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RESEARCH ARTICLE

Comparing the effect of individual and group cognitive-motor training on reconstructing subjective well-being and quality of life in older males, recovered from the COVID-19

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Abstract
While the message emanating from physiological and psychological research has extolled the general advantages of exercise in physical and cognitive health, the social distancing and the impossibility of group exercises have revealed more complex conditions. Therefore, we performed an experimental study comparing the effect of individual and group cognitive-motor training on reconstructing subjective well-being (SWB) and quality of life (QOL) in older males who recovered from COVID-19. The study's design is a single-blind, randomized controlled trial (RCT). The participants, 36 older men (65–80 yrs.) recovering from COVID-19, were randomly divided into (1) Group A (cognitive-motor training, G-CMT); (2) Group B (individual cognitive-motor training, I-CMT); and (3) Group C (control). Both training interventions involved performing a training protocol (cognitive-motor training) twice a week for four weeks. The outcomes included an assessment of the SWB and QOL of participants by SWB scale and world health organization QOL scale at baseline and two weeks after interventions. Except for the effect of age and number of children variables on QOL, other demographic variables had no significant effect on the results of SWB or WHOQOL of participants ($P > 0.05$). The SWB results in G-CMT were better than I-CMT and control groups in emotional and social well-being domains. Also, WHOQOL test results in G-CMT were better than control groups in domains of psychological and social relationships, whereas I-CMT performed better than G-CMT and control groups in domains of cognitive well-being, physical health, and environment. The results revealed that the mean test scores of SWB and WHOQOL in G-CMT and I-CMT were better than the control group ($P \leq 0.001$). The positive effects of cognitive-motor training on reconstructing SWB and QOL are associated with the synchronicity of cognitive and motor components in these exercises. We suggest that the emotional, social, and psychological benefits of cognitive-motor training override cognitive, physical, and environmental changes. The future line of the present study will include pathophysiology and further clinical aspect of recovering from COVID-19.

Keywords Cognitive health · Individual training · Group training · COVID-19 · Elderly

Abbreviations

RCT	Randomized Controlled Trial
SWB	Subjective Well-Being
COVID-19	Coronavirus Disease
QOL	Quality of Life
G-CMT	Group Cognitive-Motor Training
I-CMT	Individual Cognitive-Motor Training

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Introduction

One of the critical issues in promoting the health and QOL of the elderly is maintaining their independence in daily life activities and providing conditions for them to live actively and independently (Lee et al. 2006). During the current COVID-19 crisis, many countries have begun isolating, quarantining, and staying at home (Hwang et al. 2020). Although this procedure reduces the prevalence of the disease, it can cause further problems for the elderly, especially those who have recently survived COVID-19 and are now exposed to mental, physical, and cognitive weakening. Strong social restraint, social distancing, and quarantine measures to prevent COVID-19 have raised concerns about their mental health (Lee et al. 2006).

Community measures implemented to slow the spread of the virus have forced social distancing and cancelation of motor, cognitive, and social programs, which may have contributed to loneliness, behavioral symptoms, and worsening of QOL and SWB (Al Dhaheri et al. 2021; Alonso-Lana et al. 2020; Lábadi et al. 2022)

Research has shown that older adults with chronic diseases often present atypical symptoms at recovered from COVID-19, such as altered mental status (including confusion, stress, or loss of freshness and vitality) (Bianchetti et al. 2020; Iodice et al. 2021). So, nowadays, paying attention only to increasing life expectancy is not enough, but also the QOL should be considered; in those extra years of human life to spend in peace and physical and mental health and away from disabilities, diseases, and related complications. If such conditions are not met, scientific advances will be fruitless to ensure a better life (Brown 2014). Therefore, planning to prevent the occurrence of such outcomes after the disease is one measure that can help the elderly (Daoust 2020) and can cause increasing the quantity and the QOL.

In addition to traditional medical treatment, interventions that develop multiple cognitive and motor readiness aspects may benefit the elderly (Andrade and Radhakrishnan 2009), known as dual-tasking paradigms (Sanders 2001). Dual-task paradigms encompass a broad range of approaches to measuring cognitive load in instructional settings, and, as a common characteristic, an additional task is implemented alongside a learning task to capture the individual's unengaged cognitive capacities during the learning process (Esmaeili Bijarsari 2021). Training that used dual-tasking paradigms demonstrated beneficial effects on cognitive and motor control in older adults (Brown et al. 1999; Maylor et al. 2001), in patients with brain injury (Haggard et al. 2000; McCulloch 2007) and patients with Alzheimer's disease (Camicioli et al. 1997). Several studies have suggested that procedures to improve the dual-task performance of the elderly should be included in physical and psychological disorders prevention programs (Bisson et al. 2007; Kitazawa et al. 2015; Morita et al. 2018; Nishiguchi et al. 2015).

Kitazawa and colleagues (2015) used a dual-task net-step exercise (NSE) to improve cognitive functions in older adults and showed that dual-task NSE could improve cognitive performance in healthy older adults. (Kitazawa et al. 2015). They aimed to assess the effect of a novel dual-task net-step exercise (NSE) performed once a week for eight consecutive weeks on improvements in cognitive performance and gait function in an older population. Their results showed that the NSE group showed significant improvement in cognitive and gait performance over the eight weeks, but in the control group, there was no significant improvement (Kitazawa et al. 2015). Bisson and colleagues (2007) also examined the effect of virtual reality (VR) and biofeedback (BF) training on balance and reaction time in older people. They found that postural sway during quiet stance did not change significantly; however, significant improvements in the community balance and mobility scale (CB & M) and decreased reaction times with VR and BF training were observed (Bisson et al. 2007).

