



Three Times a Week Healthy Heart Gymnastics Series-I to Improve Physical Fitness of Elderlies

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Abstrak

Penurunan kebugaran jasmani berkontribusi terhadap angka kesakitan dan kematian lansia. Kebugaran jasmani seseorang yang berusia > 60 tahun ditentukan oleh tingkat kebugaran jasmani melalui tes jalan 6 menit (six minutes test). Upaya untuk meningkatkan derajat kebugaran jasmani diperlukan olahraga salah satunya Senam Jantung Sehat Seri-I yang memperhatikan frekuensi latihan yang tepat. Tujuan dari penelitian ini adalah untuk menganalisis frekuensi Senam jantung Sehat Seri-I yang dapat meningkatkan kebugaran jasmani pada lansia. Penelitian ini menggunakan metode pre-experimental dengan pendekatan pre-test dan post-test design yang mengikutsertakan 27 lansia sehat dan rutin melakukan senam Jantung Sehat Seri-I yang tinggal di Panti Whreda. Subjek penelitian terbagi menjadi 3 kelompok berdasarkan frekuensi aktifitas senam per minggu yaitu 3, 4, dan 5 kali seminggu selama 6 minggu. Peningkatan kebugaran jasmani ditentukan melalui jarak tempuh yang dilalui lansia setelah tes jalan 6 menit (six minutes test) pada minggu ke-1 dan ke-6. Perbedaan rata-rata jarak tempuh setelah dilakukan senam secara statistik dianalisis menggunakan uji-t berpasangan dengan p-value <0,05 dinyatakan sebagai signifikan. Berdasarkan hasil penelitian menunjukkan kelompok lansia yang melakukan Senam Jantung Sehat Seri-I 3 kali seminggu memiliki rata-rata perbedaan jarak tempuh yang signifikan (mean difference = -106,0 ; p =0,009), sementara kelompok 4 dan 5 kali seminggu tidak menunjukkan hasil yang signifikan. Penelitian ini memberikan bukti bahwa Senam Jantung Sehat Seri-I 3 kali seminggu meningkatkan kebugaran jasmani.

Abstract

The decrease of physical fitness contributes to the morbidity and mortality rates of elderlies. Physical fitness of a person aged > 60 years is determined by the level of physical fitness examined through a six minute test. Efforts to improve physical fitness level through sport are needed, one of which is Healthy Heart Gymnastics Series-I (Senam Jantung Sehat Seri-I) with the accurate exercise frequency. The purpose of this study was to analyze the frequency of Healthy Heart Gymnastics Series-I that could improve cardiorespiratory fitness in elderlies. This study used pre-experimental method with pre-test and post-test design approach involving 27 healthy elderlies who followed a routine Healthy Heart Gymnastics Series-I exercise at the Nursing Home. The research subjects were divided into 3 groups based on the frequency of gymnastics activity per week including 3, 4, and 5 times a week for 6 weeks. Improved physical fitness was determined through the distance traveled by the participants on the 6-minute test at week 1 and week 6. The traveled distance difference was analyzed by using Independent t-test with a p-value <0.05. The elderly group who did Healthy Heart Gymnastics Series-I three times a week had a significant mean difference (-106.0; p = 0.009), while groups who performed 4 and 5 times a week exercises did not show significant results. In conclusion, this study provides evidence that Healthy Heart Gymnastics Series-I three times a week could improve cardiorespiratory fitness.

INTRODUCTION

Ministry of Health of the Republic of Indonesia (2016) noted that the prevalence of elderly over 60 years in the world since 2013 had increased. Martinson and Berridge (2015) explain the increasing prevalence of the elderly has caused various physical and psychological problems due to their physiological and psychological decrease. The physiological and psychological degradation process made it difficult for the elderly to do their daily physical activities independently, and instead, become dependent on other people. The limitation in carrying out daily physical activity can result in degenerative diseases, physical disability, the disruption of pain, the decrease of cognitive function, sleep disorders, and social isolation. Likewise, the limited capability in the elderly generates the difficulty to adapt to the conditions of the aging process, as well as the feeling of lonesome, frustrated, and losing self-confidence resulting in depression that affects their quality of life.

As people get older, a degradation in the physical fitness happens. The decrease in the degree of physical fitness of the people aged 70 years is around 30-50% (Chung, Baguet, Bex, Bishop, & Derave, 2014). The tendency is caused by the decrease in body functions (Gorska-Ciebiada, Saryusz-Wolska, Borkowska, & Loba, 2015). Along with the functions of body that become limited, the influence of Indonesian people's habit which restricts the daily physical activity of the elderly contributes to the decline in the degree of physical fitness of the elderly.

As an effort to improve the physical fitness of the elderly, physical activity or sports that are safe and appropriate for the elderly are needed. For the physical activities conducted by the elderly resulting in the increase of their physical fitness, the concept of Frequency, Intensity, Time, Type (FITT) are importantly considered. Frequency refers to the amount of physical exercises to be conducted weekly, Intensity as in the dose of the exercise, Time refers to the duration of every exercise, and type means the kinds of exercise (American College of Sports Medicine, 2015).

Physical fitness is closely related to the increase in cardiopulmonary endurance. To up surge the endurance of the heart, the elderly can perform physical exercises 3-5 times per week with mild and moderate inten-

sity (mild intensity: 50-60% of Maximum Pulse Rate [DNM], moderate intensity 60-75% DNM). Time required for each exercise is around 20-60 minutes, whereas the exercise type is aerobic. The results of the exercise will increase the endurance of the pulmonary and heart after exercising for 6-12 weeks and the stability reached after 20 weeks (Pescatello, Arena, Riebe, Thomson, Willian, & Wilkins, 2014).

