg) and stature (meters) to compute the body mass index (kg/m<sup>2</sup>). The instrumental and basic activities of daily living were measured using the self-reported Lawton-Brody<sup>34</sup> and Katz<sup>35</sup> scales, respectively. We also assessed the global cognitive status through the Brazilian version of MoCA.<sup>31</sup>

### 2.5. Outcomes

#### 2.5.1. Concerns about falling

The validated and translated version of Falls Efficacy Scale-International (FESI)<sup>36</sup> was used to measure the concerns about falling. This scale encompasses questions about the different concerns during 16 activities such as “house cleaning”, “taking a shower”, “walking under uneven ground surfaces” and others. Each question had scores ranging from one to four ('1' = not at all concerned; '4' = high concern). We used the sum of scores in each question to compute an overall measure of concern about falling that range from 16 (without concern) to 64 (extreme concern).

#### 2.5.2. Depressive symptoms

The short version of the Geriatric Depression Scale (GDS-15)<sup>37</sup> was used to measure depression symptoms. The GDS-15 is a valid and reliable<sup>38</sup> 15-item screening tool with wide application in several settings such as community, acute and long-term care. Participants were asked to describe the presence of depressive symptoms is defined from five or more symptoms in the 15-items. In the present study, we used the GDS score as a continuous measure (higher values indicating more symptoms).

In this study, both outcome data were gathered by a well-trained assessor. Given that both GDS-15 and FESI are classified as Patient-Reported Outcome Measures (PROMs), it was not possible blind the participants and assessors.

## 2.6. Statistical analysis

All statistical analyses were conducted in R version 3.5.1 and followed the intention-to-treat principle. To address missing data at each time point, multiple imputation was performed in the *mice* 2.46.0 package using predicted mean matching, and visually checked for convergence of the imputation model (The R Codes are detailed in Supplementary Material 1).

Treatment effects were evaluated on the imputed data sets and between-group differences in outcomes were evaluated using analysis of covariance, wherein we controlled for baseline values of each outcome, age, and baseline global cognitive function. Significance was set at  $p < 0.05$ . Estimated marginal means, within group differences from baseline, and between group differences at 12-weeks follow-up were calculated. Statistical estimates were pooled over the 40 imputed data sets using the Barnard-Rubin procedure.<sup>39</sup> Given this was an exploratory secondary analysis, we only computed contrasts to examined mean differences between exercise-based treatments versus control.

## 3. Results

A total of 167 participants underwent an initial screening and 94 were excluded because they did not meet inclusion criteria. From 78 who attended the eligibility criteria, six were excluded and, after complete baseline assessments, 22 participants were randomized to REI, 23 to RE and 22 to CON group. During follow-up, 13 participants dropped out and the main reason included lack of interest ( $n = 9$ ) and time ( $n = 2$ ) to attend the intervention protocol who were originally assigned.

Participants' characteristics according to treatment assignment are presented in Table 1. Among each group, there were a higher

**Table 1**  
Baseline characteristics of participants according to allocation group ( $n = 67$ ).

Variables	REI ( $n = 22$ )	RT ( $n = 23$ )	CON ( $n = 22$ )
Sex (no., % women)	17 (77)	18 (78)	17 (77)
Age (years)	71 (6)	71 (6)	71 (4)
BMI ( $\text{kg}/\text{m}^2$ )	27.1 (5.4)	28.4 (3.9)	28.9 (5.6)
Lawton & Brody	26.1 (1.5)	26.5 (0.8)	26.3 (1.0)
Katz	0.1 (0.4)	0.3 (0.5)	0.1 (0.3)
MoCA	19.1 (4.4)	20.0 (4.4)	18.7 (4.7)
GDS	2.3 (2.0)	3.3 (2.5)	2.3 (1.9)
FESI	26.8 (10.1)	28.4 (7.8)	23.6 (6.6)

BMI, body mass index; FESI, Brazilian version of Falls Efficacy Scale International; GDS, geriatric depression scale; MoCA, Montreal Cognitive Assessment.

Data are presented as mean (SD) or absolute (%) values.

**Table 2**

Treatment effects of REI and traditional RT (estimated mean change from baseline; between-group differences) on outcomes.

	Mean (SD)		Mean +/- SE	Between-group differences				
	Baseline	Follow-up		Adjusted <sup>†</sup> follow-up	Adjusted mean difference (95% CI) <sup>†</sup>	p-value	REI – CON	p-value
FESI (concerns about falling)								
CON ( $n = 22$ )	23.6 (6.6)	25.5 (6.5)	26.8 +/- 1.3	-0.89 (-3.99; 2.21)	0.566	<b>-3.19 (-6.33; -0.05)</b>	<b>0.046</b>	
RT ( $n = 23$ )	28.4 (7.8)	27.0 (6.6)	25.9 +/- 1.2	...	...	...	...	
REI ( $n = 22$ )	26.8 (10.1)	24.4 (7.0)	23.6 +/- 1.2	...	...	...	...	
GDS-15 (depression symptoms)								
CON ( $n = 22$ )	2.3 (2.0)	2.0 (1.7)	2.1 +/- 0.3	-0.01 (-0.81; 0.80)	0.989	-0.29 (-1.10; 0.51)	0.469	
RT ( $n = 23$ )	3.3 (2.5)	2.3 (2.1)	2.1 +/- 0.3	...	...	...	...	
REI ( $n = 22$ )	2.3 (1.9)	1.7 (1.7)	1.8 +/- 0.3	...	...	...	...	

