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FOLIA MEDICA INDONESIANA

Vol. 56 No. 1 March 2020

DIFFERENCES OF INDIANET WALK TEST IN THE UNEXPLAINED INFERTILE AND FERTILE COUPLES

(Heri Dito Prahastoro, Pucy Kristy, Herdiana Lantika)

CHANGES ON RESONANCE TROPICIT LEVEL BEFORE AND AFTER TAKING STANDARD THERAPY MEDICATION IN HEAVY FOLICLE PATIENTS

(Yen Yen An Indrawati, Sahyoni, Murniand Anandita, Endang Retnowati, Gong Mafid Refriani)

PROFILE OF COLONRECTAL TUMORS IN GASTROENTERO-HEPATOLOGY CLINIC, DEPARTMENT OF INTERNAL MEDICINE, DR. SOETOMO HOSPITAL, SURABAYA

(Rusli Pratomo, Mardiana, Irena, W. Mawan Tjandjaja)

RATIO OF CDKN2A IN BREAST CARCINOMA WITH AND WITHOUT AXILLARY LYMPH NODE METASTATIC

(Pringgokot Wicrama, Wily Santoso)

COMPARISON BETWEEN EARLY AND LATE OVARIN RESUMED AFTER INCISED RADICAL HISTERECTOMY SURGERY THROUGH OB REPERATION OVER PROPORTION OF PERCUTANEOUS IRRADIATION TECHNIQUE OF SEMINAL PRODUCTION IN SURGICAL POLYCLINIC OF DR. SOETOMO HOSPITAL, SURABAYA

(Prita Cahya Purandayani, Nurcah Anindita)

RELATIONSHIP OF PANCREATIC VOLUME USING CT SCAN IN INDIANET WALK TEST WITH AGE, SEX AND BODY MASS INDEX

(Ade Nur H. Nurhidayah)

THE USE OF ORAL ANTIBIOTICS TO PREVENT SURGICAL SITE INFECTION ON POSTOPERATIVE MODIFIED RADICAL MASTECTOMY PATIENTS IN DR. SOETOMO GENERAL HOSPITAL, SURABAYA

(Nurcah Anindita, Nurcah Anindita)

INTRABONECULAR ALLOGENIC MESENCHYMAL STEM CELLS AND VASCULAR ENDOTHELIAL GROWTH FACTOR INJECTION IN ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION

(Dwiastutia Alim, Dwiastutia Alim, Fauziah Nur Hafidha, Nur Hafidha, Nur Hafidha, Nur Hafidha)

COMPARISON OF B2M SERUM IN HEALTHY UNWEIGHTED ADULTS ON TREADMILL EXERCISE BY INCREASING GRADUALLY SPEED VS INCLINATION

(Ulita D. Triand, Mardiana, W. Mawan Tjandjaja, Nurcah Anindita, Nurcah Anindita)

PROFILE OF SECONDARY GLAUCOMA AT A TERTIARY HOSPITAL IN EAST JAVA

(Eva Nurcah, Nurcah Anindita, Nurcah Anindita)

STRUCTURAL MODEL OF MATERNAL BEHAVIOR IN COMMUNITY SETTING TO PREVENT LOW BIRTH WEIGHT IN EAST NUSA TENGARA, INDONESIA

(Suzanna Nurcah, Nurcah Anindita, Nurcah Anindita, Nurcah Anindita)

ROLE OF AGE, BMI AND BODY MASS INDEX IN BLOOD PRESSURE AMONG STUDENTS OF ST. HENRIKUS HIGH SCHOOL, SURABAYA, INDONESIA

(Suzanna Nurcah)

TRANSORAL ESOPHAGOSCOPY EXAMINATION IN OUTPATIENT UNIT, DEPARTMENT OF GASTROENTEROLOGY, HEAT AND BECK SURGERY, DR. SOETOMO HOSPITAL, SURABAYA

(Rita Nurcah, Nurcah Anindita)

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Page 1-81

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FOLIA MEDICA INDONESIANA

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(Yen Yen Ari Indrawijaya, Suharjono, Muhammad Aminuddin, Endang Retnowati, Gilang Mauladi Rahman)

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(Husin Thamrin, Khafidhotul Ilimiah, Ni Wajan Tirtaningsih)

