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Original Article

Resistance training with and without instability does not improve overall levels of intrinsic capacity in older adults with cognitive complaints

Treinamento de força com e sem instabilidade não melhora os níveis gerais de capacidade intrínseca em idosos com queixas cognitivas

Bruno Remígio Cavalcante[1]
Mariana Ferreira de Souza[2]
Dayane Tays da Silva[3]
Gabriel de Amorim Batista[4]
Vinícius Yan Santos Nascimento[5]
Rodrigo Cappato de Araújo[6]

[1,4,5]Universidade de Pernambuco (Petrolina). Pernambuco, Brazil. br_13remigio@hotmail.com, gabriel_amorimbatista@hotmail.com, viniciusyan@hotmail.com
[2,3]Universidade Federal do Vale do São Francisco (Petrolina). Pernambuco, Brazil. mariana.ferreirasouza@univasf.edu.br, dayannethais2017@gmail.com
[6]Corresponding author. Universidade de Pernambuco (Petrolina), Pernambuco, Brazil. rodrigo.cappato@upe.br

ABSTRACT | INTRODUCTION: Intrinsic capacity (IC) is a construct that encompasses physical and mental capacities important for self-care and healthy aging. Understanding the potential role of resistance training with and without instability to promote IC needs to be clarified. **OBJECTIVE:** To assess the impact of resistance training on intrinsic capacity levels in older adults with cognitive complaints. **METHODS:** Older adults with cognitive complaints (n=67) were randomly assigned to either 12 weeks of traditional RE (n=23), RE with instability devices (REI) (n=22), or control (n=22). Both training groups performed three sets of 10-15 repetitions. REI group performed each exercise using instability devices. The control group received weekly health education classes. IC domains were analyzed using mobility and gait velocity (locomotor), global and executive functioning (cognitive), grip strength and six-minute walking test (vitality), and depressive symptoms and self-efficacy (psychological) through z-composite scores. We computed global levels of IC by the sum of each composite score. **RESULTS:** A significant within-group difference (improvement) in overall levels of IC (ΔREI = +1.69, ΔRE = +1.30) and all their domains (Locomotion: ΔREI = +2.32, ΔRE = +3.21; Cognition: ΔREI = +2.31; Vitality: ΔREI = +1.23, ΔRE = +1.42; and Psychological: ΔREI = -0.65, ΔRE = -0.62). However, no between-group differences were observed at the completion of the trial. Sensitivity analysis merging training groups revealed a between-group difference for the locomotor domain (+1.97, p=0.045). **CONCLUSION:** Resistance training with and without instability devices did not improve IC levels among older adults with cognitive complaints.

KEYWORDS: Aging. Exercise. Resistance Training. Cognitive Dysfunction. Randomized Controlled Trial.

RESUMO | INTRODUÇÃO: Capacidade intrínseca (CI) é um construto que engloba capacidades físicas e mentais para o autocuidado e envelhecimento saudável. A compreensão do papel potencial do treinamento resistido, com e sem instabilidade, para promover o CI precisa ser esclarecida. **OBJETIVO:** Avaliar o impacto do treinamento de força sobre os níveis de capacidade intrínseca em idosos com queixas cognitivas. **MÉTODOS:** Idosos com queixas cognitivas (n=67) foram aleatoriamente designados para 12 semanas de TF tradicional (n=23), TF com dispositivos de instabilidade (TFI) (n=22) ou controle (n=22). Ambos os grupos de treinamento realizaram três séries de 10-15 repetições. O grupo TFI realizou exercícios utilizando dispositivos de instabilidade. O grupo controle recebeu aulas semanais de educação em saúde. Os domínios da CI foram de mobilidade e velocidade da marcha (locomotora), função global e executiva (cognitivo), força de preensão e teste de caminhada de seis minutos (vitalidade), e sintomas depressivos e autoeficácia (psicológicos) por meio de escores-z compostos. Calculamos os níveis globais de CI pela soma de cada pontuação composta. **RESULTADOS:** Diferença significativa intragrupo nos níveis gerais de CI (ΔTFI = +1.69, ΔTF = +1.30) e seus respectivos domínios (Locomoção: ΔTFI = +2.32, ΔTF = +3.21; Cognição: ΔTFI = +2.31; Vitalidade: ΔTFI = +1.23, ΔTF = +1.42; e Psicológico: ΔTFI = -0.65, ΔTF = -0.62). Contudo, não houve diferenças entre os grupos. Análise de sensibilidade mesclando os grupos de treinamento revelou diferença significativa para o domínio locomotor após 12 semanas (+1.97, p=0.045). **CONCLUSÃO:** Treinamento de força com e sem dispositivos de instabilidade não melhorou os níveis de CI em idosos com queixas cognitivas.