Similarly, in investigating healthy older adults, Nishiguchi and colleagues (2015) discovered that a physical and cognitive program could improve cognitive function and brain activation efficiency. In this study, Exercise group participants received a weekly dual task-based multimodal exercise with pedometer-based daily walking during a 12-week intervention phase (Nishiguchi et al. 2015). Also, Schoene and colleagues (2013) showed the effectiveness of step-based exercise games on cognitive functions associated with falls (Schoene et al. 2013). In this regard, Morita and colleagues (2018) showed the effect of 2-year cognitive–motor dual-task (DT) training on cognitive functions and motor ability in healthy older adults. Their 12-week DT trial showed that participating in an exercise program comprising DT training may be beneficial for maintaining the broad domains of cognitive function in healthy elderly participants (Morita et al. 2018). Evidence suggests that combined cognitive and motor training may lead to cognitive enhancement and improve the elderly's independence. On the other hand, these exercises can lead to increased self-confidence, relaxation, and functional facilitation in the individual (Fu et al. 2020; Joubert AND Chainay 2018). On the other hand, in quarantine conditions, it is recommended that sports activities be performed individually; this may prevent people from unnecessary gatherings (Qian and Jiang 2020).

Here we examine whether cognitive-motor training designed to reconstruct SWB and QOL, when delivered in a group format, might foster improvement in cognitive functions compared to those delivered in an individual format because of the access to social interactions. Previous studies have shown that both forms of training have advantages and disadvantages, and their usefulness depends on personality, type of sports activity, and sports discipline (Brodbeck and Greitemeyer 2000). It may be possible that cognitive-motor training interventions delivered in a group format might represent an optimal intervention for reconstructing SWB and QOL for older adults recovering from COVID-19 because the group format provides access to other survivors and thus could address psychosocial needs related to increased dependence on others (Harrison et al. 1995) or isolation (Rosenbaum 2005). In addition, some studies have shown that group training can reduce stress levels and increase the enjoyment of sports and self-confidence, willpower, mental health, and social skills (Floyd and Moyer 2009). However, some researchers believe that the learning and training progress in individual training is more significant (Somasundaram and Egan 2004). In individual exercises, one may assume that individuals have the maximum opportunity to practice cognitive and motor skills without waiting in line and being distracted by other people (Liang et al. 1995).

The studies reviewed indicate that both individual and group cognitive-motor training have bodily and cognitive impacts. However, each type of training seems to enhance different cognitive functions preferentially. Even though some results argue in favor of the superiority of group training, the current knowledge does not permit any definitive conclusion. Therefore, we sought to examine whether the effectiveness of cognitive-motor training in reconstructing SWB and QOL in older adults recovering from COVID-19 differs according to whether people are training alone or with others.

Methods

Study design

The study consists of a single-blind, randomized, controlled trial.

Ethical considerations

The study was conducted after ethical committee approval from the Baqiyatallah University of Medical Sciences (Approval No. IR.BMSU.REC.1399.392). Participants were informed about how to do training and testing. Informed consent was attained from each respondent, and data were excluded from the final assessment for those refusing participation. The social distancing protocol was implemented during the study.

Participants and eligibility

Some 36 male participants aged 65–80 years old, living in the community and recently discharged from a hospital in Tehran, volunteered to participate in this study with the consent of their physician. These people had a history of hospitalization, and not more than two weeks had passed since they were discharged. The eligibility criteria included the following.

- Having 65 years of age or older,
- Being able to read and write,
- Living in the Tehran metropolitan area,
- Being independent in activities of daily life,
- Being able to walk 10 m without using a walking aid and willing to provide informed consent and comply with the study protocol.

Also, the severity of COVID-19 was set at stage 1, with symptoms including headache, loss of sense of smell, cough, fever, hoarseness, chest pain, and fatigue. Those with more severe symptoms were not admitted into the study. Exclusion criteria included an acute psychiatric condition with psychosis, an unstable medical condition that would preclude safe participation; a progressive neurological condition (such as Parkinson's disease, multiple sclerosis, Meniere's disease), cognitive impairment defined as a Pfeiffer short portable mental status questionnaire (SPMSQ) score < 824, or visual or auditory impairment that could not be corrected with assistive devices. Calculating body mass index (BMI) was done by dividing an individual's weight in kilograms by the square of height in meters (BMI = weight [kg]/height [m2]).

Potential participants undertook an initial eligibility screening via a telephone interview. This interview included oral screening using SPMSQ. In addition, trained research personnel provided detailed study information and obtained verbal consent to arrange an appointment for a baseline assessment. Study information also was posted to potential participants at this time.

Immediately before a scheduled baseline assessment, participants were asked to watch a video showing the main aspects of the intervention to establish their intention to adhere to the training protocol. As participants showed their unwillingness to adhere to the intervention protocol, they were excluded from the study.

Grouping

Following the baseline assessment (subjective well-being scale (SWB) and the world health organization quality of life (WHOQOL)) and ensuring the alignment of participants (the dimensions of the alignment of participants comprised having similar situations in terms of demographic characteristics), they were divided into three groups of approx. [(Group A.) group cognitive-motor training (G-CMT); (Group B.)

individual cognitive-motor training (I-CMT) and (Group C.) Group Control].

The cognitive-motor training was used in both groups of G-CMT and I-CMT. The course content and the instructors were the same for both groups of G-CMT and I-CMT. The evaluation tool, the SWB, and the QOL assignment were identical in three groups: G-CMT, I-CMT, and control. The difference in groups was based on how they answered the tests SWB and WHOQOL (Fig. 1).

