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Original Article

The Contribution of Physical and Mental Trainings to Depression and Insomnia Disorders in Older Adults

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Introduction: Aging is associated with biological changes and may lead to various cognitive behavioural disorders such as insomnia and depression. Non-pharmacological interventions with pharmacological therapies would be effective, economical, and safe. The present study compared the effect of muscle strength-range of movement (MSROM) training and digital game on insomnia and depression disorders in older women and men.

Methods: This was a quasi-experimental pre/post- intervention. After recruitment invitations and screening, 92 participants were randomly assigned into three groups including physical training (PT; n = 31), mental training (MT; n = 30) and control group (CG; n = 31). Insomnia and depression were measured by insomnia severity index and geriatric depression scale (short form), respectively. The training programs were held 3 days per week for 8 weeks. Physical training began with 25 minutes in the first week and finished with 60 minutes in the eighth week using Borg rating of perceived exertion within the desired 13 to 15 range. A mental game has been launched on Android operating systems on cell phones/tablets which consisted of 4 games with 3 levels. Differences in variables were assessed via Factorial ANOVA and Bonferroni post hoc test ($p \leq 0.05$).

Results: The Bonferroni post-hoc test revealed significant decreases in PT compared with CG in men ($p = 0.010$) and women ($p = 0.038$) regarding insomnia. Furthermore, there were significant decreases in PT compared with CG ($p = 0.005$) and PT compared with MT ($p = 0.003$) in men regarding depression; Significant decreases were also observed through comparing PT with CG ($p = 0.043$) in women regarding depression.

Conclusion: Findings demonstrated that MSROM training improved moderate insomnia and mild depression compared to smart thinker training in older women and men regardless of gender.

Keywords: MSROM, Smart Thinker, Insomnia, Depression, Aging

Introduction

Aging is associated with biological changes leading to various cognitive behavioural disorders such as insomnia and depression. This greatly affects daily activities and life quality of the elderly (1, 2).

Insomnia may occur in different ages; but older adults are more at risk. It is reported that 50% of people over the age of 65 tolerate this disorder, and it is more common in women (2).

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In addition, the prevalence of depression in the older adult has been higher. Depression in later life increases personal suffering, caregiver burden, and the risk of medical illness, disability, social isolation, falls, hospitalization, suicide, and non-suicide mortality. Depression has a greater impact on health than chronic diseases, such as angina and diabetes (3).

Pharmacological treatment of the disorders is associated with considerable side effects such as weight gain, blurred vision, anaemia, drowsiness, and increase of falling (4, 5). Simultaneously, instability condition and recurrence may make treatment more difficult.

Therefore, probably the use of non-pharmacological interventions with pharmacological therapies would be more effective, more economical, and safer. Also, physical training is an intervention. It is known that physical inactivity is one of the five leading risk factors for death in older people which is associated with decline in cognitive performance (6).

The results of a meta-analytic study indicated the effectiveness of physical training on reducing depression in older adults (1). On the other hand, another meta-analysis has shown that these interventions had no significant effect (7). Various results have been reported on the effect of physical activity on sleep quality in older adults (8, 9).

The reason for worrying about training for the elderly is lack of knowledge regarding appropriate training prescription for older adults in light of the potential risks and benefits of various doses and types of training. Therefore, some studies have used special trainings for older adults called Muscle Strength-Range of Movement (MSROM). Low risk of falling or physiological disorders such as a sudden rise in blood pressure and heart rate are emphasized (10).

Mental trainings are a kind of non-pharmacological treatments for behavioural disorders. Findings of research have shown that mental trainings including digital games enhance several aspects of behaviour through mechanisms such as neurogenesis and increased brain plasticity (10).

Some studies have reported that after a period of mental training, insomnia and depression disorders improved in the older adults (11-14); While some reviews have reported conflicting findings (15, 16).