According to Ginting (2011) Healthy Heart Gymnastics Series-I or Senam Jantung Sehat Seri-I is one of the sports that can be performed by elderly people. Healthy Heart Gymnastics consist of Series-I to -IV and recommended by the Indonesian Heart Foundation. Healthy Heart Gymnastics Series-I has the characteristics of regular movements and slow rhythms, as well the intensity of exercise is relatively mild and moderate so it can be carried out by the elderly. Healthy Heart Gymnastics Series-I is programmed to prevent and rehabilitate sufferers of heart and blood vessel disease. Until now, researches on Healthy Heart Gymnastics are limited to the effect of Healthy Heart Gymnastics on reducing blood pressure, hence, this research is a new study to analyze the frequency of Healthy Heart Gymnastics Series-I on physical fitness.

Healthy Heart Gymnastics Series-I is an aerobic exercise with moderate intensity and the duration of approximately 30 minutes (Ginting, 2011). To measure the intensity of the exercise, polar aids are used during Healthy Heart Gymnastics Series-I, and measurement of the degree of physical fitness of the elderly are carried out through a 6-minute walk test (Wevers & Kwakkel, 2011).

With an eye to the concept of FITT to be applied properly on the Healthy Heart Gymnastics Series-I, research needs to be conducted on the accurate frequency of training. Therefore this study aims to analyze "the Frequency of Healthy Heart Gymnastics Series-I that can improve the Physical Fitness of Elderlies"

METHODS

Research Design

This study used a pre-experimental method with a pre-test and post-test design approach. Pre-experimental

design was employed since there were no control groups in this study. Sources of data were derived from UPTD Ciparay Elderly Social Rehabilitation Social Center (PRSLU) and Hero Tomb Protection (PMP).

This study was approved by the Research Ethics Committee of Padjadjaran University no. 0518020297 with letter number: 238 / UN.6.KEP / EC / 2018.

Population and Sample

The target population was all the elderly living in PRSLU and PMP UPTD Ciparay. The total target population is 150 elderly people. The reaching population was healthy elderly people aged > 60 years who were living PRSLU and PMP UPTD Ciparay Bandung, not currently in the inpatient care, and routinely performing the physical exercises that had been programmed, as the intensity of exercise when carrying out the Healthy Heart Exercise Series-I was moderate (60-75% DNM). The number of samples was gained through purposive sampling technique, and as many as 30 elderly were obtained. At the time of the study, 2 elderly people were sick and 1 person returned from the institution, thus the final sample of the study aggregated to 27 people.

Data Collection Technique

The means and technique of data collection began with verbal explanation and informed consent (written) to the elderly with the assistance of their guardians. When the participants agreed to the research procedure, the consent form was signed. Researchers then conducted interviews to find out information and confirmation of participants demographic data involving age, sex, recent education, history of comorbidities, medical / drug history, and the length of stay in the nursing home.

The study began with the selection of healthy elderly people living in PRSLU and PMP UPTD Ciparay based on purposive sampling technique. After they signed the informed consent, a DNM measurement was performed for each individual based on the formula: $60-75\% (220 - \text{age})$ until a range of minimum and maximum figures of DNM was obtained. If when the Healthy Heart Gymnastics Series-I was performed and the DNM of the participants was below the minimum mark, or in contrast (above the maximum mark), then it was not taken into the sample. After determining the

range of minimum and maximum figures of DNM, a data collection of the average pulse rate was carried out during the Healthy Heart Gymnastics Series-I.

After conducting the gymnastics activities, the participants' intensity of exercise (mild, moderate, high) was determined. The intensity of the exercise taken was moderate to provide a positive effect of the activity, while the mild and high intensity was not included in the sample.

The elderly group that had moderate intensity was later divided into 3 groups, namely the participants who performed Healthy Heart Gymnastics Series-I with a frequency of 3 times a week, 4 times a week, and 5 times a week so that the frequency to improve the physical fitness of the elderly could be analyzed properly.

All three groups had a 6-minute walk test to measure the distance (m) that the elderly could take during the walking. Measurement of the degree of physical fitness was administered before the Healthy Heart Gymnastics Series-I and on the 6th week (after the gymnastics activities).

Data Analysis

The research data analysis design was processed using IBM SPSS version 23.0. Prior to the data analysis, Shapiro-Wilk normality test ($p \geq 0.05$) and One way ANOVA homogeneity test ($p \geq 0.05$) were performed. Normality test results for all variables: Age, Sex, Latest education, Maximum Pulse Rate, Resting Pulse Rate, Height, Weight, Systolic Blood Pressure, Diastolic Blood Pressure within normal limits, and the grade of physical fitness before conducting the Healthy Heart Gymnastics Series- I (pre) was homogeneous ($p \geq 0.05$).

Homogeneity test results were conducted to determine whether the data in advance of conducting the Healthy Heart Gymnastics Series-I (pre) could be used as a guideline to see if there was an effect of an intervention on the participants' physical fitness (cardiopulmonary endurance). Furthermore, to analyze the differences in physical fitness before and after conducting the Healthy Heart Gymnastics Series-I at week 6, a paired t-test was employed.