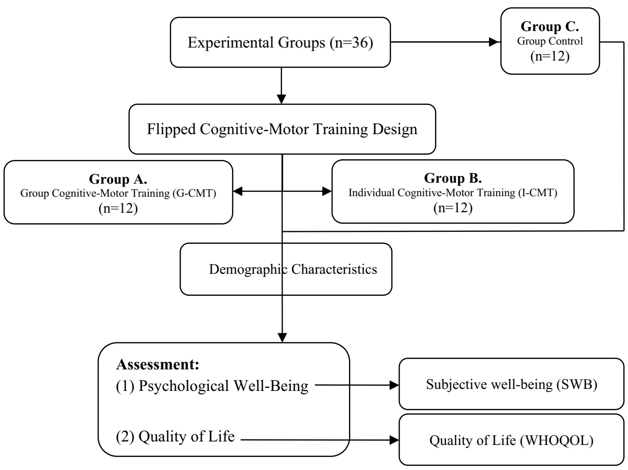

Fig. 1 Profiles of the stages of this study

Cognitive-motor training

The training period lasted four weeks and comprised two exercise sessions each week. The training protocol for experimental groups (G-CMT and I-CMT) included physical exercises with low to high cognitive load and had two types of challenging requirements: 1) Motor requirements such as shifting the center of gravity, consecutive walking, and moving the limb in the full range of motion; 2) Cognitive requirement, such as attention, quick response to visual stimuli, decision making and response inhibition (Fig. 2). The intensity and duration of the program were selected according to the guidelines of the American college of sports medicine and previous studies (Silsupadol et al. 2009), which showed that 1- to 5-h dual-task training programs (motor training and cognitive training) were effective in improving motor function and psychological performance in older adults, respectively (Erickson et al. 2007; Kramer et al. 1995; Wolf et al. 2001). No emphasis was initially placed on the speed of action to reduce the training load. Subjects were also encouraged to focus more on the motor and physical dimensions of the task, and as the work progressed, they were to increase their focus on the performance of the cognitive task.

Aligned with the "social distancing protocols," training sessions in the group of individual exercises were

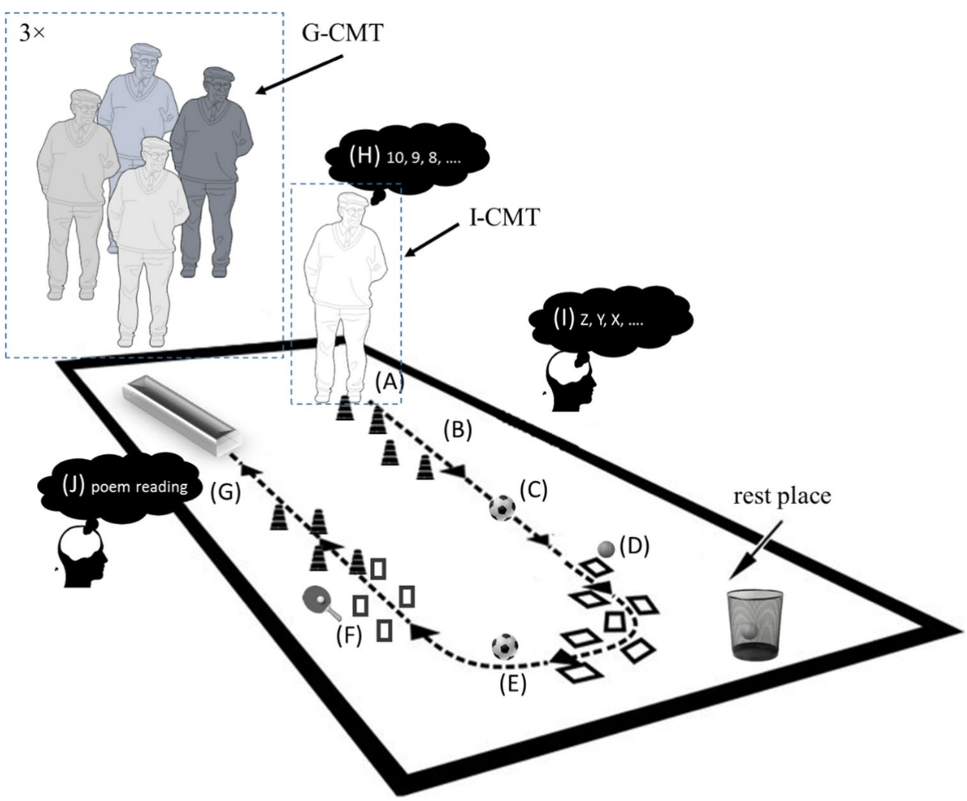

Fig. 2 The cognitive-motor training scenario considered in this study (The training program used progressive activities related to body stability, body stability plus hand manipulation, then body transport, and finally body transport plus hand manipulation. The participants receiving dual-task training with fixed-priority instructions practiced motor tasks while simultaneously performing cognitive tasks, and were instructed to maintain attention on both postural and cognitive tasks at all times.)

conducted individually and at the participants' residences to prevent the possibility of re-emergence of the disease.

Each training session lasted an average of 45 min and included six exercises in 2 to 3 sets (5–10 repetitions per set). Participants underwent a 10-min training session at each station before rotating until all exercises were completed. All participants received the same amount of contact time with the trainer. As the present research adopted a quasi-experimental design, we tried as much as possible to control possible confounders (e.g., natural change of participant's state over time, change in the infection status), and no case was reported.

The intensity of the exercise was controlled using the amount of perceived pressure by the participants. As a result, the number of repetitions and the cognitive load of the exercise increased as the participants progressed. Therefore, the training program included three levels (A, B, and C), in which the motor and cognitive load gradually increased from level A (minimum load) to level C (maximum load). This increase includes increasing the speed and number of movements of shifting the center of gravity, reducing the pause and completing the range of motion, and reducing the reaction time and the decision errors.

All participants started the exercises in level A and only entered the next level after complete success in this level. Motor training protocol included standing on the support surface, walking around obstacles, hitting the ball while standing, throwing the ball into the basket while standing, walking and hitting the ball, walking in a zigzag path while holding a ping-pong ball, and walking on a narrow support surface while holding an object. The cognitive training included countdown, reverse spelling, and poem reading (Silsupadol et al. 2009), and these were verbally conducted.

Experimental groups

Group A. group cognitive-motor training (G-CMT)

As shown in Fig. 1, in order to comply with the "social distancing protocols," training sessions in the G-CMT have conducted three groups of four at different times to maintain the active participation of individuals (Midtgaard et al. 2006) and created group solidarity and prevent the possibility of re-emergence of the disease. All groups were subjected to a single-subject research design. In the group arrangement, one participant first performed the Cognitive-Motor Training, and after completing the execution process, the next participant entered the execution cycle.

Group B. individual cognitive-motor training (I-CMT)

As shown in Fig. 1, each participant was subjected to a single-subject research design, and according to the social distancing protocol, the intervention for each participant was performed individually at his residence.