PALAVRAS-CHAVE: Envelhecimento. Exercício. Treinamento de Força. Disfunção Cognitiva. Ensaio Clínico Controlado Aleatório.

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Introduction

The contemporary "Healthy Aging" model coined by the World Health Organization (WHO) is now centered on a functioning-based approach rather than a disease paradigm.[1] In this healthcare model perspective, the concept of intrinsic capacity (IC) – a construct which encompasses 'all the physical and mental capacities' – is considered a cornerstone of healthy aging and may be captured through five domains as such: locomotion, vitality, cognition, psychological and sensory.[2] A previous study by Beard et al.[3] examined the validity of the IC construct in the English Longitudinal Study of Aging (ELSA) and showed valuable predictive data when analyzing an individual's subsequent functioning. Therefore, implementing the IC as a broad outcome in clinical trials may be useful in identifying tailored strategies that effectively promote self-care and successful aging.

Previous studies have analyzed the impact of non-pharmacological therapies for mitigating the functional and cognitive decline in older individuals living independently in the community.[4,5] Resistance Exercise (RE) training has been highlighted as an attractive intervention for older people due to its benefits for maintaining or even reestablishing part of the resilience of multisystem performance measures (e.g., motor, balance, cognition) lost during aging.[6-8] The beneficial effects of different types of RE (e.g., traditional machine-based, free-weights, power training) on health-related outcomes[7] encompass the construct of IC, such as walking capacity, muscle strength, executive functioning, and other psychological factors.[4] To the best of our knowledge, only one study has empirically examined the impact of RE training on overall IC levels. In this work, Huang et al.[9] compared whether self-paced aerobic exercise (AE), RE, and combined (AE+RE) training delivered at home would promote general health through IC assessment in 415 community-dwelling older adults with subjective memory complaints. The overall results showed an improvement in IC (composite scores) after a 26-week intervention of both protocols compared with a group who received health lectures, suggesting a potential benefit of exercise training on IC levels.

Our group has explored the preventive and therapeutic effects of resistance exercise with instability (REI) – an exercise strategy which simultaneously combines low-to-moderate intensity RE with dynamic balance through using unstable devices or surfaces aiming to provide higher attentional and motor challenge during the exercise.[10,11] We have found that REI is able to promote significant benefits in functional mobility, psychological and cognitive health variables among healthy older people and individuals with signs of neurodegeneration.[10-12] Recently, we also observed that compared with traditional RE, REI promoted better outcomes in global cognition and memory in older adults with cognitive complaints.[11]

IC construct involves several domains by which exercise training may have a significant impact. Considering that traditional RE and REI might promote different adaptations in several domains that are closely related to the global IC construct and its subdomains – e.g., REI might be more effective in promoting significant changes in mental and cognitive outcomes due to higher neuromotor complexity) –, it is reasonable that such training regimes would promote different effects on global and subdomains levels of IC. To our best knowledge, no study has examined the impact of REI and traditional RE on IC.

Therefore, we performed a non-prespecified secondary analysis to assess the impact of resistance training with and without instability on global levels of intrinsic capacity and their respective domains in older adults with cognitive complaints. To do so, we explored data from an REI study[11], a proof-of-concept randomized clinical trial which examined the effects of 12 weeks of REI or traditional RE alone compared with a health education control group on cognitive functioning in cognitively impaired older adults.

Methods

Study design

This study is a secondary analysis of a randomized controlled trial. The study was approved by the University of Pernambuco Research Ethics Board (Protocol CAAE: 81016817.7.0000.5207) and registered in the Brazilian Clinical Trials Platform under protocol (RBR-4kqs22). All participants provided written informed consent prior to baseline assessment. A detailed description of procedures has been previously described[13], and we are reporting findings according to the Consolidated Standards of Reporting Trials (CONSORT) guidelines.[14]

Participants

We recruited community-dwelling older adults with self-reported subjective cognitive complaints (Have you been experiencing cognitive complaints over the past year, such as spontaneous memory loss or attention issues in performing daily living activities?) and/or a Montreal Cognitive Assessment (MoCA) <26 points (out of 30).[15] Inclusion criteria were a) aged 65 or older; b) not engaged in structured exercise classes over the last three months; and c) did not present clinical manifestations (i.e. uncontrolled hypertension) precluding resistance training programs. We excluded those who were diagnosed with cardiovascular, neurological, or psychiatric disease and those who had substantial visual and hearing impairment that made it unfeasible to appropriately capture cognitive measures.