RESULT

The Characteristics of Research Participants

Characteristics of research subjects included data of age, sex, and lastt education. Table 1 displays the characteristics of participants by age, sex and last education in PSRLU and PMP UPTD Ciparay, West Java Province (n = 30). Based on Table 1, more than half of the participants were in the elderly group (60-74 yo). Additionally, the table showed an even distribution of male and female participants, and a few of them were elementary graduates.

Table 1. Characteristics of Research Participants Based on Age, Sex and Last Education (n=30)

Characteristic	Frequency (f)	Percentage (%)
Age		
Elderly (60-74)	23	76,67
Old (75-90)	6	20,00
Very Old (>90)	1	3,33
Sex		
Male	15	50,00
Female	15	50,00
Education Level		
Not going	6	20,00
Elementary	7	23,00
Secondary	6	20,00
High School	6	20,00
College	5	17,00

The distribution of participants regarding the Maximum Pulse Rate (x / min), Resting Pulse Rate (x / min), Height (cm), Weight (kg), Systolic Blood Pressure (mmHg), Diastolic Blood Pressure (mmHg) based on the frequency of gymnastics exercises in PSRLU and PMP UPTD Ciparay, West Java Province (n = 27) are listed in table 2.

Table 2 shows the Maximum Pulse Rate, Resting Pulse Rate, Height, Weight, Systolic Blood Pressure, and Diastolic Blood Pressure based on the three frequencies of exercise within normal limits using paired t-test. The intensity of exercise of Healthy Heart Gymnastics Series-I that are appropriate for healthy elderly people can be depicted from the DNM formula: 60% - 75% (220 - age). Table 3 shows the minimum and maximum DNM rates for the elderly as the research subjects. Based on table 3, the range of the participants' DNM rates: 77.4-119.25 x / minute. This rate is at moderate intensity for elderly people.

Table 2. The Characteristics of Participants based on Gymnastics Exercise Frequencies

Characteristic	Exercise Frequency	n	Mean ± SD	P- value	Note
Maximum Pulse Rate	3 times a week	10	84,1 ± 7,18	0,515	Normal
	4 times a week	9	72,89 ± 8,19	0,063	Normal
	5 times a week	8	72,5 ± 7,54	0,137	Normal
Resting Pulse Rate	3 times a week	10	83,9 ± 6,97	0,74	Normal
	4 times a week	9	72,89 ± 8,19	0,063	Normal
	5 times a week	8	72,5 ± 7,54	0,137	Normal
Height	3 times a week	10	146,0 ± 10,73	0,377	Normal
	4 times a week	9	151,39 ± 15,29	0,523	Normal
	5 times a week	8	150,75 ± 10,01	0,976	Normal
Weight	3 times a week	10	47,0 ± 6,53	0,113	Normal
	4 times a week	9	54,44 ± 13,05	0,168	Normal
	5 times a week	8	46,25 ± 9,6	0,679	Normal
Systolic Blood Pressure	3 times a week	10	156,6 ± 26,49	0,482	Normal
	4 times a week	9	143,11 ± 16,94	0,731	Normal
	5 times a week	8	154,13 ± 28,01	0,471	Normal
Diastolic Blood Pressure	3 times a week	10	87,4 ± 14,33	0,207	Normal
	4 times a week	9	80,0 ± 14,14	0,327	Normal
	5 times a week	8	82,0 ± 18,14	0,541	Normal

*Note: p >0,05 = data showed there was no significant difference / normal

Table 3. The Minimum and Maximum DNM Rate of the Elderly (n=27)

DNM Percentage	Minimum	Maximum
60%	77,4	96,75
75%	95,4	119,25

To perceive the right frequency of Healthy Heart Gymnastics Series-I for the healthy elderly people to improve their physical fitness properly, the paired t-test was needed with the result to determine the difference between the mean values before and after conducting the gymnastics activities on the physical fitness (cardiopulmonary endurance). The difference of mean before and after performing Healthy Heart Gymnastics Series-I on physical fitness (cardiopulmonary endurance) based on the measurement of the 6-minute walk test is listed in table 4.

Table 4. The Difference in Mean Before and After Conducting Healthy Heart Gymnastics Series-I for Physical Fitness (Cardiopulmonary endurance) (n=27)

Independent Variable	Mean	Std. Dev	Mean difference	t	p-value
PF (pre-intervention)	314,77	109,12	-52,26	-2,346	0,027
PF (post-intervention)	367,03	101,65			

Based on table 4, the physical fitness rate of the elderly has a mean difference (before and after gymnastics activities) of -52.26, which means there is an increase in physical fitness of the elderly before and after conducting the Healthy Heart Gymnastics Series-I (p-value = 0.027, p <0, 05).

To determine the frequency of Healthy Heart Gymnastics Series-I most appropriate for the elderly participants, t-test (p <0.05) post-intervention was employed as listed in table 5, then proceed with the Post Hoc test (Bonferroni) (p <0.05) to look for the difference in mean of frequency of Healthy Heart Gymnastics Series-I. Post Hoc test results listed in table 5 as well.