Group C. group control

The control group (without intervention) did not perform any similar training program and only performed their daily activities according to the previous routine.

Instruments

The participants answered a protocol comprising a demographic questionnaire, subjective well-being (SWB), and the world health organization's quality of life (WHOQOL).

The following dummy variables were defined as a reference of each demographic characteristic: age (1 = under 70, 2 = 70 or older); Education level (1 = university graduate or more, 2 = high school graduate or less); Marital status (1 = Married, 2 = Separated / Divorced, 3 = Single); Number of Children (1 = 1–2 Children, 2 = 3–5 Children, 3 = More than 5); Employment Status (1 = not employed, 2 = employed); Income (1 = less than 4 million rials of monthly household income, 0 = 4 million rial or more of monthly household income [1 USD = 274,460 Rial]);

SWB assessment

The SWB scale was one tool used in the study, which was used to measure SWB. Keyes and Magyar-Moe designed it in 2003 with three distinct but often related components: cognitive well-being, emotional well-being, and social well-being. For the Iranian version of the SWB, acceptable internal consistency (For emotional, psychological, and social well-being subscales, Cronbach's alpha coefficients were from 0.76, 0.64, and 0.76.), and construct validities (discriminant and convergent validities) have been reported above 0.78 ranging (Hashemian et al. 2007).

The psychological well-being sub-scale has 18 questions based on people's life assessment, purpose in life, mastery of the environment, autonomy, and positive relationships with others. The social well-being sub-scale has 15 questions and includes social acceptance, social realism, social participation, social cohesion, and social solidarity. Finally, emotional well-being includes 12 questions that examine emotions.

(Keyes and Magyar-Moe 2003). The items on the emotional well-being scale are to be answered on a 5-point Likert scale ranging from 1 (not present) to 5 (constantly present), leading to a raw score range from 16 to 56. Also, the items on cognitive well-being and social well-being scales are to be answered on a 7-point Likert scale ranging from 1 (I strongly disagree) to 7 (Agree Very much), leading to a raw score range from 18 to 126 for cognitive well-being scale and 15 to 105 for social well-being scale. Finally, from the sum of emotional, psychological, and social well-being scores, the SWB score is obtained. In the present study, its Cronbach alpha value was obtained at 0.78 and for subscales, respectively 0.82, 0.69, and 0.71.

WHOQOL assessment

The second tool, which was used to measure the elderly QOL, is the world health organization QOL (WHOQOL)-BREF. The WHOQOL is a general QOL instrument 26-item that measures four health-related concepts: Physical health (seven items), psychological health (six items), social relationships (three items), and environmental health (eight items), and two overall WHOQOL and general health items that are used to measure an individual's overall satisfaction with life and a general sense of personal well-being (Huang et al. 2006). A summation and calculation of the mean score for each domain were carried out according to the WHOQOL transformation table to yield a score ranging from 0 to 100 for each domain (Harper and Orley 1996; Murphy et al. 2000). A higher score on this questionnaire represents a better WHOQOL.

Acceptable internal consistency (Cronbach's alpha coefficients were for physical health (0.80), psychological health (0.76), social relationships (0.66), and environmental health (0.80)) and construct validities (discriminant and convergent validities) have been reported above 0.78, ranging (Kekäläinen et al. 2018) and the test–retest reliability was appropriate (Nejat et al. 2006). In the present study, its Cronbach alpha value was obtained at 0.87.

Statistical analysis

Data were analyzed using SPSS version 26. Two-way ANOVA was used to determine the interactive effect of demographic variables on SWB and QOL in groups. Repeated measures ANOVA was also used to compare within-group and out-group mean SWB and QOL dimensions in the three groups, and the Bonferroni post hoc test was used to show the differences between the groups. A P value less than 0.05 was considered significant.

Results

Participants demographic profile

The total number of participants included in the study was 36, with 12 participants in each group. The mean age of the participants was 71.33 years (SD = 4.33) within a range of 65–80 years as well as the mean Body mass index (BMI) of 23.80 ± 5.34 (Table 1).

Some 28% of participants had unfinished high school education, and 72% were high school graduates or higher. Some 58% of participants were married, 31% were divorced, and 11% were single. Some 25% of participants had 1–2 children, 56% had 3–5 children, and 7% had five children or more. Some 42% of participants were unemployed, and 58% were employed. Finally, 56% of participants had under 40 million rials monthly income, and 44% had 40 million Rials and higher.

Demographic characteristics of all sample members based on the frequency and density percentage are reported in Table 2. Table 2 shows that the three groups were similar in terms of demographic characteristics. The chi-square ratio was obtained by comparing the frequencies of three groups in two levels of age ($\chi2 = 0.22$, $P = 0.89$), two levels of education ($\chi2 = 1.94$, $P = 0.38$), three levels of marital status ($\chi2 = 2.63$, $P = 0.62$), three levels of the number of children ($\chi2 = 0.37$, $P = 0.98$), two levels of employment status ($\chi2 = 0.69$, $P = 0.71$) and two levels of monthly income ($\chi2 = 0.23$, $P = 0.89$), that none of these values are statistically significant (Table 2).

Using two-way ANOVA, the interactive effect of two categorical variables (demographic variables and three groups) on the total score of SWB and QOL was investigated (Table 3). The equality of variances was not significant by performing Levene's test in the pre-test stage. Therefore, the hypothesis of equality of variances of demographic variables was confirmed [F (5, 30) = 1.45 & $P = 0.24 > 0.05$].

The results showed that (Table 3), except for the Age variable [F (1, 11) = 4.52 & $P = 0.04$, $\eta^2 = 0.16$] and the number of children variable [F (2, 11) = 52 & $P = 0.04$, $\eta^2 = 31$] in WHOQOL, other variables no significant

Table 1 Baseline demographic and clinical characteristics

Scale	Age	Height	Weight	BMI
Mean	71.33	170.63	69.24	23.80
Std	4.33	7.46	6.21	5.34

*Body Mass Index (BMI)

interaction effect was observed between the levels of groups and demographic variables ($P > 0.05$).