RATIO OF CD68/CD163 IN BREAST CARCINOMA WITH AND WITHOUT AXILLARY LYMPH NODE METASTATIC

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(Putra Gelar Parindungan, Hartoro Ishardiyanto)

RELATIONSHIP OF PANCREATIC VOLUMES USING CT SCAN IN INDONESIAN ADULTS WITH AGE, SEX, AND BODY MASS INDEX

(Abdul Mu'ti, Swandari Paramita)

THE USE OF ORAL ANTIBIOTICS TO PREVENT SURGICAL SITE INFECTION ON POSTOPERATIVE MODIFIED RADICAL MASTECTOMY PATIENTS IN DR. SOETOMO GENERAL HOSPITAL, SURABAYA

(Norman Hadi, Hartoro Ishardiyanto)

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(Dwikora Novembri Utomo, Ferdiansyah Mahyudin, Arif Zulkarnain, Purwati, Rossy Setyawati)

COMPARISON OF IRISIN SERUM HEALTHY UNTRAINED MALES ON TREADMILL EXERCISES BY INCREASING GRADUALLY SPEED VS INCLINATION

(Uda'a B, Tinduh D, Masduchi HR, Laswati H, Wibisono S, Soenatalina, Theodora S)

PROFILE OF SECONDARY GLAUCOMA AT A TERTIARY HOSPITAL IN EAST JAVA

(Evelyn Komaratih, Yuyun Rindiastuti, Yulia Primitasari)

STRUCTURAL MODEL OF MATERNAL BEHAVIOR IN COMMUNITY SETTING TO PREVENT LOW BIRTH WEIGHT IN EAST NUSA TENGGARA, INDONESIA

(Simplicia Maria Anggraheni, Hari Basuki Nototroto, Irwanto, Ahmad Suryawan)

ROLE OF AGE, SEX, AND BODY MASS INDEX ON BLOOD PRESSURE AMONG STUDENTS OF ST. HENDRIKUS HIGH SCHOOL, SURABAYA, INDONESIA

(Susilowati Andajani)

TRANSNASAL ESOPHAGOSCOPY EXAMINATION IN OUTPATIENT UNIT, DEPARTMENT OF OTORHINOLARYNGOLOGY HEAD AND NECK SURGERY, DR. SOETOMO HOSPITAL, SURABAYA

(Rizka Fathoni Perdana)

