

Senam Jantung Sehat Seri-I Improves Physical Fitness, Decreases the GDS Scores and the Level of NF-kB Plasma Elderly Depression

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ABSTRAK

Kemurungan dapat mengurangi kualiti hidup di kalangan warga emas. Senaman dapat membantu untuk mengurangkan masalah ini. Oleh yang demikian, untuk orang tua adalah diperlukan. Senam Jantung Sehat Seri-I (SJSS-I) merupakan salah satu sukan yang dicadangkan untuk orang tua. Tekanan oksidatif yang berlaku pada orang tua yang murung dapat dicirikan dengan peningkatan aras faktor nuklear-kappa B (NF-kB) plasma. Tujuan penyelidikan ini adalah untuk mengkaji kesan SJSS-I dalam meningkatkan kecergasan fizikal sambil menurunkan skor Skala Kemurungan Geriatrik-15 (GDS-15) dan aras NF-kB plasma pada orang tua. Reka bentuk kajian ini melibatkan 30 orang tua berusia >60 tahun yang dibahagikan kepada tahap kemurungan ringan dan sederhana dan menjalani SJSS-I 3 kali seminggu selama 12 minggu. Kecergasan fizikal diukur dengan ujian 6 minit, skor GDS-15 dan pengambilan darah periferil sebelum dan selepas senaman. Aras NF-kB diukur dengan menggunakan asai ELISA. Ujian-t berpasangan dan Wilcoxon digunakan untuk analisa statistik. Kecergasan fizikal dalam kumpulan kemurungan ringan adalah lebih tinggi daripada kumpulan kemurungan sederhana (352.73 ± 8.86 m vs 264.40 ± 118.18 m; $p < 0.001$). Skor GDS-15 dan aras plasma NF-kB dalam kumpulan kemurungan ringan adalah lebih rendah dibandingkan dengan kumpulan kemurungan sederhana (3.00 vs 7.00 ; $p = 0.001$ dan 7.60 ± 4.17 pg/ml vs 8.86 ± 3.85 pg/ml; $p < 0.001$). SJSS-I dapat meningkatkan kecergasan fizikal dan mengurangkan skor GDS-15, aras NF-kB plasma di kalangan warga tua kemurungan ringan daripada yang kemurungan yang sederhana.

Kata kunci: depresi, kecergasan fizikal, orang tua, plasma NF-kB

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ABSTRACT

Depression decreases the quality of life of the elderly. An exercise can help overcome this problem. Therefore, an exercise in the elderly is needed. *Senam Jantung Sehat Seri-I* (SJSS-I) was one of the proposed sport for the elderly. Oxidative stress that occurs in depressed elderly is characterised by an increase in plasma NF-kB levels. This research aimed to investigate the effects of SJSS-I in enhancing the physical fitness while decreasing the Geriatric Depression Scale (GDS)-15 score and plasma NF-kB level in the elderly. The experimental design was involved 30 elderly aged individuals with >60 years that further categorised into mild and moderate depression level, and then completed the SJSS-I for 3 times a week for 12 weeks. Physical fitness was measured by the 6-minute test, GDS-15 score, and peripheral blood withdrawal done in pre- and post-workout. Plasma NF-kB level was measured by ELISA assay. A paired t-test and Wilcoxon test were used in statistical analysis. The results showed the physical fitness for mild levels was higher than moderate depression (35.273 ± 8.86 m vs 264.40 ± 118.18 m; $p < 0.001$). Depressed GDS scores and NF-kB plasma levels were lower in mild depression group than moderate depression group (3.00 vs 7.00; $p = 0.001$ and 7.60 ± 4.17 pg/ml vs 8.86 ± 3.85 pg/ml; $p < 0.001$). SJSS greatly improved of the physical fitness with a decrease in GDS-15 scores and plasma NF-kB in the elderly with mildly depression than those with moderate level of depression.

Keywords: elderly, depression, NF-kB plasma levels, physical fitness

INTRODUCTION

Expectation age increasing in elderly is the indicator of the success of achieving national development, especially in the health sector. If the life expectancy of the elderly increases, the quality of their life increases. Since 2004-2015, life expectancy in Indonesia has increased from 68.6 years to 70.8 years and the projection for 2030-2035 is 72.2 years (Kementerian Kesehatan Republik Indonesia 2016).