Also, SWB and QOL of the elderly recovered from COVID-19 were significantly affected by the levels of groups as an independent variable ($P \leq 0.01$). Therefore, the effect of different types of intervention on the dimensions of SWB and QOL was compared (Tables 4 and 9).

Difference in SWB of G-CMT, I-CMT and control groups

The result of Levene's test showed the homogeneity of variance of the data in different stages of the SWB test [F (5, 30) = 0.51 & $P = 0.60 > 0.05$]. The results of repeated measures ANOVA in assessing the difference between the scores of SWB dimensions of the elderly in the three

Table 2 Demographic characteristics of participants based on frequency and density percentage

	Variables	Frequency			Statistical test
		G-CMT	I-CMT	Control	
Age (years)	< 70	6 (50.00)	5 (41.67)	5 (41.67)	$\chi^2 = 0.22$
	≥ 70	6 (50.00)	7 (58.33)	7 (58.33)	$p = 0.89$
Education	≤ High School Graduates	2 (16.67)	3 (25)	5 (41.67)	$\chi^2 = 1.94$
	> High School Graduates	10 (83.33)	9 (75.00)	7 (58.33)	$p = 0.38$
Marital Status	Married	9 (75.00)	6 (50.00)	6 (50.00)	$\chi^2 = 2.63$
	Separated / Divorced	2 (16.67)	5 (41.67)	4 (33.33)	$p = 0.62$
	Single	1 (8.33)	1 (8.33)	2 (16.67)	
Number of Children	1–2 Children	3 (25.00)	3 (25.00)	3 (25.00)	$\chi^2 = 0.37$
	3–5 Children	6 (50.00)	7 (58.33)	7 (58.33)	$p = 0.98$
	5 > Children	3 (25.00)	2 (16.67)	2 (16.67)	
Employment Status	Unemployed	5 (41.67)	4 (33.33)	6 (50.00)	$\chi^2 = 0.69$
	Employed	7 (58.33)	8 (66.67)	6 (50.00)	$p = 0.71$
Monthly Income	< 40 Million Rials	7 (58.33)	7 (58.33)	6 (50.00)	$\chi^2 = 0.23$
	≥ 40 Million Rials	5 (41.67)	5 (41.67)	6 (50.00)	$p = 0.89$

*Significance level $P \leq 0.05$

Table 3 Effect of demographic characteristics on SWB and QOL

	SWB				QOL			
	MS*	F	P	η^2	MS	F	P	η^2
Age	0.31	0.06	0.80	0.002	27.53	4.52	0.04*	0.159
Education	3.08	0.59	0.45	0.024	23.45	3.85	0.06	0.138
Marital Status	2.53	0.49	0.61	0.039	5.56	0.96	0.39	0.074
Number of children	1.65	0.32	0.73	0.026	36.17	5.94	0.01*	0.331
Employment status	0.21	0.40	0.84	0.002	10.52	1.73	0.20	0.067
Monthly income	0.67	0.57	0.45	0.005	0.25	0.04	0.84	0.002

*Significance level $P \leq 0.05$

[a]Mean Square

Table 4 Changes SWB test of groups G-CMT, I-CMT and control

Groups	G-CMT		MD	I-CMT		MD	Control		MD
Dimensions of PWB	Mean ± SD			Mean ± SD			Mean ± SD		
	Pre-test	Post-test		Pre-test	Post-test		Pre-test	Post-test	
Cognitive well-being	36.08 ± 2.85	57.10 ± 2.26	21.02	35.06 ± 2.12	66.17 ± 2.37	31.11	34.04 ± 3.87	36.58 ± 2.81	2.54
Emotional well-being	20.92 ± 1.87	32.58 ± 2.51	11.66	21.50 ± 1.77	29.08 ± 3.48	7.58	19.83 ± 2.05	22.58 ± 1.81	2.75
Social well-being	25.08 ± 2.19	56.75 ± 2.28	31.67	24.75 ± 2.22	49.64 ± 2.50	24.89	23.25 ± 1.70	25.42 ± 2.71	2.17
SWB	27.42 ± 2.17	48.75 ± 2.81	21.33	27.08 ± 1.73	48.25 ± 3.51	21.17	25.67 ± 1.83	28.25 ± 3.71	2.58

groups showed a statistically significant difference [F (5, 30) = 184.980 & $P \leq 0.05$, ηp2 = 0.98] (Table 5).

According to the results of the Bonferroni post hoc test, the mean scores of all three dimensions of SWB in the individual and group cognitive-motor training were significantly higher than the mean scores in the control group ($P \leq 0.01$) (Table 6).

There was a significant difference between cognitive and social well-being dimensions in the two experimental groups after the intervention ($P \leq 0.01$). However, although the mean scores of emotional well-being and total SWB were not the same in the two experimental groups after the intervention, they were not statistically significant ($P > 0.05$). The SWB results in G-CMT were better than I-CMT in the domains of emotional well-being and social well-being, but I-CMT obtained a better status in the Cognitive well-being variable than G-CMT (Table 6).

Although there were slight changes in the post-test scores of SWB dimensions of the elderly in the control group compared to the pre-test, this difference was not statistically significant ($P > 0.05$) (Table 4) & (Fig. 3).