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CONTENTS

DIFFERENCES OF INDIRECT MAR TEST IN THE UNEXPLAINED INFERTILE AND FERTILE COUPLES (Nur Hafiz Ramadhona, Aucky Hinting, Hawndami Lunardhi)	1 – 3
CHANGES ON SERUM TROPONIN T LEVEL BEFORE AND AFTER TAKING STANDARD THERAPY MEDICATION IN HEART FAILURE PATIENTS (Yen Yen Ari Indrawijaya, Suharjo, Muhammad Aminuddin, Endang Retnowati, Gilang Mauladi Rahman)	4 – 14
PROFILE OF COLORECTAL TUMOR IN GASTROENTERO-HEPATOLOGY CENTER, DEPARTEMENT OF INTERNAL MEDICINE, DR SOETOMO HOSPITAL, SURABAYA (Husin Thamrin, Khafichotul Umiah, Ni Wajan Terharingsih)	15 – 18
RATIO OF CD56/CD163 IN BREAST CARCINOMA WITH AND WITHOUT AXILLARY LYMPH NODE METASTATIC (Priangga Adi Wiratama, Willy Sandhika)	19 – 23
COMPARISON BETWEEN EARLY AND LATE DRAIN RELEASED AFTER MODIFIED RADICAL MASTECTOMY SURGERY THROUGH OBSERVATION OVER PROPORTION OF PERCUTANEOUS ASPIRATION TECHNIQUE OF SEROMA PRODUCTION IN SURGICAL POLYCLINIC OF DR. SOETOMO HOSPITAL, SURABAYA (Putra Gelar Perlindungan, Hantoro Ishardyanto)	24 – 30
RELATIONSHIP OF PANCREATIC VOLUMES USING CT SCAN IN INDONESIAN ADULTS WITH AGE, SEX, AND BODY MASS INDEX (Abdul Mulli, Swandani Paramita)	31 – 35
THE USE OF ORAL ANTIBIOTICS TO PREVENT SURGICAL SITE INFECTION ON POSTOPERATIVE MODIFIED RADICAL MASTECTOMY PATIENTS IN DR. SOETOMO GENERAL HOSPITAL, SURABAYA (Norman Hadi, Hantoro Ishardyanto)	36 – 40
INTRAARTICULAR ALLOGENIC MESENCHYMAL STEM CELLS AND VASCULAR ENDOTHELIAL GROWTH FACTOR INJECTION IN ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION (Dwikora Novembri Utomo, Ferdiansyah Mahyudin, Anif Zulkarnain, Purwati, Rossy Setyawati)	41 – 48
COMPARISON OF IRISIN SERUM HEALTHY UNTRAINED MALES ON TREADMILL EXERCISES BY INCREASING GRADUALLY SPEED VS INCLINATION (Udafa B, Tinduh D, Masduchi HR, Laswati H, Wibisono S, Soenatalina, Theodora S)	49 – 55
PROFILE OF SECONDARY GLAUCOMA AT A TERTIARY HOSPITAL IN EAST JAVA (Evelyn Komaratih, Yuyun Rindiastuti, Yulia Primitasari)	56 – 59
STRUCTURAL MODEL OF MATERNAL BEHAVIOR IN COMMUNITY SETTING TO PREVENT LOW BIRTH WEIGHT IN EAST NUSA TENGGARA, INDONESIA (Simplicia Maria Anggrahini, Hari Basuki Notobroto, Irwanto, Ahmad Suryawan)	60 – 66
ROLE OF AGE, SEX, AND BODY MASS INDEX ON BLOOD PRESSURE AMONG STUDENTS OF ST. HENDRIKUS HIGH SCHOOL, SURABAYA, INDONESIA (Susilowati Andajani)	67 – 74
TRANSNASAL ESOPHAGOSCOPY EXAMINATION IN OUTPATIENT UNIT, DEPARTMENT OF OTORHINOLARYNGOLOGY HEAD AND NECK SURGERY, DR. SOETOMO HOSPITAL, SURABAYA (Rizka Fathoni Perdana)	75 – 81

COMPARISON OF IRISIN SERUM HEALTHY UNTRAINED MALES ON TREADMILL EXERCISES BY INCREASING GRADUALLY SPEED VS INCLINATION

Uda'a B¹, Tinduh D¹, Masduchi HR¹, Laswati H¹, Wibisono S², Soenatalina³, Theodora S¹

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ABSTRACT

Aerobic exercise can improve cardiorespiratory fitness in young people. Irises released into the bloodstream function to execute regulation of energy metabolism, triggering browning white adipose, which is useful in mitochondrial biogenesis. The American College of Sport Medicine (ACSM) recommends moderate intensity cardiorespiratory fitness training with a frequency of 3-5 times a week, duration of 20-60 minutes, using a treadmill. Study subjects ($n = 20$) were divided randomly into 2 groups, namely the moderate intensity Treadmill training group with gradual speed improvement and gradual inclination increase. Serum slices are measured on the first and last day of exercise. There was an increasing of irisin serum in the moderate intensity Treadmill training group by increasing gradually speed after 2 weeks of exercise, both 30 minutes pre-exercise ($p = 0.02$) and 1 hour post exercise ($p = 0.01$). Medium intensity Treadmill training with 2 weeks gradual speed increase with frequency 3 times a week can increase serum slice in men, healthy untrained young men.

Keywords: Moderate intensity treadmill exercise; aerobic exercise; irisin serum; speed increase gradual; gradual inclination increase

ABSTRAK

Latihan aerobik dapat meningkatkan kebugaran kardiorespirasi pada orang muda. Iris dilepaskan ke dalam fungsi aliran darah untuk melaksanakan regulasi metabolisme energi, memicu adiposa putih kecoklatan, yang berguna dalam biogenesis mitokondria. American College of Sport Medicine (ACSM) merekomendasikan pelatihan kebugaran kardiorespirasi intensitas sedang dengan frekuensi 3-5 kali seminggu, durasi 20-60 menit, menggunakan treadmill. Subjek penelitian ($n = 20$) dibagi secara acak menjadi 2 kelompok, yaitu kelompok pelatihan Treadmill intensitas sedang dengan peningkatan kecepatan bertahap dan peningkatan kecenderungan bertahap. Irisin serum diukur pada hari pertama dan terakhir latihan. Ada peningkatan serum irisin dalam kelompok intensitas sedang pelatihan Treadmill dengan meningkatkan kecepatan secara bertahap setelah 2 minggu latihan, baik 30 menit sebelum latihan ($p = 0,02$) dan 1 jam setelah latihan ($p = 0,01$). Intensitas sedang Pelatihan treadmill dengan 2 minggu peningkatan kecepatan bertahap dengan frekuensi 3 kali seminggu dapat meningkatkan slice serum pada pria, pria muda yang sehat dan tidak terlatih.