The morbidity rate is used to measure health status. The lower number of morbidity indicates that the health level of the elderly is getting better

with an increase of life expectancy. Morbidity of the elderly population in 2014 was 25.05%, indicating that there are every 25 out of 100 elderly who were suffering with certain diseases. Most diseases in the elderly are non-communicable and chronic diseases including hypertension, arthritis, stroke, chronic obstructive pulmonary disease and diabetes mellitus (DM). In addition to the emergence of non-communicable diseases in the elderly, there are also chronic diseases such as cardiovascular disease, cancer, osteoarthritis, and osteoporosis (Afif 2014). The prevalence of elderly who were aged >65 years, with one chronic

disease was 85%, two chronic diseases were 20% and three or more chronic diseases were 33% (Bestari & Kusuma Wati 2016).

When the high morbidity cannot be overcome, then it becomes a burden to the nation. One of the appropriate effort to reduce the morbidity, improve health status and increase the life expectancy of the elderly is via a physical activity in the form of safe exercise that can improve the elderly physical fitness. The elderly are safe with some light-to-moderate intensity aerobics with the frequency of 3-5 times a week in duration of 20-60 minutes/activity (Lee et al. 2017).

Physical fitness in the elderly is generally poor, with a decline in physical fitness of around 30-50% at the age of 70 years (Chung et al. 2014). Elderly who were diagnosed with depression, were displayed with a further reduction of physical fitness than healthy elderly where there was a need to approach the right sport to increase their physical fitness (Wedhari 2013).

Depression is an emotional disorder and mental health problems that occur in the elderly where it is life-threatening if not being recognised and left untreated. Depression always comes with the feeling of sadness, helplessness, and pessimism related to suffering, directed at oneself or others. According to World Health Organization (WHO 2015, depression is the leading cause of disability as well as the major contributor to the global burden of disease (Touhy et al. 2014).

According to World Health Organization (WHO 2015), the

prevalence of depression in the elderly over 60 years is around 10-20% whereas, it is 15.9% in developing countries. In developing countries, there was <35% of depressed patients who sought for adequate medical care. The Indonesian Ministry of Health expected that in 2025 the prevalence of depression in the world's elderly will reach 36 million worldwide (Forti et al. 2015).

One of the sports that can be done to improve physical fitness among depressed elderly is SJSS-I. This gymnastic exercise was created by the Indonesian Heart Foundation since 1978. SJSS-I is programmed to increase the ability of the heart, lungs, muscle strength, muscle endurance and the flexibility of joints. SJSS-I also can reduce those risk factors for heart disease, like high cholesterol, high triglycerides, hypertension, obesity, and DM. However, the research on SJSS-I in improving the physical fitness of healthy elderly and reducing systolic and diastolic pressure for elderly hypertension are limited. Research on the effect of SJSS-I on depressed elderly has not been reported. SJSS-I has VI series and it is a safe exercise for the elderly due to its simple and slow rhythms (Anonym 2001).

Nuclear Factor-kappa B (NF-kB) is a family of transcription factors that play a role in the cellular response to stimuli such as stress, cytokines, free radicals, heavy metals, ultraviolet radiation, oxidized LDL, and bacteria or viruses (antigens) (Almi & Abdurrohman 2015). Depression could trigger an increase in plasma NF-kB levels. Depressive conditions require up to 100-200

times more, hence causing oxidative stress. Oxidative stress causes the increase of anaerobic metabolism and inflammation due to the high level of electron leak by mitochondria, which becomes Reactive Oxygen Species (ROS) (Hacimusalar & Esel 2018).

The ROS is a free radical that is very harmful to the body. The ROS causes the lipid peroxidation (fat oxidation on the membrane of muscle cells) and causes cells to become easier to experience the aging process (Hacimusalar & Esel 2018). The physiological aging process that occurs in the elderly, becomes faster when accompanied by depression, where it potentially threatens the lives of the elderly. Additionally, plasma NF-kB levels are used as biomarkers of inflammation in depressed elderly.

The majority of depressed patients receive antidepressant treatment. However, patients undergoing antidepressant treatments often have side-effects and cannot continue the treatment. An approaches with no or less side-effects is highly needed. Sports is one of the complementary therapies for mildly and moderately depressed patients (Fitri et al. 2014). Therefore, SJSS-I may improve the physical fitness with the reduction of plasma NF-kB levels among mildly and moderately depressed elderly.