Timeline and interventions

All interventions were conducted in a gym facility from August 27 to November 23, 2018. The therapists underwent a training workshop before the beginning of the study to perform more reliable interventions in both the exercise and control groups.

Training groups

The detailed exercise prescription for the training protocols (RE and REI) was previously described.[11] Briefly, both interventions were delivered thrice weekly during a 12-weeks period. They comprised seven whole-body resistance training exercises which were structured in three sets of 10-15 maximum repetition (RM) (except for abdominal exercises that were performed for either 15-30 RM or 10-30 seconds of isometric contractions). Participants assigned to REI intervention performed the same training program as the RE group in the first month, and then, uneven surfaces and instability devices (e.g., balance pads) were individualized and progressively introduced over the weekly training. The increase in the degree of "instability" was defined "as the individual improved their balance and/or muscle strength quickly".[10]

Health education control group (CON)

Participants in the CON group received weekly health education seminars, including group-based lectures on the prevention and treatment of health-related issues (i.e., cognitive impairment and dementia), maintenance of healthy behaviors (e.g., physical activity, nutrition, sleep), and stretching and relaxation classes (light intensity movements). Each meeting (a total of 12) was administered by research staff, and the duration was roughly 60 minutes.

Descriptive measures

The participants' characteristics, including age, sex, education level, and medical comorbidities, were obtained. We measured body mass (kg) and stature (meters) to compute the body mass index (kg/m^2). The instrumental and basic activities of daily living were assessed using self-report scales.[16,17] Overall cognitive status was measured through the Brazilian version of MoCA[15] – a simple set of cognitive tasks targeting multiple domains of cognitive function, such

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as visual-spatial/executive functions, including naming, memory, attention, language, abstraction, and orientation. The total score was obtained by the sum of each domain, ranging up to 30 points, in which a higher score means better overall cognitive performance.

Outcome – Intrinsic capacity

The overall IC levels were computed through the sum of z-scores (higher scores indicate better performance) which was created for each locomotor, cognition, vitality, and psychological domain as follows:

$$\text{Overall IC} = \frac{([(\text{z-locomotor})+(\text{z-cognition})+(\text{z-vitality})-(\text{z-psychological})])}{4}$$

The locomotor domain was measured by the sum of z-scores of Timed Up and Go (TUG)[18], Short Physical Performance Battery (SPPB)[19], gait velocity (GVT), and five times sit-to-stand test (STS).[20] The TUG is a measure of functional mobility and involves the time (in seconds) that the participant takes to get up from a chair, walk to a line at a 3-meters distance, walk around it, and return and sit back in the chair. The SPPB is a battery for evaluating overall mobility throughout five sub-tests, including the five times STS, usual 4-meter GVT, and three static balance postures.[19] The total SPPB score ranges from 0 (poor mobility) up to 12 (better mobility). The usual 4-meter GVT (in m/s) and five times STS (in seconds) were extracted from the SPPB as separate measures.

The cognitive domain was measured by the MoCA[15], verbal fluency (sum of words starting with F, A, and S + animal naming)[21], processing speed, and working memory (coding test, trail making test part B minus A, and Digit Span Forward minus Backward)[22], and immediate and delayed logical memory.[23] Each cognitive function test was converted to z-scores and then summed and divided by 8 (number of tests) to create a z-score for the cognitive IC domain.

The vitality domain was measured by the z-scores of the grip strength test[24] and the six-minute walking test (6MWT) measures.[25] The handgrip assessment was obtained by a hydraulic dynamometer with a scale ranging from 0 to 100 kg. The participant was familiarized (submaximal contraction) prior to the trials. Participants were asked to perform the maximal voluntary contraction for five seconds. Three attempts were performed with each hand, with a one-minute interval between them. The average of the three attempts was recorded, and a second average between hands was adopted as an outcome (higher values represent better muscle strength). For the 6MWT each participant was encouraged to "walk at their usual pace for six minutes and cover as much ground as possible" in a corridor.[25] Participants received standardized encouragement in the form of statements by the same evaluator. The maximum distance completed (in meters) at the end of six minutes was obtained as an outcome of cardiorespiratory capacity.