Some researchers who used mental protocols for controlling depression and insomnia in older adults applied trainings such as chess and yoga (13, 17, 18). On the other hand, researches who used digital games have not measured mild depression and moderate insomnia (19).

Finally, more research is required due to the importance of the issue of older adults, age-related diseases, movement restrictions, and medical costs, as well as the lack of adequate research, especially on the effect of digital training and conflict results, therefore, the randomized control trial study compares the effect of eight-week MSROM training and digital game on mild depression and moderate insomnia disorders in older women and men. Findings may provide insight for the control of depression and insomnia disorders.

Methods

Design and participants

This was a quasi-experimental pre/post-intervention study. Before the start of the study, recruitment invitations were distributed across the city. After selection of participants and initial evaluations, the authors collected the information about schedules and the voluntarily signed consent of 178 older adults from Aliabad Katoul city, Golestan province, Iran in 2019.

All participants were examined for a number of physiological tasks with respect to the following inclusion criteria: scores 5 to 8 for geriatric depression scale-short form (10), score 15 to 21 in insomnia severity index (20), normal eyesight and hearing, no skeletal and physiological diseases restricting movement, not using antidepressants and anti-Alzheimer's drugs and the ability to read and write.

Lack of knowledge about the number of population and use of screening for entering the research were considerable. Therefore, the sample size was calculated based on the following equation, after analysing some studies (21- 23).

$$\text{Cohen's } d = M1 - M2 / \sigma\text{pooled}$$

The effect size for these studies was estimated between d = 0.40 to 0.78, Power = 0.85 to 0.90 with $\alpha = 0.05$. The initial estimated sample size was 13.32, but due to the availability of the participants, 15 people were selected for each group.

Finally, a total of 95 older adults were randomly selected and divided into three groups: physical training (PT; 16 women and 16 men), mental training (MT; 16 women and 15 men), and control group (CG; 16 women and 16 men). ninety two participants completed the protocol accurately till the end of the experiment and 3 people left the study. (Figure 1)

After receiving the written consents, an introductory session was held. During the training sessions, participants were asked not to change their life style regarding sleep/wake cycle, daily activity and their diet.

Instrument

Insomnia Severity Index: This was a seven-item self-assessment questionnaire composed of four-choice items. The scores indicated the severity of the disorder. The total score was interpreted as follows: absence of insomnia (0–7); sub-threshold insomnia (8–14); moderate insomnia (15–21); and severe insomnia (22–28) (20). The validity and reliability of this questionnaire in older adults were calculated as 0.91 and 0.93, respectively (24). Moreover, the reliability of this questionnaire in Iranian society was assessed as 0.80 using Cronbach's alpha (25).

Geriatric Depression Scale (short form): This was a 15-item self-assessment questionnaire performed to diagnose the severity of depression in older adults. Each question had 1 point that should only be answered with Yes or No. The total score was interpreted as follows: normal (0–4); mild (5–8); moderate (9–11); and severe (12–15) (10). The validity and reliability of the questionnaire were evaluated through clinical and

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research processes (26). Researchers found out that it carried 92% sensitivity and 89% specificity against diagnostic criteria. Moreover, having high correlation (P = 0.001, r = 0.84), it has an acceptable distinction power in identifying depressed older adults (26).

Before and after the test, the weight and height of participants using a digital scale model GES-07 with an accuracy of ± 0.1 kg in were measured. This was conducted without shoes and with minimum clothing and a wall gauge model 44440 which was made by Kaveh Company Iran with accuracy ± 1 cm. Moreover, the subjects were standing next to the wall. Body mass index was calculated by dividing body weight (kg) by squared height (m^2). Waist to hip ratio was obtained by an inelastic tape measure, without bearing any pressure on the body, with an accuracy of 1 centimeter. This was conducted through measuring the waist circumference in the narrowest area between the ribs to the iliac crest and dividing it to the size of the pelvic circumference in the largest part of the bulge of serine muscle (27).