Table 5. The Difference in Mean of Frequency of Healthy Heart Gymnastics Series-I using Post-Hoc test (n=27)

Frequency	Mean Difference	95% CI		p-value
		Min	Max	
3 vs 4 times a week	-65,17	-224,25	93,89	0,906
3 vs 5 times a week	-171,09	-335,32	-6,87	0,039
4 vs 5 times a week	-105,92	-274,15	62,3	0,355

Table 6. The Difference in Mean Before and After Conducting Healthy Heart Gymnastics Series-I Based on The Frequency of Exercise (n=27)

Frequency	Independent Variable	Mean	Std. Dev	Mean diff	t	p-Value
3 times a week	Pre	269,5	102,5	-106	-3,348	0,009
	Post	375,5	79,98			
4 times a week	Pre	323,22	104,62	3,33	0,138	0,894
	Post	319,89	132,88			
5 times a week	Pre	361,87	112,46	-47,63	-0,893	0,402
	Post	409,5	70,36			

Based on table 6, the Healthy Heart Gymnastics Series-I performed with a frequency of 3 times a week will increase physical fitness in healthy elderly by 139.33% (mean difference = -106 and p-value = 0.009, p <0.05). The test results show that Healthy Heart Gymnastics Series-I with a frequency of 4 times a week will reduce physical fitness in healthy elderly by 98.96% (mean difference = 3.33 and p-value = 0.894, p <0.05), while the gymnastics activities conducted with a frequency of 5 times a week will increase physical fitness in healthy elderly by 113.16% (mean difference = -47.63 and p-value = 0.402, p <0.05). Even though Healthy Heart Gymnastics Series-I with a frequency of 5 times a week can improve the elderly's physical fitness, but the p-value is not significant (p > 0.05), hence it cannot be used as a result standard. From table 6 it can be concluded that conducting Healthy Heart Exercise Series-I 3 times a week is more appropriate than 4 times a week or 5 times a week in improving physical fitness (cardiopulmonary endurance).

DISCUSSION

The Table 6 shows that Healthy Heart Gymnastics Series-I conducted three times a week will improve

physical fitness on the elderly people compared to the exercises with a frequency of 4 and 5 times a week.

The degree of physical fitness of elderly people portrays their cardiopulmonary endurance which is called aerobic capacity. The physical fitness depicts the ability and capacity to carry out activities in a relatively long time without causing excessive fatigue (Chung, Baguet, Bex, Bishop, & Derave, 2014).

The increasing age on the elderly causes the degradation of physical fitness around 30-50% particularly at the age of 70. The elderly people will experience an attenuation in physical fitness due to a decrease in the lung capacity to capture oxygen, the ability of hemoglobin to bind oxygen, the ability of heart to pump blood throughout the body and the ability of myoglobin to catch oxygen (Chung, Baguet, Bex, Bishop, & Derave, 2014).

Research on 95 elderly people with an average age of 84 by using a 6-minute test found the mean score of cardiopulmonary endurance was (264 m \pm 95m). It shows that as people age, there is a decrease in physical fitness for approximately 10-20% per decade (Wevers & Kwakkel, 2011). In this study more than half of the elderly aged between 60-74 conducting the 6-minute walk test evidenced an average distance travelled of 269.5 m (pre) and 375.5 m (post). These findings show that age affects someone's physical fitness.

Oliveira & Silveira (2013) explains the factors that affect a person's physical fitness including age, sex, body mass index (BMI) and physical activities. According to the 2007 Riskesdas national report, lack of physical activity was most prevalent in the age group above 75 and had an effect on physical fitness by 76.0%. In this study the majority of the participants aged 60-74 years, hence, the exercise of the Healthy Heart Gymnastics Series-I will have a better impact in improving physical fitness of the elderly.

The results of other studies reported by Riskesdas in 2013 show that sedenter activities for more than six hours a day conducted by people in the age group over 65 years significantly affect physical fitness by 87.4%. In the 65-74 years age group with low physical activity, it was reported to affect physical fitness by 58.5%. In the age group above 75 years who have musculoskeletal disorders, causing reduced physical activity, this situa-

tion affects physical fitness by 85.1%. Based on the study, sedenter activity in the elderly lead to a decrease in physical fitness greater than the elderly who do less activity and the elderly who have musculoskeletal disorders. The decrease in the rate of physical fitness will affect the quality of life of people in their old age (Touhy, Jett, Ebeersole & Hess, 2014).

Sundari, Suhadi & Maryati (2014) note that metabolic syndrome which causes degenerative diseases is often found in elderly people. Degenerative diseases experienced by the elderly include hypertension, diabetes mellitus, and coronary heart disease. A study was conducted on elderly patients with hypertension (aged 60-74) using one group of pre-test and post-test study design, and reported that the physical activities of the elderly influenced on increasing cardiopulmonary endurance, the improvement of the nutritional status of the elderly, and decreasing systolic blood pressure ($p < 0,05$).

The intensity of exercise which is recommended to maintain the physical health of elderly people and to prevent stroke is the moderate one, while the mild intensity is for coronary disease patients (Calvin, Paula, Anne, Shirley Charlotte, Michael & Sharon, 2010). The study employed an intervention of Healthy Heart Gymnastics Series-I which was aerobic exercise with moderate intensity, hence, it was safe for elderly people.