The psychological domain encompassed the sum of z-scores of the Geriatric Depression Scale (GDS-15)26 and the Fall Efficacy Scale Index (FESI) measures.[27] The GDS-15 is a 15-item scale that evaluates the participant's depressive symptomatology over the past week (higher values indicate more symptoms). The FESI comprehends a standard Likert scale that asks the level of concerns about falling during 16 daily living activities such as "house cleaning", "taking a shower", and "walking on uneven ground surfaces". 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 the overall levels of concern about falling, ranging from 16 (no concern) to 64 (extreme concern).

Sample size and statistical analysis plan

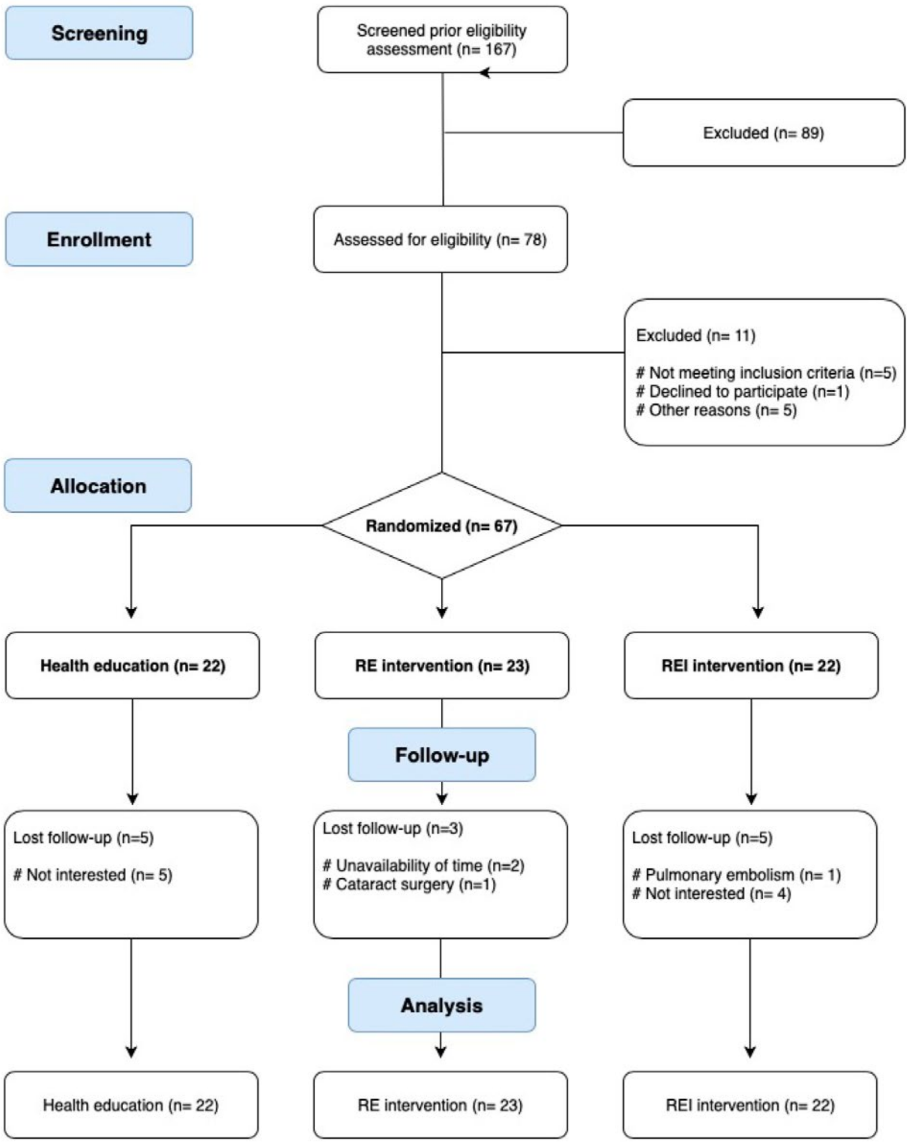
The estimated sample size was computed using the G*Power 3.1.9.2 software program (Universität Düsseldorf, Germany)[28] considering an ANOVA for repeated measures within-between interaction. The number of participants was calculated based on an 80% probability of detecting an effect size of 0.405 for the composite score of cognitive functioning (primary outcome), an alpha of 5%, and correlation of 0.5 between measures (baseline and follow-up). A sample of 66 participants was determined (22 per group). We estimated a dropout rate of 15% at follow-up, which provided a final sample size of 75 participants (n=25 by group).