The Program and protocol

Physical training protocol: MSROM section involves a set of body movements performed in 3 days per week for 8 weeks. Equipment used here consisted of a chair, a ball, 2 to 3 lb hand weights, and a resistance band with handles. Participants should imitate the movements of an instructor and complete muscular range of motion trainings coupled with a light cardio. According to the principle of overload, duration would be raised by 5 minutes per week. It began with 25 minutes in the first week and finished with 60 minutes in the eighth week. The Borg rating of perceived exertion was used within the desired range of 13 to 15 (Table 1) (10). The original Borg 6 – 20 scale has most often been validated in older adults and designed to describe perceptions of physical exertion during a wide range of training modes. The scale consists of numbered categories, 6 – 20, and verbal cues, from “very, very light” to “very, very hard” (28). Whenever, participants expressed tiredness, they would sit on a chair. Warm-up and cool-down activities consisted of 5 minutes of stretching movement.

Mental training protocol: The smart thinker is one of the interesting games that done 3 days per week for 8 weeks. The game designed for older adults has been launched on Android operating system on cell phones/tablets. The program consists of 4 games with 3 levels: easy, medium and hard. The challenges and difficulty of the games are increased by the software. The games are:

High -Low: A math puzzle game that requires players to decide whether a digit is greater/less than previously displaced digit. A user needs to be constantly focused to quickly recall the previously displayed digit.

Color game: A game displaying a grid of colors that becomes visible on a background color. A user must constantly be focused to keep up with grid colors are match the background color due to constant change.

Rock, paper, scissors: A popular fun game that uses concepts rock, paper, or scissor. In each round, the users follow the rules to determine which object wins.

Find me: A sentence game that requires users to constantly recall displayed sentences and the object places in each round (29).

The control group would be scheduled not to initiate any supervised training programs until the end of the period.

Statistical analysis

Data were expressed as the mean ± SD, with the significance set at $p < 0.05$ using the SPSS software packages. Distributional assumptions were verified using the Kolmogorov-Smirnov test.

Homogeneity of initial values was measured by one-way analysis of variance (ANOVA).

Independent sample t-test was used to compare delta among pre and post-test of variables. Paired sample t-test were used to compare post-test with baseline. Comparisons among measures at baseline and after the intervention in each group and between groups were made using a 2×3 Factorial ANOVA and Bonferroni post hoc test.

To determine the significant difference between the variables in the groups of women and men, researchers used 2×2 Factorial ANOVA test.

Ethical consideration

This study was conducted in accordance with the code of ethics of the World Medical Association (Declaration of Helsinki) and approved by the Ethics and Research Committee of the Islamic Azad University, Aliabad Katoul Branch (code: IR.IAU.AK.REC.1397.010). Moreover, it has the registration code IRCT20190131042571N1 issued by Iranian Registry of Clinical Trials. All ethical considerations have been observed in various stages.

Results

Distribution of age, level of education, domain of social functioning and rate of smoking were higher in men than women. Marital status was similar among women and men. The family income was less than average wage. Descriptive characteristics of participants have been shown in table 2.

Paired samples t-test regarding insomnia of PT groups revealed significant decrease in post training compared with the baseline in women (p = 0.001) and men (p = 0.001). Also, concerning depression of PT groups, researchers found significant decrease in post training compared with the baseline in women (p = 0.001) and men (p = 0.001). (Table 3)

One-way ANOVA indicated no significant difference in pre-test between the groups regarding depression and insomnia. Factorial ANOVA related to insomnia revealed significant differences between the groups in women ($F_{2, 44} = 24.851$, p = 0.001) and men ($F_{2, 44} = 16.266$, p = .001). Bonferroni post-hoc test indicated significant decreases in PT compared with CG in men (p = 0.010) and women (p = 0.038) regarding insomnia. Furthermore, significant

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differences were observed regarding depression between the groups in women (F2, 44 = 14.315, p = 0.001) and men (F2, 44 = 20.421, p = 0.001). Bonferroni post-hoc test demonstrated a significant decrease in PT compared with CG (p = 0.005) and in PT compared with MT (p = 0.003) in men regarding depression; there was also a significant difference in PT compared with CG (p = 0.043) in women. (Table 3)

In addition, in order to compare the genders in groups, delta changes revealed no significant difference between women and men in the variables (F2, 44 = 2.132, p = 0.155). No significant differences were found between other research variables.