Table 5 Compared difference SWB test of groups G-CMT, I-CMT and control with repeated measures ANOVA

Dimensions of PWB	Group			Time			Time * Group		
	$F_{(2/22)}$	P	η^2	$F_{(1/11)}$	P	η^2	$F_{(2/22)}$	P	η^2
Cognitive well-being	288.32	0.001	0.96	2360.74	0.001	0.995	150.83	0.001	0.932
Emotional well-being	41.674	0.001	0.79	274.21	0.001	0.961	21.25	0.001	0.659
Social well-being	259.78	0.001	0.95	1270.68	0.001	0.991	382.83	0.001	0.972
SWB	274.30	0.001	0.96	270.139	0.001	0.961	106.12	0.001	0.906

*Significance level $P \leq 0.05$

Table 6 Results of the Bonferroni post hoc test related to the comparison of groups in the SWB

Measure	Groups	Groups	Mean difference	Std. error	P
Cognitive well-being	G-CMT	I-CMT	− 4.028*	0.672	0.001
		Control	11.276*	0.780	0.001
	I-CMT	G-CMT	4.028*	0.672	0.001
		Control	15.305*	0.500	0.001
	Control	G-CMT	− 11.276*	0.780	0.001
		I-CMT	− 15.305*	0.500	0.001
Emotional well-being	G-CMT	I-CMT	1.462	0.655	0.142
		Control	5.554*	0.690	0.001
	I-CMT	G-CMT	− 1.462	0.655	0.142
		Control	4.092*	0.537	0.001
	Control	G-CMT	− 5.554*	0.690	0.001
		I-CMT	− 4.092*	0.537	0.001
Social well-being	G-CMT	I-CMT	3.722*	0.501	0.001
		Control	16.582*	0.841	0.001
	I-CMT	G-CMT	− 3.722*	0.501	0.001
		Control	12.860*	0.889	0.001
	Control	G-CMT	− 16.582*	0.841	0.001
		I-CMT	− 12.860*	0.889	0.001
SWB	G-CMT	I-CMT	0.419	0.483	0.960
		Control	11.132*	0.480	0.001
	I-CMT	G-CMT	− 0.419	0.483	0.960
		Control	10.713*	0.635	1.000
	Control	G-CMT	− 11.132*	0.480	1.000
		I-CMT	− 10.713*	0.635	0.001

* Significance level $P \leq 0.05$

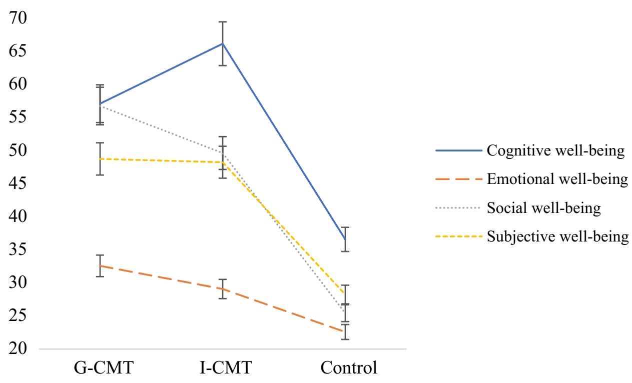

Fig. 3 Comparing the effect of individual and group cognitive-motor training on reconstructing SWB

Difference in QOL of G-CMT, I-CMT and control groups

The result of the Levene test showed the homogeneity of variance of the data in different stages of the SWB test [F (5, 30) = 0.32 & $P = 0.73 > 0.05$]. The results of repeated measures ANOVA in assessing the difference between the scores of quality-of-life dimensions of the elderly in the three groups showed a statistically significant difference [F (5, 30) = 94.306 & $P \leq 0.05$, ηp2 = 0.94].

According to the results of the Bonferroni post hoc test, the mean scores of all four dimensions of QOL in the individual and group cognitive-motor training were significantly higher than the mean scores in the control group ($P \leq 0.01$) (Table 9).

There was a significant difference among the dimensions of psychological relationships, social relationships, and total QOL in the two experimental groups after the intervention ($P \leq 0.01$) (Table 9). However, although the mean scores of physical health and environment were not the same in the two experimental groups after the intervention, they were not statistically significant ($P > 0.05$) (Table 9). The WHO-QOL results in G-CMT were better than I-CMT in the psychological, social Relationships, and QOL. Although there were slight changes in the post-test scores of quality-of-life dimensions of the elderly in the control group compared to the pre-test, this difference was not statistically significant ($P > 0.05$) (Table 7) & (Fig. 4).

Discussion

This study aimed to assess the difference between the two designs of cognitive-motor training. Specifically, two execution methods, individual and group training, were tested, and their effectiveness in reconstructing SWB and QOL of older males recovered from COVID-19 was compared (Tables 8 and 9).

The results of the analysis of variance on the effect of demographic variables on each of the areas of well-being and QOL showed that among the various components of age, education, marital status, number of children, employment status, and monthly income, only the age and number of children had a significant effect on the mental well-being and QOL of the elderly recovered from COVID-19. Therefore, the elderly with younger age and more children had higher mental well-being scores. This finding is consistent with the previous results (Brown, 1995) that introduce age and number of children as significant indicators affecting the QOL of the elderly. Brown (1995) defined mental quality according to two levels: micro (mind) and macro (aim). Studies in his typology of quality-of-life indicators, considers age and number of children as one of the aim factors affecting the QOL at the individual level. Hörnquist et al. (1990) also consider the family realm as one factor influencing the QOL. These results are consistent with the findings of the present study. Probably the reason for this effect is the motivational role of age and having children on mental well-being and QOL of the elderly improved by COVID-19.

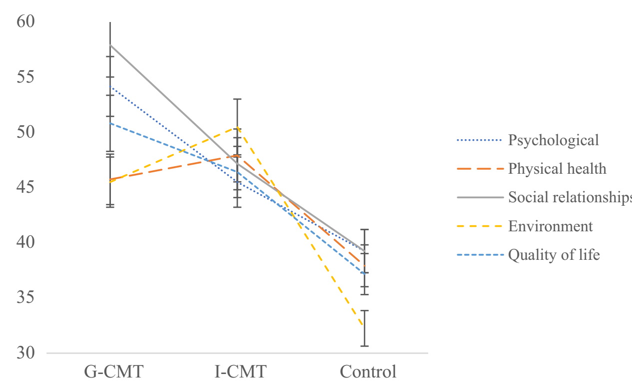

Fig. 4 Comparing the effect of individual and group cognitive-motor training on reconstructing QOL

The results indicate that the results of the tests of SWB and QOL in the elderly who were engaged in cognitive-motor training conducted in groups (G-CMT) were better than the elderly who accomplished individual training in the cognitive-motor training (I-CMT), and the difference in the mean test scores across the two groups for test QOL was highly significant.