All statistical analyses were conducted in SPSS version 25 for Mac OS X and followed the intention-to-treat principle. We conducted the Last Value Carried Forward (LVCF) imputation procedure to address missing data upon completing the study. Intervention effects were evaluated on the imputed data sets, and within- and between-group differences in IC levels and each domain were examined using Linear Mixed Models (LMM). Restricted Maximum Likelihood estimation was employed to include all randomized participants and to explore the treatment effects regardless of follow-up loss. Estimated marginal means, within-group differences from baseline, and between-group differences (e.g., REI vs. CON, RE vs. CON, REI vs. RE) at 12-week follow-up were calculated. Lastly, we performed a sensitivity analysis merging the training groups and compared them with health education control to explore the role of resistance training on IC composite scores and their domains. Significance was set at $p<0.05$ for all analyses.

Results

A total of 167 participants underwent an initial screening, and 94 were excluded because they did not meet the inclusion criteria. Of 78 who attended the eligibility criteria, six were excluded, and then 22 participants were randomized to the REI, 23 to RE, and 22 to the CON groups after completing baseline assessments. A total of 13 participants dropped out during follow-up, and the main reasons included lack of interest (n=9) and they did not have time (n=2) to attend the intervention protocol that was originally assigned (Figure 1).

Figure 1. Flow diagram of study



Source: The authors (2023).

Participants' characteristics according to treatment assignment are presented in Table 1. There was a higher prevalence of women (77%) among each group, and the mean age was 71 years (SD= 5). The participants were, on average, overweight (BMI, mean= 28.1, SD= 4.9) and had probable mild cognitive impairment (MoCA, mean= 19.2, SD= 4.4).

Table 1. Descriptive characteristics of older people by allocation group

Variables	REI (n=22)	RE (n=23)	Control (n=22)
Gender (no., % women)	17 (77)	18 (78)	17 (77)
Age (years)	71 (6)	71 (6)	71 (4)
Education (%)			
< 12	45	43	45
≥ 12	55	57	55
BMI (kg/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	18.8 (4.4)	20.0 (4.4)	18.7 (4.7)
Fall history in previous year (% yes)	33	35	10
Hypertension (% yes)	55	78	41
Osteoporosis (% yes)	18	22	22
Rheumatic diseases (% yes)	36	44	36

Legend: BMI - Body mass index; MoCA - Montreal Cognitive Assessment.
Data are presented as mean (SD) or absolute (%) values.
Source: The authors (2023).

The within- and between-group effects of treatment groups on IC outcomes are presented in Tables 2 and 3. Despite a significant within-group difference in overall levels of IC (ΔREI = +1.69, 95%CI = 1.20; 2.18, p<0.001, ΔRE = 1.30, 95%CI = 0.83; 1.77, p<0.001) and their respective domains (Locomotion: ΔREI = 2.32, 95%CI = 1.04;3.60, p<0.001, ΔRE = 3.21, 95%CI = 2.01;4.41, p<0.001; Cognition: ΔREI = +2.31, 95%CI = 1.47;3.16, p<0.001; Vitality: ΔREI = 1.23, 95%CI = 0.79;1.67, p<0.001, ΔRE = 1.42, 95%CI = 1.00;1.84, p<0.001; and Psychological: ΔREI = -0.65, 95%CI = -1.22;-0.07, p=0.028, ΔRE = -0.62, 95%CI = -1.17;-0.07, p=0.027) through 12-weeks intervention, no between-group differences were observed at the end of the trial for any IC outcomes.

Sensitivity analysis merging resistance training groups revealed similar within-group differences through the intervention (Table 4). However, the between-group analysis showed a significant difference in favor of the 'training' group for the locomotor domain of IC upon completion of 12 weeks of intervention (1.97, 95%CI = 0.05; 3.90, p=0.045).