Kata kunci: Latihan treadmill intensitas sedang; olahraga aerobik, serum irisin; peningkatan kecepatan bertahap; peningkatan kecenderungan bertahap

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INTRODUCTION

Aerobic exercise can improve cardiorespiratory fitness in young people. The irisin is released into the bloodstream, it functions to execute the regulation of energy metabolism, triggering white adipose browning, which is useful in mitochondrial biogenesis (Inyang & Stella 2015, Plowman & Smith 2014, Pescatello et al 2014). The most common aerobic exercise used for

cardiorespiratory fitness training is moderate intensity. Aerobic exercise can also cause changes in mitochondrial density, where mitochondria are involved in the use of oxygen for produce Adenosine TriPhosphate (ATP) as a form of energy, resulting in increased muscle endurance (Abrantes et al 2012). The American College of Sport Medicine (ACSM) recommends moderate intensity cardiorespiratory fitness training with a frequency of 3-5 times a week,

duration of 20-60 minutes, using a treadmill Plowman & Smith 2014, Pescatello et al 2014).

Treadmill is one exercise tool that is used to train cardiorespiratory fitness and training tests to determine individual VO_{2max} values. The advantage of treadmill is one of the simple and applicable aerobic exercise modalities in accordance with the daily physical activities carried out, namely walking (Kuys et al 2008).

The treadmill training component consists of speed and inclination. Treadmill training to improve cardiorespiratory fitness can be done by increasing the speed and inclination to achieve the target heart rate according to the desired exercise intensity (Ferley et al 2014, Norheim et al 2013). Irisin is a polypeptide hormone derived from proteolytic cleavage protein fibronectin-type III domain containing 5 (FNDC5). If irisin releases into the circulation during exercise or due to cold exposure, irisin will stimulate browning of white adipose tissue (WAT), and uncoupling protein 1 (UCP1) elevated with increased of energy expenditure through the addition of thermogenesis-mediated UCP1. Park's study showed that irisin increase twice immediately after acute exercise and returned to baseline after 2 hours of rest. There was no significant increase in irisin after 12 weeks of endurance training in healthy people (Norheim et al 2013, Zhao et al 2017, Zhang et al 2017). There are few studies comparing gradual increase in speed and incremental inclination in treadmill exercise to improvement of irisin serum. The aim of this study was to compare serum irisin levels in medium intensity treadmill exercises with gradual speed increase and with gradual inclination increases in healthy untrained young male.

MATERIALS AND METHODS

This study was conducted for 2 weeks with the number of participants 20 people who met the inclusion criteria and did not include exclusion criteria. Most of the subjects are employees Medical Rehabilitation Unit of Dr. Soetomo hospital in Surabaya. Inclusion criteria were healthy men, aged 26-35 years, Body Mass Index (BMI) 18.5 - 22.9 kg/m², systolic blood pressure 110 - 130mmHg/diastole 70-80 mmHg, willing to participate in this study by signed informed consent and medical action approval sheet. Exclusion criteria is undergoing a routine aerobic exercise program 2 times a week; suffering from ischemic heart disease, restrictive or obstructive airway disease, neuromusculoskeletal disease in the lower limbs; have motion of both ankle joints for plantar flexion over 45 degrees and dorsiflexion over 30 degrees. The criteria for drop out of the test were that the research subjects were not willing

to continue the research for any reason, the subjects could not complete the training in accordance with the established research protocol, if there was a complaint of chest pain or tightness during or after exercise, if there was a complaint of calf pain during or after exercise, the subjects were unable to complete the training according to the research protocol that had been determined, or participant were unable to complete the treadmill training in accordance with the training protocol used in this study for 2 consecutive training sessions of the total number of training sessions for 2 weeks of training.