American College of Sports Medicine (2015) explains that to prevent the decline in physical fitness, elderly people need to do physical exercises or sports activities that meet the rules of Frequency, Intensity, Time, and Type (FITT). The experimental study conducted by Undari, Suhadi, & Maryati (2014) has only been limited to Fit Gymnastics for the Elderly or Senam Bugar Lansia in improving physical fitness. The results show that, based on the 6-minute walk test, there was an increase in cardiopulmonary endurance of the elderly after performing Senam Bugar Lansia (1.6255 vs 1.6276) km. The results of the test showed that the physical fitness in the group was considered deficient, notwithstanding, there was an increase of fitness score so that Senam Bugar Lansia could increase the cardiopulmonary endurance of the elderly. Based on the results of the Wilcoxon signed ranks test, it was reported that there were significant differences between the elderly's cardiopulmonary endurance in the fourth week

during conducting Senam Bugar Lansia ($p = 0.001$ ($p < 0.05$). In this study, Healthy Heart Gymnastics Series-I was carried out by the elderly people for six weeks to attain a better effect in improving physical fitness.

The Healthy Heart Gymnastics Series-I is an aerobic physical exercise that has a moderate intensity and lasts about 30 minutes. This gymnastics is certainly propitious and safe for elderly people to conduct. To fulfil the concept of FITT, it is necessary to research the right frequency to be able to effectively improve physical fitness (cardiopulmonary endurance) of the elderly (Ginting, 2011).

Experimental studies involving Healthy Heart Gymnastics largely have a positive effect on the reduction of systolic and diastolic blood pressure. In Vancafort Research (2016), 30 patients with moderate hypertension aged 39-60 were given the treatment of Healthy Heart Gymnastics 3 times a week with moderate intensity (70-80% DNM), duration of exercise for around 20-60 minutes, and the type of exercise was aerobic. The results showed a decrease in systolic blood pressure of 3.346% and diastolic of 4.273%.

Another related study was conducted by Lalarni (2015) on 8 elderly men aged 60-65 years by using a quasi-experimental design. The t-test result reports the average blood pressure after conducting the Healthy Heart Gymnastics Series-1 was (147.50 ± 10.35 mmHg vs $135/85 \pm 11.95$ mmHg). The mean of resting pulse rate after the gymnastics activities were (97.88 ± 6.24 mmHg VS 74.13 ± 7.81 mmHg).

Research by Abdul and Cerika (2011) on 15 elderly people aged > 60 with mild hypertension (140 - 159 / 90-99 mmHg) and 15 elderly people with moderate hypertension (160-179 / 100-109 mmHg) by using a one group pre test - post test approach showed that Healthy Heart Gymnastics can reduce systolic blood pressure (145.33 vs 137.33 mmHg, $p = 0.000$ ($P \leq 0.05$) as well as diastolic blood pressure (88 mmHg vs 82 mmHg, $p = 0.003$ ($P \leq 0, 05$).

The aforementioned researches show that the majority of Healthy Heart Gymnastics activities provide changes to the reduction of systolic and diastolic blood pressure and no research has been found on the effect of Healthy Heart Gymnastics in increasing the degree of physical fitness (cardiopulmonary endurance) of the

elderly, therefore it is indispensable to conduct a research on the right frequency of Healthy Heart Gymnastics Series-I for physical fitness.

Healthy Heart Gymnastics Series-I has a particular pattern of movement. Possible exercise patterns that can improve cardiopulmonary function are the movement I, IV, VI, VII, VIII, IX, X, XII, XIV, XV, XVI, XVII, XVIII, XIX, and XX. Healthy heart gymnastic movements are generally in the form of a walk in place movement by moving the hands, clapping hands above the head, stretching hands forward, upward and inhaling the fresh air (Ginting, 2011)., clapping hands above the head, stretching hands forward, upward and inhaling (Ginting, 2011).

Healthy Heart Gymnastics have three movement principles, namely the warming up, core, and cool-down activities. The basic of warming up is to relax the body muscles. The signs that a person has successfully warmed up are the increasing heart rate, the rise of body temperature by 1-2 degrees of Celcius, and the sweates coming from the body. This warm-up activities are substantial to reduce the risk of injury and fatigue (Ginting, 2011).

The second principle of Healthy Heart Gymnastics movements is the core activities. The purpose of these movements are in accordance with the type of gymnastics favoured. Healthy Heart Gymnastics is intended to increase the work power of the heart. Exercises are performed for approximately 20 minutes or adjusted to the purpose of the exercise (Ginting, 2011).

The last movement in Healthy Hearth Gymnastics is the cool-down activities. The cooling down phase aims to restore the body to its riginal state. The movement that can be performed in this phase involves standing while moving the legs, walking in place, or other light movements. This stage lasts for 5 minutes (Ginting, 2011).

During the aging process, the volume of mitochondria, collagen contents, and joint flexibility witness the degradation. Meniscus and articular cartilage functions have decreased so that the risk of injury is greater by 20%, especially in the lower extremities. In addition, there is microtrauma and lack of oxygen in the vascularization around the tendon, hence, the tendon experiences inflammation which results in a decrease in aero-

bic energy in the musculoskeletal system (Darmojo, 2014).

The decrease in aerobic energy physiologically in elderly people requires the right effort from them to do sports. The kinds of physical activities that are safe for the elderly are in the forms of aerobics with moderate intensity, should not cause stress on the orthopedic part, and should not be more than 150 minutes per week (Banerjee, Jadhav, & Bhawwkar, 2012).

To improve cardiopulmonary endurance on elderly people, physical exercises can be done 3-5 times per week with mild and moderate intensity (mild intensity: 50-60% of Maximum Pulse Rate [DNM], moderate intensity: 60-75% of DNM). The duration is around 20-60 minutes for the type of aerobic activities. The training results will increase the endurance of cardiopulmonary after 6-12 weeks and the condition of the organ will be stable for 20 weeks (Ralph, Klippel, John, Koopman, & William, 2013). According to WHO in Harber & Scoot (2009), elderly people can perform aerobic exercises with moderate intensity for 30 minutes with a frequency of five times a week.