Table 2. Descriptive data from baseline and trial completion; Within-group treatment effects on global levels of IC and each domain separately

Outcomes	Baseline		Final		Within-group effect			
	Mean	SD	Mean	SD	Δ change	95%CI		p-value
IC Composite Score¶								
REI	-0.61	1.88	1.08	2.28	1.69	1.20	2.18	<0.001
RE	-0.98	1.92	0.32	1.51	1.30	0.83	1.77	<0.001
HEALTH EDUCATION	-0.22	2.23	0.05	2.16	0.28	-0.20	0.75	0.246
IC domains								
Cognition¶								
REI	-1.02	4.72	1.54	5.75	2.31	1.47	3.16	<0.001
RE	-0.22	4.19	-0.29	4.52	0.12	-0.75	0.98	0.790
HEALTH EDUCATION	-0.73	5.34	-0.28	5.06	0.40	-0.45	1.24	0.356
Locomotion¶								
REI	-1.25	3.39	1.56	3.95	2.32	1.04	3.60	<0.001
RE	-1.71	4.34	1.36	3.31	3.21	2.01	4.41	<0.001
HEALTH EDUCATION	-0.64	3.16	-0.41	3.44	0.23	-1.09	1.55	0.730
Vitality¶								
REI	-0.65	1.68	0.77	1.81	1.23	0.79	1.67	<0.001
RE	-1.20	1.58	0.30	1.49	1.42	1.00	1.84	<0.001
HEALTH EDUCATION	0.13	1.68	0.52	1.67	0.38	-0.05	0.80	0.085
Psychological‡								
REI	0.18	1.94	-0.45	1.42	-0.65	-1.22	-0.07	0.028
RE	0.90	1.79	0.32	1.40	-0.62	-1.17	-0.07	0.027
HEALTH EDUCATION	-0.36	1.56	-0.38	1.16	-0.02	-0.59	0.55	0.941

IC - Intrinsic capacity; REI - Resistance Exercise with Instability; RE - Traditional Resistance Exercise. ¶- Higher values denote improvements; ‡- Lower values denote improvements.
(Imputation dataset following the Last Value Carried Forward approach – LVCF).
Source: The authors (2023).

Table 3. Between-group differences of IC outcomes at trial completion

Outcomes	REI vs. HEALTH EDUCATION				RE vs. HEALTH EDUCATION				REI vs. RE			
	MD	95%CI		p-value	MD	95%CI		p-value	MD	95%CI		p-value
IC composite score¶	1.03	-0.27	2.32	0.120	0.27	-1.01	1.54	0.676	0.76	-0.50	2.01	0.232
IC Domains												
Cognition¶	1.73	-1.19	4.65	0.242	-0.05	-2.97	2.88	0.975	1.77	-1.15	4.70	0.231
Locomotion¶	1.90	-0.35	4.14	0.096	2.04	-0.16	4.24	0.068	-0.14	-2.28	2.00	0.895
Vitality¶	0.12	-0.86	1.11	0.807	-0.08	-1.06	0.89	0.869	0.20	-0.76	1.17	0.677
Psychological‡	-0.19	-1.13	0.75	0.685	0.54	-0.38	1.46	0.244	-0.74	-1.67	0.20	0.120

IC - Intrinsic capacity; REI - Resistance Exercise with Instability; RE - Traditional Resistance Exercise; MD - Mean difference.
¶- Higher values denote improvements; ‡- Lower values denote improvements. (Imputation dataset followed the Last Value Carried Forward approach – LVCF.
Source: The authors (2023).

Table 4. Sensitive analysis examining the impact of resistance exercise training arms compared to health education control on IC capacity outcomes upon completion of the 12-week intervention period

Outcomes	Baseline		Within-group effect				REI+RE vs. HEALTH EDUCATION			
	Mean	SD	Δ change	95%CI		p-value	MD	95%CI		p-value
IC Composite Score¶										
REI + RE	-.90	1.88	1.48	1.14	1.82	<0.001	0.63	0.48	1.74	0.260
HEALTH EDUCATION	-.22	2.23	0.28	-0.20	0.75	0.246				
IC domains										
Cognition¶										
REI + RE	-0.59	4.40	1.24	0.58	1.90	<0.001	0.87	-1.72	3.46	0.506
HEALTH EDUCATION	-0.73	5.34	0.40	-0.53	1.32	0.397				
Locomotion¶										
REI + RE	-1.50	3.89	2.79	1.92	3.67	<0.001	1.97	0.05	3.90	0.045
HEALTH EDUCATION	-0.64	3.16	0.23	-1.09	1.55	0.730				
Vitality¶										
REI + RE	-0.95	1.63	1.33	1.03	1.63	<0.001	0.02	-0.84	0.88	0.967
HEALTH EDUCATION	0.13	1.68	0.38	-0.05	0.80	0.083				
Psychological‡										
REI + RE	-0.06	1.87	-0.63	-1.02	-0.24	0.002	-0.19	-0.90	0.51	0.589
HEALTH EDUCATION	-0.36	1.56	-0.02	-0.59	0.55	0.941				