The technique of taking participants with consecutive sampling technique. The study was conducted from April to May 2018, located in the gait laboratory Medical Rehabilitation Unit of Dr. Soetomo hospital in Surabaya, using EN-Mill® Treadmill, and this research has received Ethical eligibility from the Ethics Committee of Dr. RSUD. Soetomo Surabaya with number 0304/KEPK/V/2018.

Participants were randomized using sweepstakes into two groups, namely the group that received moderate intensity treadmill training with gradual speed improvement and the group that received moderate intensity treadmill training with gradual inclination improvement. The medium intensity treadmill training group with gradual speed improvement received moderate intensity treadmill training (70% maximum heart rate) with gradual increase in speed during exercise and permanent inclination. Whereas the group that received moderate intensity treadmill training with increased inclination gradually received moderate intensity treadmill exercise (70% maximum heart rate) with a gradual increase in inclination during exercise and steady pace. Frequency of exercise 3 times a week, and carried out for 2 weeks. Measurement of serum irisin levels was carried out 30 minutes pre and 60 minutes post exercise the first day, and 30 minutes pre and 60 minutes after the sixth day exercise in a 2 week exercise program Data were analyzed computerized with SPSS using several tests, namely: Kolmogorov one-sample test Smirnov to determine data homogeneity in each group A and B, paired t-test to compare serum irisin levels before and after exercise program for 4 weeks in each group A and B, t-2 test free sample (independent t-test) to compare serum irisin levels before and after a 2-week exercise program between groups A and B.

RESULTS

Prior to statistical analysis, normality and homogeneity tests were carried out on the characteristics of research

subjects using the Kolmogorov one-sample test Smirnov test, the results of which could be seen in Table 1.

The Kolmogorov-Smirnov test results showed that the age, heart rate and Body Mass Index (BMI) data in both groups were normally distributed so that parametric statistical tests were used. The mean age of the study subjects in the inclination group was 31.1 ± 2.92 years, while the speed group was 32.3 ± 2.31 years. Based on the Independent T test statistical test, no significant differences were found for the age characteristics of the study subjects between the two groups with the price of $p = 0.322$ ($p < 0.05$). The mean heart rate of the study subjects in the inclination group was 83.9 ± 4.14 times/minute, while the speed group was 84.5 ± 2.91 times/minute. Based on the Independent T test statistical test, there were no significant differences in the heart rate characteristics of the study subjects between the two groups with the price of $p = 0.713$ ($p < 0.05$).

The mean BMI of the study subjects in the inclination group was 21.9 ± 1.43 kg/m², while the speed group was 22.6 ± 1.54 kg/m². Based on the Independent T test statistical test, there were no significant differences in

the BMI characteristics of the study subjects between the two groups $p = 0.465$ ($p < 0.05$). Data on serum slices of pre and post exercise both first week and second week were also normally distributed in both groups.

Kolmogorov-Smirnov test results showed that the serum irisin level data was normally distributed so that parametric statistical tests were used. The mean level of serum irisin of the study subjects in the pre-exercise inclination group was 5.63 ± 0.73 µg/ml, whereas after the first week of exercise was 5.58 ± 1.56 µg/ml. Based on the Independent T test statistical test, there were no significant differences in serum irisin levels between pre and post week I exercise for subjects in the inclination group at a price of $p = 0.890$ ($p < 0.05$). The mean serum irisin level of the study subjects in the pre-exercise inclination group was 5.06 ± 1.40 µg/ml, while the post-treatment was 5.38 ± 0.98 µg/ml. Based on the Independent T test statistical test, there were no significant differences in serum irisin levels between pre and post treatment week II for subjects in the inclination group with a price of $p = 0.305$ ($p < 0.05$).