Our study revealed that cognitive-motor training with group cooperation promotes SWB achievement in domains of emotional well-being and social well-being, but individual cognitive-motor training promotes the domain of cognitive well-being. Also, cognitive-motor training

Table 7 Changes QOL test of groups G-CMT, I-CMT and control

Groups	G-CMT		MD	I-CMT		MD	Control		MD
Dimensions of PWB	Mean ± SD			Mean ± SD			Mean ± SD		
	Pre-test	Post-test		Pre-test	Post-test		Pre-test	Post-test	
Psychological	33.50 ± 2.48	54.17 ± 3.31	20.67	2.52 ± 3.44	45.50 ± 2.54	12.76	34.17 ± 2.65	39.25 ± 3.12	5.08
Physical health	37.36 ± 1.88	45.75 ± 3.22	8.39	38.32 ± 2.83	47.92 ± 4.42	9.60	36.75 ± 1.97	37.92 ± 4.55	1.17
Social relationships	39.42 ± 2.04	57.92 ± 4.22	18.75	38.50 ± 2.47	47.17 ± 4.73	8.67	37.58 ± 1.88	39.25 ± 3.75	1.67
Environment	31.33 ± 2.21	45.50 ± 4.31	14.17	30.75 ± 2.01	50.50 ± 3.45	19.75	29.50 ± 3.11	32.25 ± 3.70	2.75
QOL	35.08 ± 2.38	50.83 ± 3.19	15.75	33.63 ± 2.47	46.42 ± 5.70	12.79	31.08 ± 2.31	37.17 ± 4.94	6.29

Table 8 Compared difference QOL test of groups G-CMT, I-CMT and control with repeated measures ANOVA

Dimensions of WHOQOL	Group			Time			Time * Group		
	$F_{(2/20)}$	P	η^2	$F_{(1/10)}$	P	η^2	$F_{(2/20)}$	P	η^2
Psychological	20.81	0.001	0.675	877.89	0.001	0.989	67.99	0.001	0.872
Physical health	19.23	0.001	0.658	67.95	0.001	0.872	9.22	0.001	0.480
Social relationships	44.59	0.001	0.817	189.45	0.001	0.950	46.75	0.001	0.824
Environment	58.05	0.001	0.853	451.18	0.001	0.978	29.40	0.001	0.746
QOL	47.31	0.001	0.836	111.68	0.001	0.918	7.76	0.001	0.437

*Significance level $P \leq 0.05$

with group cooperation boosts Psychological and social relationships in seniors, promoting QOL, but individual cognitive-motor training promotes the domains of physical health and environment.

Therefore, while all cognitive health components benefit the CMT, whether as a group or individually, individual cognitive-motor training provides fewer benefits for cognitive health than group cognitive-motor training and uses less involvement in social relationships, however, it is more effective than inactivity for improving cognitive health.

This study aimed to assess the difference between the two designs of cognitive-motor training. Specifically, two execution methods, individual and group training, were tested, and their effectiveness in reconstructing SWB and QOL of older males recovered from COVID-19 was compared.

The results of the analysis of variance on the effect of demographic variables on each of the areas of well-being and QOL showed that among the various components of age, education, marital status, number of children, employment status, and monthly income, only the age and number of children had a significant effect on the mental well-being and QOL of the elderly recovered from COVID-19. This finding is consistent with the previous results (Brown, 1995) that introduce age and number of children as significant indicators affecting the QOL of the elderly. Brown (1995) defined mental quality according to two levels: micro (mind) and macro (aim). Wolf (2001), in his typology of quality-of-life indicators, considers age and number of children as one of the aim factors affecting the QOL at the individual level. Hörnquist et al. (1990) also consider the family realm as one factor influencing the QOL. These results are consistent with the findings of the present study. Probably the reason for this effect is the motivational role of age and having children on mental well-being and QOL of the elderly improved by COVID-19.

The results indicate that SWB and QOL in the elderly who were engaged in cognitive-motor training conducted in groups (G-CMT) were better than the elderly who accomplished individual training in the cognitive-motor training (I-CMT), and the difference in the mean test scores across the two groups for test QOL was highly significant.

These results are consistent with other research, who reported higher social, emotional, and psychological functioning scores in group training compared to individual training, however. However, this result is inconsistent with this research to improve the physical health dimension.

Cognitive-motor training, when performed collectively, promoted both physical and psychological improvements. In addition, individuals with higher levels of involvement in social relationships were more active. Thus, the higher the level of personal relationship involvement, the greater the social support the elderly receive. However, doing individual exercises in the present study could also improve the SWB and QOL of the elderly.

In the social context, physical activity promotes better integration in society. In addition, it improves satisfaction with life and reduces solitude. Our results agree with other

Table 9 Results of the Bonferroni post hoc test related to the comparison of groups in the quality-of-life test

Measure	Groups	Groups	Mean Difference	Std. error	*P*
Psychological	G-CMT	I-CMT	4.165*	1.027	0.007
		Control	6.806*	.961	0.001
	I-CMT	G-CMT	– 4.165*	1.027	0.007
		Control	2.640	1.190	0.153
	Control	G-CMT	– 6.806*	.961	0.001
		I-CMT	– 2.640	1.190	0.153
Physical health	G-CMT	I-CMT	– 1.558	.869	0.310
		Control	4.122*	.986	0.006
	I-CMT	G-CMT	1.558	.869	0.310
		Control	5.680*	.980	0.001
	Control	G-CMT	– 4.122*	.986	0.006
		I-CMT	– 5.680*	.980	0.001
Social relationships	G-CMT	I-CMT	5.550*	.875	0.001
		Control	10.598*	.976	0.001
	I-CMT	G-CMT	– 5.550*	.875	0.001
		Control	5.049*	1.436	0.017
	Control	G-CMT	– 10.598*	.976	0.001
		I-CMT	– 5.049*	1.436	0.017
Environment	G-CMT	I-CMT	– 2.475	.949	0.078
		Control	7.155*	.931	0.001
	I-CMT	G-CMT	2.475	.949	0.078
		Control	9.631*	.905	0.001
	Control	G-CMT	– 7.155*	.931	0.001
		I-CMT	-9.631*	.905	0.001
QOL	G-CMT	I-CMT	3.015*	.881	0.020
		Control	9.012*	.925	0.001
	I-CMT	G-CMT	– 3.015*	.881	0.020
		Control	5.997*	1.018	0.001
	Control	G-CMT	– 9.012*	.925	0.001
		I-CMT	– 5.997*	1.018	0.001

*Significance level $P \leq 0.05$

studies that show a positive relationship between physical activity and improved WHOQOL (Haider et al. 2016).