Harber & Scoot (2009) notes that sport is a physical activity characterized by the capacity to move according to the purpose of the sport. The capacity of movement in the elderly can be measured with an accelerometer or pedometer. One of the indicators to portray the moving ability of the elderly is through the number of steps commonly taken by them daily. Healthy elderly people on average can take as much as 2000-9000 steps per day. Sports conducted with moderate intensity (10 minutes-150 minutes per week) is equivalent to 5000 steps per day. Thus, the appropriate capacity of elderly taking the walk exercises is at moderate intensity.

Darmojo (2014) argues that sport is a form of physical activity that can increase physical fitness, because sport does not only involve musculoskeletal system but also includes other systems such as the cardiovascular system, respiration system, respiratory system, excretion system, and nervous system. Sports or physical exercises based on the use of oxygen or the dominant energy system used in an exercise is divided into 2 parts, namely aerobic and anaerobic sports.

The main difference between aerobic and anaero-

bic exercise lies in the involvement of oxygen in producing energy. Aerobic exercise is a sport that is performed continuously and the need for oxygen can still be covered by the body. A physical activity that includes aerobic exercise is jogging. When jogging, oxygen needs can still be fulfilled by the body, since jogging does not require speed and includes low-intensity exercise and the lactic acid buildup takes.

On the other hand, oxygen needs cannot be fulfilled by the body in anaerobic exercise. The anaerobic state carries out when the energy requirements in the body exceed those provided by breathing so the body is forced to work without oxygen. For example, anaerobic type of sport is 100m sprint running because the sport requires speed so that the body's immune system decreases quickly and lactic acid buildup occurs faster (Darmojo, 2014).

According to Harber & Scoot (2009), physiological adaptation to physical work occurs during sports. Physiological adaptation consists of acute and chronic adaptations. Acute adaptation is the immediate adjustment of the body when the activities are carried out. Meanwhile, chronic adaptation is the result of changes in the body by a certain period of physical exercise program. The physical activities induce a burden on the body and it will result in the adjustment mechanism of the body's organs. This adaptation process depends on age, ambient temperature, weight, duration, methods or techniques, and the number of organs involved during the physical activities.

Acute adaptation during sports is an immediate body adjustment when exercising. Chronic adaptation when performing sports is the result of changes in the body after a physical training program that is carried out in a programmed and planned manner and meets the FITT rules (Harber & Scoot, 2009).

After sports activities, acute and chronic adaptations occur in the vascular system (Sebastianus, 2014). The occurrence of acute adaptation is indicated by the form of changes in heart rate frequency, stroke volume and cardiac output, blood pressure, and blood supply. After exercises, the cardiac output increases from 5900 cc to 24000 cc, blood flow to the heart increases from 250 cc to 1000 cc, blood supply to skeletal muscle increases from 650 cc to 28,250 cc (Aaronson, Philip,

Jeremy, & Ward, 2010).

In addition to the upsurge of heart rate frequency, stroke volume and cardiac output, blood pressure, and blood supply, there is also an increase in sympathetic activity in the SA node which causes the speed or frequency of the heart rate to mount. The higher the intensity of the exercise, the faster the heart rate takes place (Kerling et al., 2015).

Based on the theory of anaerobic threshold, if the intensity of the exercise is increased, then the heart rate will also workup, but if the intensity continues to be augmented, there will be a time when the connection is no longer linear (in a straight line) but will curve. An increase in heart rate frequency when the intensity is increased will not increase cardiac output (Kerling et al., 2015).

After 160 times per minute for the untrained or 180 times per minute for trained people, the heart rate will experience a floater, hence the stroke volume, as well as cardiac output, will decrease (Kerling et al., 2015).

The maximum heart rate is determined by the formula of 220 minus age. Cardiac output at 100% intensity does not differ much from the cardiac output at 90% intensity (Sebastianus, 2014). In line with the previous theory, a 3 times a week Healthy Heart Gymnastics Series-I with moderate intensity can increase the frequency of heart rate and stroke volume, thus the cardiac output will increase, and so the cardiopulmonary. Otherwise, the Healthy Heart Gymnastics Series-I performed in the frequency of 4 and 5 times a week does not have a similar effect of increasing cardiac output because the heart experiences overtraining or excessive training load.

Overtraining can be identified from the response of someone who has been doing routine exercises for a long time, but feels the progress is very slow or insignificant. The slow progress of a person can be examined by the lack of adaptation on the organs expected would have acquired the effects of sports (Sebastianus, 2014).

Sebastianus (2014) argued that, in principle, every exercise always results in injury or adaptive microtrauma. The microtrauma in the body will produce cyto-

kines. This substance is the initial alarm for someone experiencing overtraining after exercise. Overtraining also causes excessive free radical production. These free radicals can damage body cells and lead to the potential of heart disease, cancer, premature ageing and a decrease in the immune system, therefore it is very important to assign the right frequency of exercise for elderly people, so as it does not cause overtraining and the increase in free radicals production. If these conditions can be overcome then heart disease, cancer, premature ageing and a decrease in the immune system will not occur in the elderly and they can live a more productive and quality life.