Covariates included age, global cognitive function (baseline MoCA scores) and baseline values for each outcome of interest (GDS-15 and FESI).

prevalence of women (77%), and the mean of age was 71 years. Additionally, they were overweight (mean BMI  $> 25 \text{ kg}/\text{m}^2$ ), cognitively impaired (mean MoCA  $< 20$  points) with minimal restrictions in instrumental and daily living activities. Participants showed moderate levels of concerns about falling and no signs of depressive symptoms at baseline.

Table 2 illustrates the treatment effects of REI and traditional RE on participants' concerns about falling and depression symptoms.

Participants assigned to REI experienced greater decrease on FESI scores compared to CON (-3.19, 95% CI: [-6.33; -0.05]) after 12-weeks of intervention. However, non-significant results were observed for traditional RE on concerns about falling relatively CON (-0.89, 95% CI: [-3.99; 2.21]). Compared with CON, no significant between-group differences were observed for the GDS-15 scores after trial completion in both REI (adjusted mean differences: -0.29, 95% CI: [-1.10; 0.51]) and traditional RE (-0.01, 95% CI: [-0.81; 0.80]).

## 4. Discussion

Our results indicate that 12-weeks of REI reduced concerns about falling compared with the CON group in older adults with subjective cognitive complaints. However, we did not find that either RE or REI improved depressive symptomology compared with CON.

Individuals that experience declines in their physical and cognitive capabilities are more worried about falls.<sup>6,10</sup> Combining activities that simultaneously challenge muscular strength and balance are effective to promote intrinsic capacity which may lead improvements in the level of confidence to perform daily living activities.<sup>40</sup> Here, we observed a significant reduction in concerns about falling among participants allocated to the REI group compared with CON. Previous work by our group determined that REI reduced fear of falls following 24-weeks in healthy older adults (-4 points).<sup>26</sup> Older adults with Parkinson's disease have reduced concerns about falling after 12-weeks of REI (-3 points), although these changes did not differ from the control group.<sup>41</sup> Altogether, these results suggest that adding complexity to traditional RE training may be a promising strategy to optimize the effects of exercise on psychological fall-related variables in older individuals at initial stages of cognitive impairment.

We did not find that 12 weeks of RE reduced concerns about falls. One plausible explanation is that there was a low requirement of balance during traditional RE compared to REI. Previous studies showed that balance performance is related with less concerns about falling<sup>42</sup> and strategies that combine functional exercise and balance are promising to ameliorate fall risk and potentially reduce fear/concerns about falling.<sup>40</sup> We suggest that future trials be large enough to compare the effects of RE with REI.

Interestingly, we did not find that either REI or RE reduced de-

pressive symptoms compared to CON. Strong evidence indicates that exercise in older adults has a protective effect on neuropsychological outcomes including mood, anxiety and cognitive function.<sup>21</sup> A meta-analysis by Gordon et al. showed moderate-sized benefits on depression-related outcomes after a RE training program among older adults and patients with diagnosis of psychiatric disorders such as major depression.<sup>18</sup> Our sample did not show signs of depressive symptoms at baseline and was not diagnosed with any psychiatric disorder. Hence, it is possible that the effects of exercise on mood are less potent in people without depressive symptoms. Future trials should explore the effects of training on depressive symptoms in older adults with MCI and depression. This approach will clarify the clinical significance of this type of multimodal intervention on mood.

This work has limitations. Since we performed a secondary analysis, further studies are necessary to confirm our current findings. Participants were screened using self-reported cognitive complaints and MoCA scores. Despite these two screening strategies amplify the external validity of our trial, the absence of further clinical cognitive evaluation may have enrolled non-MCI or dementia patients. We were powered to detect an effect size of 0.40; however, the effect of REI and RE on depressive symptoms may be more modest and thus would require a larger sample. Our small sample size and participant's characteristics hindered the evaluation of potential moderator effects (e.g., sex differences). We analyzed the effects of exercise on 'symptoms' of depression; therefore, generalizations of our results to patients with depression should be done with caution. Lastly, we did not measure trait anxiety in our study.<sup>28</sup>

## 5. Conclusion

Moderate-intensity REI reduces overall concern about falling but does not promote changes in depressive symptoms among older adults with subjective cognitive impairment. Prescribing added complexity to traditional RE is a promising strategy to reduce concerns about falls.

## Conflict of interests

None.

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## Supplementary Materials

Supplementary materials for this article can be found at <http://www.sgecm.org.tw/ijge/journal/view.asp?id=21>.

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