We conclude that although individual cognitive-motor training modes are effective in inducing improvements in physical and cognitive among older adults, group cognitive-motor training modes may offer additional physical, cognitive, and social benefits.

Nevertheless, the results showed that, individually and in groups, participation in the CMT training twice a week could reconstruct SWB and QOL in older males who recovered from COVID-19. These results were obtained after observing a significant difference between the individual training group (I-CMT) and the control group (group C.).

Kekäläinen et al. (2018), Allen et al. (2017), and Haider et al. (2016) performed multiple cuasi-experimental studies. They determined that CMT intervention of all types was more beneficial for improving the QOL empathy and symptoms of depression to manage mental functioning, physical and cognitive health, and social participation in older adults. Elhakeem et al. (2017) performed a moderator analysis within their meta-analysis and determined that cognitive-motor programs were more beneficial for the QOL in older adults (Elhakeem et al. 2017).

To explain these findings, one may say that considering that the physical dimension of QOL includes concepts such as strength, energy, ability to perform daily activities, and self-care, CMT, both as a group and individually, is closely related to physical function and improves these factors, resulting in better perception in the elderly (Collinet and Delalandre 2017).

It seems CMT training similar physical activity or exercise induces alterations at the cellular and molecular level (Sobhani et al. 2018), likely initiating structural and functional adaptations in the brain and behavioral/socio-emotional changes that eventually influence cognitive and mental health. It is possible that CMT training influences the neurophysiological mechanisms caused by reconstructing cognitive and mental health components in older adults. In explaining this finding, it can be said that CMT training may cause an increase in cerebral blood flow (Ruitenberg et al. 2005) and angiogenesis (Rhyu et al. 2010) to improve cognitive health. In this regard, Ohsugi et al. (2013) reported that CMT training significantly increased blood flow and the activity assessed by the quantity of oxygenated hemoglobin in the prefrontal cortex, the primary brain area that exerts executive function (Ohsugi et al. 2013); Therefore, the favorable effect of CMT training on reconstructing SWB and QOL may be partly because of an increase in cerebral blood flow.

The researchers of the present study believe that if the elderly are encouraged to do these exercises spontaneously and routinely for a long time, these exercises will have a more significant impact on the components of mental well-being and their QOL. Gradually, functional improvement in psychological and physical health, social relationships, and environment will have a more significant impact on mental and physical conditions and, thus, improve their mental well-being and QOL (Nitz and Choy 2004).

Therefore, combined cognitive-motor training made it possible for the elderly to perform motor training, such as balance training, in addition to a cognitive task simultaneously, which causes simultaneous involvement of motor and cognitive activity. This leads to improving mental and physical abilities and improving mental well-being and QOL (Cao et al. 2007).

It can be inferred from the results of the present study that attending cognitive-motor exercises in a group can, to a large extent, save the elderly from psychological problems caused by isolation and cognitive disorders induced by coronary heart disease. Apart from physiological benefits, previous findings indicated that daily cardio-motor activity also significantly affects psychological parameters.

The study's findings must be interpreted carefully since the COVID-19 quarantine situation influenced the study design. As such, our results may not apply to critical conditions and severe social distancing. However, as previously mentioned, a training program composed of group cognitive-motor training is beneficial to reconstructing SWB and QOL in older adults recovering from COVID-19.

Future studies could evaluate the effect of various subtypes of training modes on reconstructing SWB and QOL in older males who recovered from COVID-19.

Due to the limited population studied in this study (elderly over 60 years), further studies are needed to make the results more stable about the effect of CMT training on SWB and QOL.

It is also necessary to compare the effect of this training method with other methods to determine and use the most appropriate training method to reconstruct and promote SWB and QOL dimensions in older adults recovering from COVID-19. Meanwhile, determining the ideal CMT training prescription that targets psychological and physical health, social relationships, and environmental abilities should be considered.

One of the study's limitations was a small sample size. Of course, it should be noted that the current COVID-19 quarantine situation in the community led to the use of a small sample size. Our other limitation was that we did not evaluate the sociocultural factors, nutritional conditions, activity outside study time, and genetic differences between subjects. Further research with a longitudinal study design is recommended. This study only reports the effectiveness of two individual and group cognitive-motor training designs on reconstructing SWB and QOL in older males who recovered from COVID-19. Future studies that may explore elderly satisfaction in different designs of cognitive-motor training are also recommended.

Conclusion

A cognitive-motor training design with group-based activities yields better test scores in reconstructing SWB and QOL in older males who recovered from COVID-19 compared to a cognitive-motor training design with individual activities irrespective of their demographic characteristics. Group cooperation is more effective in 'SWB achievement,' 'emotional well-being,' 'social well-being,' and 'QOL' than individual training.' In contrast, cognitive-motor training design without group cooperation, entirely focused on individual activities, is effective in domains of 'cognitive well-being,' 'physical health,' and 'environment.' The key to a successful cognitive-motor training execution is in the design selection in consideration of the specific objectives of the course. What is certain is that a long-term perspective is needed for promoting SWB and QOL and independence of daily life for older adults recovering from COVID-19 and for constructing sustainable social systems in this aging society.

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Data availability The datasets generated during or analyzed during the current study are available from the corresponding author upon reasonable request.

Declarations

Conflict of interest The authors have no conflicts of interest to declare relevant to this article's content.

Ethics approval The study protocol has been approved by Regional Research Ethics Committee at Baqiyatallah University of Medical Sciences (reference IR.BMSU.REC.1399.392).

Consent to participate Informed consent was obtained from all participants in the study.

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