Aside from increasing the heart rate, stroke volume, and cardiac output, physical exercises can also cause venous vasoconstriction induced by sympathetic nerves and the increasing activities of skeletal muscle pump and respiration pump, resulting in venous return to mount. (Aaronson, Philip, Jeremy & Ward, 2010).

The increase of venous return through the Frank-Starling mechanism and the increase of myocardial contractility stimulated by the sympathetic nerves cause the stroke volume in the heart to increase. The upsurging stroke volume and heart rate will increase cardiac output. (Aaronson, Philip, Jeremy & Ward, 2010).

The greater increase of cardiac output of total peripheral resistance causes an increase in arterial blood pressure. A locally controlled arteriolar vasodilation, which is amplified by the vasodilation effect of epinephrine, results in blood flow to the heart muscle and active skeletal muscle to be more increasing while blood flow to the brain remains stable due to stimulation sympathetic nerves having no effect on the arterioles in the brain. (Aaronson, Philip, Jeremy & Ward, 2010).

The increased blood flow to active skeletal muscles causes the hypothalamus control centre to induce cutaneous arterioles resulting in increased blood flow in the skin and generates heat to the skin surface. The increase of stroke volume and cardiac output will be followed by the increasing number of blood vessels in the heart muscle, hence blood flow in the muscles runs smoothly. A large number of blood vessels in the heart muscle will replace each other if there is one or several other blood vessels that are blocked (Aaronson, Philip,

Jeremy & Ward, 2010).

Healthy Heart Gymnastics Series-I performed 3 times a week with moderate intensity induces an increase in cardiopulmonary endurance because the right frequency will intensify an increase in heart rate and stroke volume, hence the cardiac output is increased as well. Prijo (2011) explained that an increase in cardiac output will increase oxygen supply to active skeletal muscle. Thus venous return also increases and augments the growth of blood vessels around the heart muscle (neovascularization), so that the myocardium gets stronger in contraction and affects the endurance of the cardiopulmonary.

In elderly people who routinely perform Healthy Heart Gymnastics Series-I, the condition of their blood vessels during exercise experiences vasodilation and elasticity gain so as to facilitate the delivery of nutrients and oxygen. Exercise can also increase the diameter of blood vessels, decrease the ratio of intima-media thickness to the tunica as well as permanent enlargement of blood vessels (Cornelissen, & Neil, 2013).

According to research by Colberg, Sigal, & Ronald (2010), aside from causing acute adaptation to the vascular system, doing sports as well lead to a chronic adaptation. One of the changes occurred due to chronic adaptation is enlarged heart space, increased the elasticity of blood vessels, improved metabolic control in the form of improved blood glucose levels and insulin resistance, improved kidney function and decreased blood pressure.

Healthy Heart Gymnastics Series-I with 3-times a week frequency can stimulate heart space enlargement, increase the elasticity of blood vessels, improve metabolic control, improve kidney function, and decrease blood pressure. It shows that the gymnastics exercise not only increases the cardiopulmonary endurance but also ameliorates the metabolic process of GIT and urinary systems so as to improve its function.

Colberg, Sigal, & Ronald. (2010) explained, the condition of the need for oxygen supply to skeletal muscle is not optimal when exercising, it will occur a buildup of metabolites and stimulate sensory nerves in the muscles. The activation of the sensory nerve stimulates the chemoreceptors of the muscle mechanoreceptor nerves which increases sympathetic nerve activity to

intensify arterial pressure.

Chemoreceptors function to respond to the changes in O₂ and CO₂ concentrations and are responsible for working up lung ventilation. There are two chemoreceptors, namely central chemoreceptors in the brain (ventral spinal cord surface) and peripheral chemoreceptors (between carotids and aortic bodies) (Colberg, Sigal, & Ronald, 2010).

Peripheral chemoreceptors connect the respiratory centres in the medulla oblongata and the smallest nucleus pathways and respond to hypoxic states (Guimaraes, Belli, Juliana, & Bacal, 2009). When these receptors feel an increase in CO₂ production and O₂ deficiency, peripheral chemoreceptor will stimulate respiratory muscles through chemoreflex (Kerling et al, 2015).

The improvement in kidney function is also an exemplification of chronic adaptation that occurs when exercising appropriately and regularly. The kidneys function in the regulation of sodium plasma so as they contribute to the process of regulating plasma and cardiac output. It is very helpful in reducing blood pressure in people with hypertension (Prijo, 2011).

Kenney, Larry, Wilmore, Jack, Costill, & David, (2011) explained that the autonomic nervous system especially the sympathetic nervous system and parasympathetic nervous system play an important role in the body during physical exercise. The sympathetic nervous system is referred to as a fight-or-flight system, preparing the body to face a crisis and sustain or maintain its function during the crisis.

Sympathetic nerves affect on the increase in heart rate and strength of heart contraction, dilation of coronary vessels, escalation of blood supply to the heart muscle, working up peripheral vasodilation of blood flow to active skeletal muscle, vasoconstriction to most tissues to prevent blood flowing and divert it to active muscles, increasing blood pressure, provide muscle perfusion, and improving venous blood flow to the heart (Kenney, Larry, Wilmore, Jack, Costill, & David, (2011).

An autonomic nerve in the form of a sympathetic nerve stimulates the adrenal medulla to release epinephrine and norepinephrine hormones (circulating catecholamines). Catecholamine circulation can increase heart

rate frequency and additional contractions, metabolic rate, glycogenesis, the release of glucose in the blood, blood pressure and respiration as well as blood redistribution in active skeletal muscles (Kenney, Larry, Wilmore, Jack, Costill, & David, 2011).