Discussion

The purpose of this study was to compare the effectiveness of two training methods. They included MSROM and smart thinker regarding moderate insomnia and mild depression between women and men. Findings revealed significant improvements between PT and CG in women and men with respect to moderate insomnia. Afterwards, physical activities in older adults were confirmed to improve sleep quality and increase in sleep duration (30). Moreover, after an acute exercise training in the morning and evening, the authors reported similar findings (31). On the other hand, some studies demonstrated no significant correlation between the amount of physical activity and quality/quantity of sleep (32, 33). Exercising was significantly correlated with a decrease in rapid eye movement sleep, which explained the mechanism of physical activity's effect on sleep (34).

A recent systematic review illustrated that evening exercise training can positively affect sleep, but vigorous exercise might impair sleep-onset latency, and thus, the total sleep duration (35). The intensity of activity should to be considered while elaborating the relationship between training and sleep quality. Low to moderate intensity of Tai Chi programs were reported to be beneficial in improving sleep quality (36). The training program of the present study was also performed in the evening with moderate intensity.

Studies have shown that during exercise training, the catabolic system is raised by glucagon and cortisol hormones to consume energy. To restore energy, the body needs to increase the anabolic system during rest time; especially in deep night's sleep. Therefore, fatigue, desired drowsiness and improvement of sleep quality after training are known as body's control system to create a balance between catabolic and anabolic processes (8).

The results of this study revealed significant improvements regarding mild depression between PT and CG in women and men; and between PT and MT in men. Various studies have reported positive effects of exercise training regarding the depression of older adults (5, 8).

Table1. Duration and intensity physical training program in eight weeks

Week	First	Second	Third	Fourth	Fifth	Sixth	Seventh	Eighth
Duration (min)	25	30	35	40	45	50	55	60
Intensity (RPE)	12	12	13	13	14	14	15	15

Table 2. Descriptive characteristics of participants

Group	Gender	Age (year)	BMI (Kg/m^2)	WHR (%)	MAP (mmHg)
PT	**Women (16)**	72.62 ± 6.63	24.90 ± 3.12	81.43 ± 6.68	101.62 ± 4.30
	Men (15)	74.73 ± 6.57	23.70 ± 2.69	83.40 ± 4.38	100.86 ± 4.13
MT	**Women (15)**	72.40 ± 5.65	26.03 ± 3.67	83.73 ± 6.73	100.53 ± 4.43
	Men (15)	74.33 ± 7.15	23.15 ± 1.90	82.53 ± 5.28	101.06 ± 4.47
CG	**Women (16)**	72.25 ± 5.93	24.05 ± 4.00	100.53 ± 4.43	99.18 ± 3.39
	Men (15)	77.33 ± 6.21	25.02 ± 2.26	101.06 ± 4.47	100.00 ± 5.37

Abbreviations: PT: Physical Training; MT: Mental Training; CG: Control Group; BMI: Body Mass Index; Kg/m^2: Kilogram per Square Meter; WHR: Waist Hip Ratio; MAP: Mean Arterial Pressure; mmHg: Millimetre of Mercury

Table 3. Factorial analysis of variance parameters before and after eight weeks of intervention