To date, there is no gold standard for sports that have been established to reduce mild and moderate depression in the elderly. Therefore, this research is important to determine the effect of SJSS-I in improving the physical fitness with the decrease of Geriatric Depression Scale (GDS) scores and

plasma NF-kB level among the elderly.

MATERIALS AND METHODS

Study Design

This was an experimental with research variables consisting of mild depressed elderly, moderate depression, physical fitness, plasma NF-kB level and GDS-15 score, with a total sample of 30 elderly who had fulfilled the criteria for inclusion. The criteria were: >60 years, not in hospitalization care, have MMSE values within normal limits (score 24-30), for junior secondary education history the minimum score of MMSE was 20, history of junior high school education minimum score of MMSE was 23, for educational history of Higher Education the MMSE minimum score was 24, the elderly entered the level of mild depression (Score: 5-8) and moderate depression (Score: 9-11) following measurement of depression level using GDS-15, elderly who had 60-75% Pulse Maximum Pulse (DNM) before conducting SJSS-I. Determination of the number of samples was based on the average difference formula for 2 groups with 15 elderly with mild depression and another 15 elderly with moderate depression. Plasma NF-kB level was used as biomarker for inflammation in depressed elderly. The experimental protocol was approved approved by the Health Research Ethics Committee of Universitas Padjadjaran with the number: 328/UN.6/KEP/EC/2018 and registration number: 0518020297. This study followed the ethical standards of The Declaration of Helsinki.

Study Population

The targeted population in this study was the elderly who lived in Nursing Home. The size of the population was 150. The sampling technique in this study was purposive sampling based on the sample calculation formula to test the difference in two averages and found 15 elderly with mild depression and 15 elderly with moderate depression. GDS-15 measurements were taken to determine scores and depression levels in the sample of 30 elderly to group them into non-depression (scores 0-4), mild depression (score 5-8), moderate depression (score 9-11) and severe depression (score 12-15). This study only used a sample of elderly people who had mild depression and moderate depression. Before the SJSS-I intervention, the average Maximum Pulse Rate (MPR) measured for each individual based on the formula: $60-75\% (220-\text{age})$ so that the minimum and maximum MPR value obtained. This measurement was done to determine the intensity of the sport. Sports that are safe for the elderly are in moderate intensity with pulse between the minimum and maximum range.

Measuring instrument for MPR was assisted by polar which was connected with an android tablet so that it can be seen the MPR variations of each elderly during gymnastics. During the gymnastics, the pulse rate that was below the minimum or above the maximum value were not taken as a sample. After the MPR collection, each elderly was then measured for the average MPR values of mild and

moderate elderly depressed at the level of SJSS-I.

Physical fitness data collection was measured through a 6 minutes walking test by measuring the distance travelled by the elderly when walking or running for 6 minutes (meter units) (Vancampfort et al. 2016). Physical fitness measurements were carried out before gymnastics and the 12th week after gymnastics GDS-15 score was measured by using GDS-15 instruments. The GDS score measurement was performed before gymnastics and 12th week following gymnastics. The measurements of plasma NF-kB level required the elderly peripheral blood as much as 2 ccs. Measurement of plasma levels of NF-kB as one of the biomarkers of depression in the elderly was carried out 5-10 minutes before performing gymnastics and the 12th week after gymnastics (the period between the 15 minutes to the 45 minutes) (Hacimusalar & Esel 2018). Measurement of blood biochemical parameters in the form of plasma NF-kB level was carried out using the Enzyme Link Immunosorbent Assay (ELISA) assay. A lysis procedure was carried out to lyse cell membranes and nucleolus membranes in the form of Phenyl Methyl Sulfonyl Fluoride (PMSF) DDT through the FICOLL 400 or Histopaque 1077 method to collect the intracellular NF-kB (p50 / p65).

Data Analysis

The data analysed using the Statistical Package for Social Science (SPSS) version 23. The initial step was to test the normality of the data with Shapiro-

Wilk ($p > 0.05$).

To analyse the differences in the averages of various numerical variables on the measurement of pre and post for each study group using paired t-test or Wilcoxon test (if the data were not normally distributed). Physical fitness variables used paired t-test while the GDS score variable and NF-kB plasma level used the Wilcoxon test.

RESULTS

Characteristics of the respondents in the form of data on gender, age, education, BMI, diastolic blood pressure, systolic blood pressure, and MMSE were not homogeneous between the two levels of mild and moderate depression levels with a probability value of all variables $p > 0.05$.