Table 1. Participants characteristics

Characteristics	Inclination (n=10)	Speed (n=10)	p
Age (year)	31.1 ± 2.92	32.3 ± 2.31	0.322
Heart rate(x/mnt)	83.9 ± 4.14	84.5 ± 2.91	0.713
BMI (Body Mass Index) (kg/m ²)	21.9 ± 1.43	22.6 ± 1.54	0.465
Irisin serum baseline level pre exercise day 1 (ng/ml)	5.63±0.73	4.79±1.53	0.259
Irisin serum baseline level post exercise day I (ng/ml)	5.58±1.56	5.05±1.45	0.590
Irisin serum baseline level pre exercise day 6 (ng/ml)	5.06±1.40	6.49±0.90	0.259
Irisin serum baseline level post exercise day (ng/ml)	5.38±0.98	6.40±1.11	0.590

Note: p value is significant if < 0.05

Table 2. Comparison irisin serum (ng/ml) pre and post week I and II (in group)

Groups	Pre Week I	Post week I	P	Post week II	Post week II	p
Inclination	5.63±0.73	5.58±1.56	0.890	5.06±1.40	5.38±0.98	0.305
Speed	4.79±1.53	5.05±1.45	0.530	6.49±0.90	6.40±1.11	0.686

Note: p value is significant if < 0.05

Table 3. Comparison irisin serum (ng/ml) pre-pre and post-post baseline and week II (in group)

Groups	Pre week I	Post week I	P	Pre week II	Post week II	p
Inclination	5.63±0.73	5.06±1.40	0.259	5.58±1.56	5.38±0.98	0.590
Speed	4.79±1.53	6.49±0.90	0.002*	5.05±1.45	6.40±1.11	0.010*

Note: p value is significant if < 0.05, *significant

Table 4. Comparison irisin serum (ng/ml) pre-post week I and week II (in group)

Groups	Pre-Post week I	Pre-Post week II	p
Inclination	0.05±1.11	-0.32±0.93	0.505
Speed	-0.26±1.25	0.09±0.68	0.454

Note: p value is significant if <0.05

Tabel 5. Comparison increasing irisin serum (ng/ml) between inclination and speed groups

Variable	Inclination	Speed	p
Pre day 1-pre day 6	0.05±1.11	-0.26±1.25	0.567
Post day 1-post day 6	-0.32±0.93	0.09±0.68	0.275

Note: p value is meaningful if <0.05

The results of the comparison between the pre-exercise week I and the second week pre-training in the inclination group did not show a significant difference of $p = 0.259$ ($p < 0.05$), nor did the comparison results after the first week of exercise and after the second week of exercise in the inclination group did not show results. meaningful $p = 0.590$ ($p < 0.05$).

Parametric statistical test results in the speed group also showed results that were not much different, where the mean serum I irisin level in the study subjects in the pre-exercise speed group was $4.79 \pm 1.53 \mu\text{g/ml}$, while post exercise was $5.05 \pm 1.45 \mu\text{g/ml}$. The mean serum irisin level in the second week of the study subjects in the pre-exercise speed group was $6.49 \pm 0.90 \mu\text{g/ml}$, while the post-exercise was $6.40 \pm 1.11 \mu\text{g/ml}$.

Different results were found in the speed group, where the results of the comparison of the pre-training week I and pre-training week II in the velocity group showed significant differences $p = 0.002$ ($p < 0.05$). Significant differences were also found in the comparison results after the first week of training and after the second week of training at the speed group $p = 0.10$ ($p < 0.05$).

Comparison of irisin levels in the inclination group and speed is calculated using the Independent sample test statistical test, because the data is normally distributed. Static test results showed no significant difference in irisin increase between inclination groups and velocity groups both pre-post exercise $p = 0.567$ ($p > 0.05$) and pre-post exercise II $p = 0.275$ ($p > 0.05$) after get an intensity fitness exercise using a treadmill for 2 weeks, can be seen in Table 5.

DISCUSSION

The mean age of participants in both groups was 32 and 31 (Table 1) which showed that the average participants

were still in the productive age range which still allowed cardiorespiratory fitness training to reduce the risk of developing the disease.

The mean basal heart rate (Table 2) shows the heart rate of the study subjects in normal scope. During the exercise, showed improvement in basal heart rate. Improvement of heart rate in participants after receiving treadmill intensity training was in line with previous studies which stated that the mechanism of compensation for heart rate 1-4 was lower after receiving moderate intensity fitness training (Colaianni & Grano 2010, Benedini et al 2017, Fatouros 2017).