IC - Intrinsic capacity; REI - Resistance Exercise with Instability; RE - Traditional Resistance Exercise; MD - Mean difference.
¶- Higher values denote improvements; ‡- Lower values denote improvements. (Imputation dataset following the Last Value Carried Forward approach – LVCF).
Source: The authors (2023).

Discussion

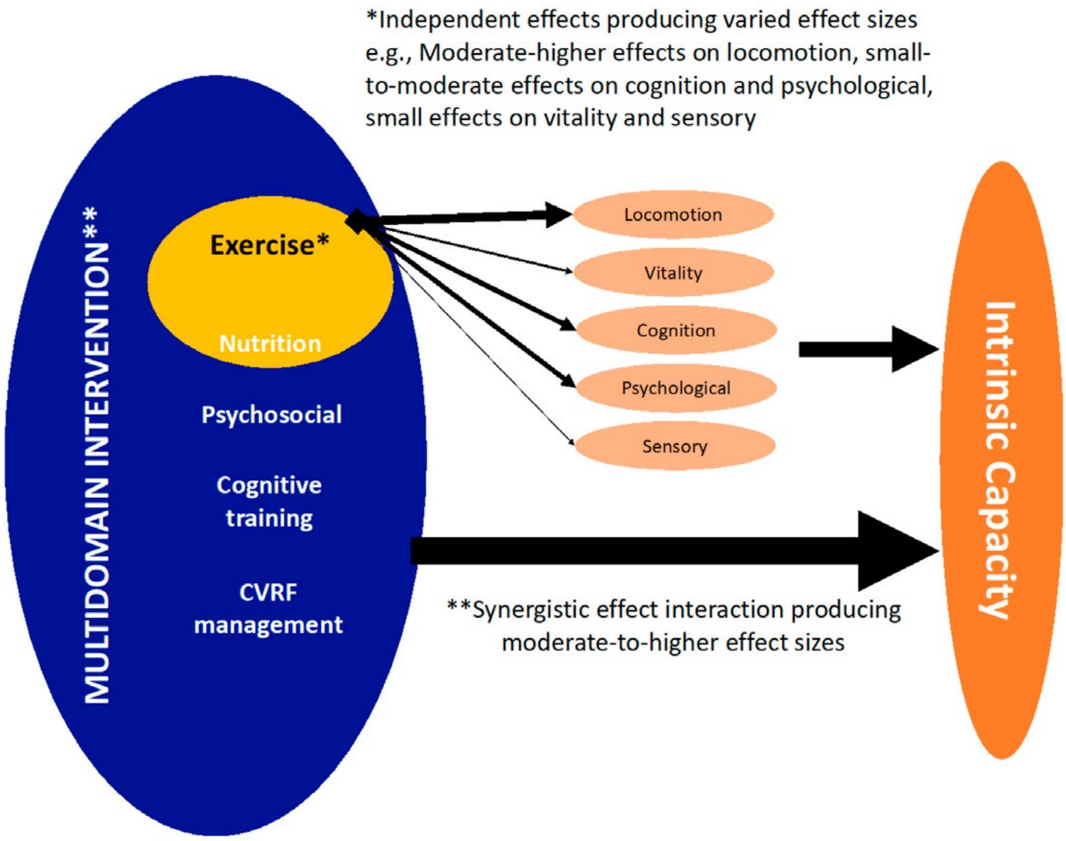
Our exploratory analysis showed no substantial effect of exercise training (traditional RE and REI) on overall IC levels or each separate domain among older adults living independently in the community. When we merged the training groups (sensitivity analysis), we found a significant improvement in the IC locomotor domain compared with the health education control group after 12 weeks of intervention.