Group		PT Women = 16; Men = 15		MT Women = 15; Men = 15		CG Women = 16; Men = 15	
Index	**Gender**	**Pre-test**	**Post-test**	**Pre-test**	**Post-test**	**Pre-test**	**Post-test**
ISI	**Women**	17.87 ± 1.78	16.87 ± 1.50$^{*\#}$	17.13 ± 1.59	16.86 ± 1.72	17.75 ± 1.69	17.68 ± 1.85
	Men	17.40 ± 1.80	16.86 ± 1.68$^{*\#}$	17.33 ± 2.05	17.06 ± 1.70	17.46 ± 1.84	17.60 ± 1.54
GDS-SF	**Women**	7.37 ± 1.58	6.50 ± 1.78$^{*\#}$	7.06 ± 1.75	6.80 ± 1.85	7.56 ± 1.82	7.43 ± 1.03
	Men	6.66 ± 1.34	6.04 ± 1.43$^{*\#¥}$	7.40 ± 1.59	7.06 ± 1.48	6.88 ± 1.25	6.80 ± 1.40

Abbreviations. ISI. Insomnia Severity Index; GDS-SF: Geriatric Depression Scale-Short Form.
* Significant differences between the pre-test and post-test values (p ≤ .05).
# Significant differences between PT with CG (p ≤ .05).
¥ Significant differences between PT with MT (p ≤ .05).

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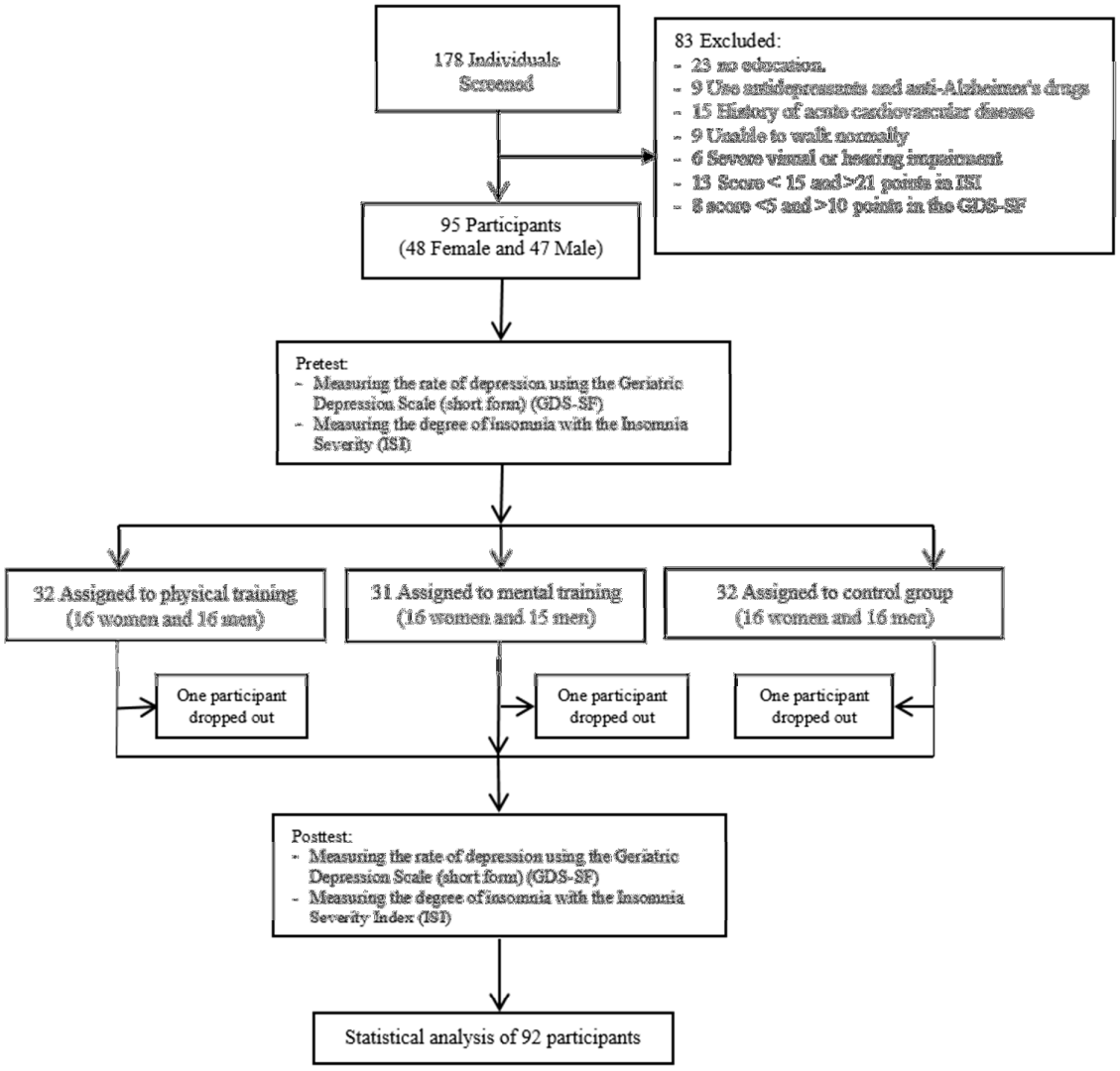