Increased levels of pre-basal serum iris and 1 hour post-exercise in the aerobic exercise group with a significant increase in gradual inclination were not significant. Gradual inclination increases involving more working muscles compared to gradual increase in speed. The muscles involved not only work to produce energy but also play a role in maintaining balance when climbing up on the treadmill. This condition allows not only irisin which is released by the muscle to the cellular, so that the serum irisin level is not significantly increased, although the data shows an increase in some subjects (Pescatello et al 2014, Perakakis et al 2017, Zhang et al 2015, Arias-Loste et al 2014). The duration required with a gradual increase in inclination to reach THR also affects the results of serum irisin levels. Slower inclination increases compared to increased speed, causing the use of type II muscle fibers to produce slower energy compared to gradual increase in speed. This situation may also affect the amount of serum irisin released to cellular, but this phenomenon still needs further research to prove it (Zhang et al 2017, Perakakis et al 2017, Arias-Loste et al 2014).

The results of this study showed that there were no significant differences in serum irisin levels in pre and post 2 weeks of cardiorespiratory fitness training using medium intensity treadmills with gradual increase in

speed and incremental increments. A study showed that there was a significant increase in serum irisin levels at 3 minutes after moderate intensity aerobic exercise, but there was a decrease approaching basal values at 1 hour after exercise. In other studies showed that there was an insignificant increase in serum irisin levels in untrained subjects who were given aerobic exercise for 12 weeks, but in healthy subjects of old age there was an increase in serum irisin levels after 6 weeks of aerobic exercise (So et al 2014, Daskalopoulou et al 2014, Kerstholt et al 2015).

Another study showed an increase in serum irisin levels in subjects who received high intensity aerobic exercise compared to moderate intensity. The results of these studies are in accordance with the results of this study, which shows that irisin has an acute effect on exercise that is at 3 minutes after exercise. Irises are also affected by exercise intensity, high intensity in aerobic exercise will have a significant impact on serum irisin levels. The length of time the exercise does not show a positive correlation to elevated serum irisin levels, but this does not mean that aerobic exercise is not ideal for a long period of time to increase serum irisin levels because further research is needed on this subject (Norheim et al 2013, So et al 2014, Daskalopoulou et al 2014, Kerstholt et al 2015).

Increased levels of pre-exercise basal serum irisin and serum irisin levels 1 hour after exercise in the speed group according to previous studies. Other studies say that there is an increase in serum irisin in individuals who do aerobic exercise by running on a treadmill. This is possible because the release of serum irisin from the muscles of the lower limbs to the cellular triggers the formation of UCP-1 which plays a role in browning WAT (Sanchez-Delgado et al 2015, Tang et al 2016, Hoffmann et al 2014, Panati et al 2016, Jacobs 2015). Browning WAT or called brite adypose triggers mitochondrial biogenesis in WAT to produce ATP. Increased serum irisin levels indicate increased amounts of brite adypose, which reflects increased oxygenation in muscle cells. This situation correlates with an increase in cardiorespiratory fitness as a goal of aerobic exercise (Norheim et al 2013, Zhao et al 2017, Kisan et al 2012, Polen & Joshi 2014, Gibbons et al 2002, Porszasz et al 2003).

Previous studies have shown that increasing levels of serum irisin in young pradiabetic patients has a positive correlation with inhibition of insulin resistance (Gibbons et al 2002, Badawy & Muaidi 2017, Froelicher et al 1975, Harun et al 1995, Pratanu 2008). Increased levels of serum irisin obtained one of them with aerobic exercise (Norheim et al 2013, Sanchez-Delgado et al 2015, Panati et al 2016, American Heart

Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science 2010, Tsuchiya et al 2014, WHO 2000).

The homogeneous age, level of activity, and BMI in this study have reduced the bias towards the results of serum irisin levels, but still require further scientific studies through more specific studies to assess the correlation of these factors in aerobic exercise using a treadmill with incremental increments (Zhao et al 2017, Hamlin et al 2012, Niemann 2011, Ferley et al 2014, Kim et al 2016).

CONCLUSION

Medium intensity Treadmill training with a gradual increase in speed for 2 weeks with a frequency of 3 times a week can increase serum slice in men, healthy young males not trained. Research limitation is lack of literature and research on the effect of exercise on serum irisin causes difficulties for researchers to determine the right time to see the effect of increased serum irisin. The duration of exercise and the short frequency in the study could not show the actual increase in irisin in the inclination group. Body fat composition also affects the levels of serum slices and aerobic exercise. The failure to measure the fat composition in this study also becomes one of the research limitations that can be corrected in subsequent studies.

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