Data normality of all variables were with normal distribution except MMSE, height, GDS score (pre), NF-kB (pre and post).

Differences in the Effects of SJSS-I on Physical Fitness between Mildly and Moderately Depressed Elderly

To find out the difference in the effect of SJSS-I on physical fitness between mild and moderate depressed elderly, the level of analysis of unpaired t-test or paired t-test was conducted ($p < 0.05$) as listed in Table 1.

Based on Table 1, it showed SJSS-I improved the physical fitness in mildly depressed elderly ($244 \text{ m} \pm 68,94$ vs $352.73 \text{ m} \pm 88.86$; $p\text{-value} < 0.001$). SJSS-I also improved the physical fitness in moderately depressed elderly ($225.73 \text{ m} \pm 98.33$ vs 260.40

$\text{m} \pm 118.18$; $p\text{-value} < 0.001$). Physical fitness for mildly depressed elderly was greatly improved compare to moderate depressed elderly upon SJSS-I intervention ($p\text{-value} = 0.002$).

Differences in the Effect of SJSS-I on GDS Scores between Mildly and Moderate Depressed Elderly

To determine the differences in the effect of SJSS-I on GDS-15 scores between mildly and moderately depressed elderly, Mann-Whitney analysis or Wilcoxon test ($p < 0.05$) were employed as listed in Table 2

Table 2 shows SJSS-I reduced the GDS-15 scores in mildly depressed elderly people (8.00 vs 3.00 ; $p\text{-value} = 0,001$) and moderately depressed elderly (10.00 vs 7.00 ; $p\text{-value} < 0.001$). GDS-15 scores of mild depressed elderly levels were reduced in greater magnitude compared to moderately depressed elderly upon SJSS-I intervention ($p\text{-value} < 0.001$).

Differences in the Effect of SJSS-I on NF-kB Plasma Levels between Mildly with Moderately Depressed Elderly

To determine the differences in the effect of SJSS-I on NF-kB plasma levels between mildly and moderately depressed elderly, Mann-Whitney test analysis or Wilcoxon test ($p < 0.05$) were performed as listed in Table 3.

Table 3 shows SJSS-I reduced the plasma levels of NF-kB in mildly depressed elderly ($15.73 \text{ pg/ml} \pm 4.94$ vs $7.60 \text{ pg/ml} \pm 4.17$; $p\text{-value} = 0.001$). SJSS-I had an effect on decreasing

Table 1: Differences in the effect of SJSS-I on physical fitness between mild and moderate levels of depression (n = 30)

Physical fitness	Elderly Groups		p-value*
	Mild depression (n = 15)	Moderate depression (n=15)	
1 Pre-test Data :			0.553
- Average (SD)	244.33 ± 68.94	225.73 ± 98.33	
- Range	100 – 350	49 – 414	
2 Post-test Data :			0.028
- Average (SD)	352.73 ± 88.86	264.40 ± 118.18	
- Range	176 – 464	84 – 443	
Comparison of pre vs post	p<0.001**	p<0.001**	
% increase (on average)	47.0 %	19.8 %	0.002

*: used unpaired t-test; **: with a paired t-test

plasma NF-kB levels in moderately depressed elderly (14.30 pg/ml ± 3.99 vs 8.86 pg/ml ± 3.85; p-value=0.001). NF-kB plasma levels in mildly depressed elderly were reduced in greater magnitude than moderately depressed elderly upon SJSS-I intervention (p-value=0.006).

DISCUSSION

Physical fitness is the ability to do

daily work efficiently without causing excessive fatigue. In the elderly aged 70 years, there is commonly a decrease in physical fitness around 30-50% (Chung et al. 2014). Physical fitness in the elderly is generally relatively low due to the decrease in cell function. Decreasing cell function causes a decrease in energy production from aerobic and anaerobic metabolism during daily activities. Decreased metabolism in the elderly is more

Table 2: Differences in the effect of SJSS-I on GDS-15 scores between mildly and moderately depressed elderly (n = 30)

GDS Score	Elderly Groups		p-value
	Mild depression (n = 15)	Moderate depression (n=15)	
1 Pre-test Data :			<0.001
- Median	8.00	10.00	
- Range	5 – 8	8 – 11	
2 Post-test Data :			<0.001
- Median	3.00	7.00	
- Range	0 – 4	6 – 8	
Comparison of pre vs post	p = 0.001**	p<0.001**	
% decrease (median)	62.5%	27.3%	<0.001