The autonomic nervous system is centred in the hypothalamus, medulla oblongata, and spinal cord. The parasympathetic nerve is directly connected to the medulla oblongata, while the sympathetic nerve is related to the spinal cord. These two autonomic nerves branch off with sino atrial node (SA) and atrioventricular valve node (AV). These nodes will be affected by the sympathetic and parasympathetic nerves to control heart rate (Kenney, Larry, Wilmore, Jack, Costill, & David, 2011).

When the branches of the sympathetic and parasympathetic nerves are stimulated, the norepinephrine hormone is released, resulting in an increase in heart rate and ventricular contractions. The parasympathetic that supplies the heart from the vagus nerve is controlled by the vasomotor centre (Kenney, Larry, Wilmore, Jack, Costill, & David, 2011).

The increasing amount of epinephrine hormone produced during exercise induces a stronger contraction of the heart muscle. However, systolic pressure is not directly elevated because the influence of epinephrine on blood vessels can cause vasodilation (Sebastianus, 2014). Significant increase in systolic pressure and pulse, led by blood ejection by the left ventricle is faster and stronger, which causes an average increase in arterial blood pressure (Aaronson, Philip, Jeremy, & Ward, 2010).

The effects of decreased systolic blood pressure begin to appear at 1-3 hours after exercising for about 30-45 minutes. This blood loss effect will occur more than 9 hours after the exercise. A steadier alleviation in blood pressure will be more visible after 4-6 weeks of training (Lucifora, 2015). This research was conducted for 6 weeks, so as the hypertensive elderly who conducted Healthy Heart Gymnastics Series-I also experienced a decrease in blood pressure. A reduce in diastolic blood pressure after doing the physical activities is related to the duration of exercise performed (Kenney, Larry, W., Wilmore, Jack, Costill, & David, 2011).

When conducting the exercises, the blood supply

flows to the muscles involved in the movement. Blood will cover the body needs during the exercise such as fat and sugar for energy supply and carry metabolic remnants such as water and CO₂. The higher the intensity of the exercise, the more blood supply to the muscles will be. This is the evidence that a healthy elderly person who performs Healthy Heart Gymnastics Series-I three times a week with moderate intensity acquires a greater supply of blood to the moving muscles.

Cornelissen & Neil (2013) stated that blood pressure in people with hypertension will decrease due to the improvement of factors that affect blood pressure, among others: the increased elasticity of blood vessels, a more optimal work of the heart (cardiac output), a decreased peripheral resistance due to increased diameter of blood vessels, decreased blood viscosity, and a controlled blood volume.

A decrease in peripheral blood vessels after conducting the physical exercise causes the diameter of the blood vessels to inflame, due to a decrease in the influence of the sympathetic nerves or an increase in the influence of local vasodilators such as nitric oxide. The other factor inducing a decrease in blood pressure due to exercise is a decrease in blood plasma norepinephrine associated with vasodilation of blood vessels and the improvement of kidney function (Cornelissen & Neil, 2013).

According to Prijo (2011), physical exercise should be performed in accordance with the body's ability to respond to stress. If the body is given a training load that is too light, there will be no adaptation process occurred. Conversely, if given too much exercise and the body cannot tolerate, it will disrupt homeostatic processes in the body's system and lead to the tissue damage. Healthy Heart Gymnastics Series-I conducted by healthy elderly with a frequency of 4 and /or 5 times a week is considered to give a large training load for the body so that it does not have a better effect on the body's system and can even cause tissue damage and disrupt the body's homeostasis.

Conducting sports as physical exercise will also affect the respiratory system. The exercise affects O₂ and CO₂ levels. O₂ in a large amount will diffuse from alveoli into venous blood back to the lungs. Conversely, CO₂ enters from the blood to the alveoli. Therefore the

ventilation process will increase to maintain alveolar gas concentrations, in order to increase the exchange of O₂ and CO₂ (Prijo, 2011).

Before the exercise, proprioceptive feedback from active skeletal muscles and joints induces the motor cortex to become more viable and sends impulses to the centre of inspiration, hence, the respiration gradually increases. When the body starts to perform the movements, the respiratory inspiration escalates and triggers the depth and level of breathing to improve (Prijo, 2011).

During exercise, there is an increase of metabolism in the muscles generating heat, escalating CO₂ and H⁺. All of these factors will increase the use of oxygen in the muscles and the arteries hence, consequently, more CO₂ and H⁺ are spread in the blood. These conditions encourage chemoreceptors to stimulate the center of respiratory inspiration, resulting in an increase in the depth of breathing. Healthy Heart Gymnastics Series-I 3 times a week, in addition to having an effect on reducing blood pressure in the cardiovascular system, has a positive effect on the respiratory and urinary system, thus affects the body homeostasis to be optimal.

CONCLUSION

Healthy Heart Gymnastics Series-I with the frequency of 3 times a week can improve physical fitness (cardiopulmonary endurance) of elderlies. The results of this study form the basis for researchers to further examine the frequency of other sports that are safe for the elderly. The corresponding institutions such as PRSLU and PMP UPTD Ciparay can use Healthy Heart Gymnastics Series-I 3 times a week program as a routine for the healthy elderly people and to presumably evaluate their physical fitness improvement.

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