Figure 1. Subject flow diagram from process of research

According to the "endorphins hypothesis", training augments the secretion of endogenous opioid peptides in the brain and causes general euphoria. In turn, the latter reduces depression levels (37).

The majority of published evidence relevant to this research suggests an inverted dose-response relation between training frequency and depression. More specifically, a recent study examined the efficacy 8 weeks exercise training in low-frequency with 1 session/week and high-frequency with 3-5 sessions/week. Result has shown that high-frequency training was more effective in reducing depression (38).

Findings also mentioned that replacing only 30 minutes of sedentary time with physical activity during one day led to with a 5% decrease in depression score (39).

Continuous physical activity can positively affect mental health and reduce depression. This is because it can strengthen social support such as growing friendships, emotional relationships, and discussing problems (40).

Results have revealed that smart thinker mental training had no significant effect on variables; whereas, some researchers observed an improvement in the sleep quality of the older adults after mental training. Researchers reported that the training program of individuals were not similar (13). Therefore, personalization of computer training regarding the ability of the older adults was considerable; whereas, mental training of the present study was similar for participants. Research results also indicated that the effectiveness of mental training on improving depression in older adults was more significant in long-term protocols (41).

The current study found no significant difference between genders regarding moderate insomnia and mild depression. However, numerous studies reported

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that women experienced poorer sleep quality for specific factors such as menopause (42, 43). Some studies revealed that depression is more prevalent in women (44, 45), and can be influenced by serotonin 5-HT2A receptors. The difference in results may be related to the large sample size in their studies.

Conclusion

Findings demonstrated that MSROM training improved moderate insomnia and mild depression compared to smart thinker training in older women and men. This is regardless of their gender, and probably can prevent them from getting worse. Concerning the growth of elder population and increase of economic costs of health in Iran, the authors recommend the use practical and safe training programs such as MSROM, designed for the elderly.

Study limitation

There were some limitations to this study; however, future research can address them. There was low adherence to the training by some older adults, which required supervision to keep it to minimum. The survey covered only the older adults living in Aliabad Katoul city. Comparing the elderly living in two or more cities might lead to more accurate conclusions. However, through measuring biological variables such as neurohormonal and brain imaging there is a need for long-term studies in larger groups.

Conflict of interest

Authors declared no conflict of interest.

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Author's contributions

All authors contributed to the conception and design of the study and drafting of the initial manuscript. FH and RR contributed substantially to the acquisition of data. AJ and RR analysed and interpreted the data. FH and SGH drafted the original manuscript and all authors critically revised it. All the authors approved the final version submitted for publication and take responsibility for the statements made in the published paper.

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