*: used the Mann-Whitney test; **: with the Wilcoxon test

Table 3: Differences in the effect of SJSS-I on NF-kB plasma levels between mildly and moderately depressed elderly (n = 30)

Expression of NF-kB protein	Elderly Groups		p-value
	Mild depression (n = 15)	Moderate depression (n=15)	
1 Pre-test Data :			0.443
- Average (SD)	15.73 ± 4.94	14.30 ± 3,99	
- Median	15.15	13.31	
- Range	11.10 – 26.85	11.05 – 27.77	
2 Post-test Data :			0.078
- Average (SD)	7.60 ± 4.17	8.86 ± 3.85	
- Median	5.40	7.90	
- Range	3.53 – 18.83	5.22 – 21.27	
Comparison of pre vs post	p = 0.001**	p = 0.001**	
% decrease (median)	52.9 %	43.3 %	0.006

*: used the Mann-Whitney test; **: and Wilcoxon test.

dominant due to the decrease of aerobic metabolic ability (Almi & Abdurrohman 2015).

Elderly depression has low physical fitness compared to healthy elderly (Zanco et al. 2106). Vice versa, a healthy elderly with low physical fitness have higher risk of depression by 75% and those with moderate physical fitness have the risk 23% (Stubbs et al. 2016). This is coherent with Table 1 where the SJSS-I could improved the physical fitness in both mildly and moderately depressed elderly. Physical fitness for mildly depressed elderly was improved further as compared to moderate depression group.

Physical fitness in mildly depressed elderly improved after SJSS-I because of the gradual improvement on the structure and brain function. Through MRI examination, the damage to brain structure can be detected by a decrease in hippocampal volume and brain function in inter-cell communication

between the posterior cingulate cortex, the anterior ventral cingulate cortex, the hippocampus, and bilateral inferior cortex parietal (Zhang et al. 2016). The SJSS-I that performed 3 times a week for 12 weeks could gradually improve the brain structure and function.

Table 2 shows SJSS-I significantly reduced the GDS-15 scores in both mildly and moderately depressed elderly. The decrease of GDS-15 score on mildly depressed elderly was lower than moderately depressed elderly. When exercising with light intensity and moderate intensity, the NF-kB gene expression in the hippocampus is decreased so that BDNF protein expression is increased in the hippocampus and plasma. The expression of the NF-kB gene in the hippocampus is closely associated with the plasma plasma NF-kB levels in macrophage cells thus affecting depression in mild and moderate depression (Zhang et al. 2016). The

increase in physical fitness in the mildly depressed elderly caused a decrease in the GDS-15 score compared to the decrease in the GDS-15 score of moderately depressed elderly.

Table 3 shows SJSS-I reduced the NF-kB plasma levels both in mildly and moderately depressed elderly. NF-kB plasma levels in mildly depressed elderly were reduced greater than moderately depressed elderly (p-value=0.006).

Decreased plasma NF-kB levels was closely related to the increased physical fitness after exercise. The improvement of physical fitness improved cell communication in the brain and it influenced the functioning of other organs such as increased endothelial function and decreased arterial stiffness, decreased oxidative stress, decreased blood vessel inflammation, increased oxidation capacity increased mitochondrial function, increased angiogenesis and neurotrophic factors (BDNF) (Afif 2014).

NF-kB also plays a key role in the immune system against infections in the human body as well as immune plasticity and memory responses in the brain (Immune and Neuroprotective 2018). The heavier the physical activity carried out, the more oxygen is needed for muscle contractions up to 100-200 times so that it causes oxidative stress. Oxidative stress increases the anaerobic metabolism and inflammation by the upregulation of ROS (Hacimusalar & Esel 2018).

ROS is a free radical that harmful to the body. ROS such as superoxide anion and hydrogen peroxide can cause oxidative damage to DNA,

protein, and fat. ROS also causes lipid peroxidation (on the membrane of muscle cells) and this will further fasten the aging process (Hacimusalar & Esel 2018). The SJSS-I performed with a moderate-intensity does not induce oxidative stress for the elderly.

This research was limited to Bandung, where the nursing home is located in West Java and also in Garut, Bekasi, and Kerawang. The findings of SJSS-I are applicable to the elderly in West Java.

CONCLUSION

Regular Exercise like SJSS-I was found to improve physical fitness and decrease the GDS-15 scores and the level of plasma NF-kB in mildly and moderately depressed elderly.

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