The WHO conceptualized a healthcare model[1,2] almost six years ago in which the IC construct, environmental factors, and the interaction between them determine the different levels of functional ability for older adults. In this framework, there is a shift of the disease paradigm into a functioning-based approach that focuses on the root of the cause, offering unique opportunities to identify the effects of personalized interventions to maintain or improve IC levels during the biological aging process. Traditional RE and REI are effective in promoting health-related benefits; however, the adaptations might slightly differ in terms of the domain assessed. For example, we have found significant effects of REI on cognitive outcomes (global cognition and memory) compared with traditional RE.[11] Another analysis showed that only REI was effective in reducing fear of falling in older adults with signs of cognitive impairment.[12] Herein, we did not find substantial effects of 12 weeks of different resistance training modes to enhance overall IC levels, nor in each separate domain (locomotor, cognition, vitality, and psychological), despite the effectiveness of the exercise prescription observed through the strength gains.[11]

Conversely, as mentioned before, Huang et al.[9] observed significant benefits of home-delivered AE and RE on IC levels after a 26-week intervention in older individuals with cognitive complaints, suggesting that improvements in IC levels through exercise training may only be realized with lasting interventions. Additionally, a previous analysis in the MAPT study[29], a trial that combined omega-3 supplementation with multimodal lifestyle interventions (preventive consultations with physicians, group sessions for cognitive stimulation, as well as physical activity and nutritional counseling), showed no benefit of long-term omega-3 supplementation associated multimodal lifestyle among older adults with spontaneous memory complaints. Altogether, these findings reinforce the role of more aggressive single- and multimodal interventions (e.g., including planned and structured strategies such as exercise training) to promote maintenance or improvements of overall IC levels. Further studies are needed to fill the gaps and present more consistent evidence in this field.

Our sensitivity analysis demonstrated a significant between-group difference in favor of resistance exercise training groups compared with the health education control for the locomotion domain. Despite caution (type I error) in the interpretation of this finding, it is reasonable to expect that structure and tailored protocols of exercise have the potential to induce changes in specific IC domains such as locomotion. Previous meta-analyses[4,5] notably showed significant moderate-to-higher effects of training regimes on physical functioning outcomes (e.g., mobility, functional capacity, aerobic fitness, etc.) among community-dwelling older adults with and without established cognitive impairment. On the other hand, these effects seem to be smaller or less evident for outcomes[4,5] associated with domains such as cognition, vitality, and psychological (Figure 1). Further investigations looking at the role of exercise training on specific IC capacity domains are needed to shed light on this field.

Figure 2. Hypothetical model by which Multidomain and structure exercise intervention could promote maintenance or improvements in overall IC levels or domain-dependent effects



Note: Arrows denote the strength of the effect sizes after Multidomain intervention and structure exercise strategy alone on IC outcomes.
Source: The authors (2023).

This study has limitations. 1) Our study encompasses an exploratory analysis from a small-scale trial, which drives the necessity of confirmatory studies. 2) Some measures gathered for computing IC composite scores were blinded due to the limited number of staff. 3) The screening for cognitive complaints was self-reported, which makes it impossible to identify the nature of the complaint. Further studies should use validated and reliable tools to better capture the presence of subjective cognitive complaints and to discern their type (e.g., memory, attentional, mixed). 4) We operationalized the IC outcomes based on converted z-values. We recognize that this approach may have promoted shared variance among variables; however, the standard way to examine the effects of treatments on IC levels is not defined, and further valid approaches are needed.30 5) Our findings may not be transferred to other sub-groups of older adults, such as institutionalized older people or patients with a diagnosis of dementia.

Conclusion

In this study, traditional machine-based and free-weight resistance exercise training, performed with and without instability devices, did not improve overall intrinsic capacity levels and their respective domains as compared with a health education control group among older individuals with subjective cognitive complaints living independently in the community, despite the significant changes within-group over 12 weeks. Future well-designed randomized clinical trials are crucial to understanding the influence of single- or multi-component interventions on intrinsic capacity levels.

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Authors' contributions

Cavalcante BR, Souza MF, and Araújo RC worked on the study's concept and design. Cavalcante BR, Souza MF, Batista GA and Nascimento VYS participated in the acquisition of data. Cavalcante BR and Araújo RC contributed to the analysis and interpretation of data. All authors worked on the preparation of the manuscript.

Conflict of interest

No financial, legal or political conflicts involving third parties (government, private companies and foundations, etc.) has been declared for any aspect of the submitted work (including, but not limited to, grants and funding, advisory board participation, study design, manuscript preparation, statistical analysis, etc.).

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