EFFECTS OF STRUCTURED EXERCISE AMONG OVERWEIGHT AND OBESE FEMALE MALAY PARTICIPANTS ON HEALTH RELATED FITNESS

By

WONG FOO YEN

Dissertation submitted in partial fulfillment

of the requirements for the

degree of Bachelor of Health Sciences

(Exercise and Sports Science)

SCHOOL OF HEALTH SCIENCES

UNIVERSITI SAINS MALAYSIA

JUNE 2014

CERTIFICATE

This is to certify that the dissertation entitled

EFFECTS OF STRUCTURED EXERCISE INTERVENTION AMONG OVERWEIGHT AND OBESE FEMALE MALAY PARTICIPANTS ON HEALTH-RELATED FITNESS

is the bona fide record of research work done by

WONG FOO YEN

during the period of November 2013

to March 2014

ACKNOWLEDGEMENT

It has been a long and winding journey for me throughout the whole course of doing this final year project and thesis-writing. It isn't easy feat without the help of everyone along the way. It is one hell of a roller coaster ride spanning from September 2013 to June 2014. Emotional disturbance, motivation, cares from other, suicidal attempt, brain-draining sleepless night which still leaves side effects on me till this day. Nevertheless, the journey is a willing teacher that taught me more worthy than the value of the ticket. First of all, my greatest gratitude and appreciation to all those who lend a help hand to me when I was in my worst demotivated situation. Their support and guidance in term of opinions, experiences, critics, praises, and more will forever be remembered in my heart.

To put in the first place, I would like to channel my utmost sincere gratitude to my kind supervisor, Assoc. Prof. Dr. Mohamed Saat Bin Ismail for putting up with me for the entire 10-months long research. His valuable insight, suggestion, limitless guidance and assistance and also encouragement throughout this period of time and along the 4 years in my study is greatly appreciated and I am thankful for all destined arrangement from God.

I am grateful of Research Ethic Committee of USM for their effort in making sure that this research is compliance with research ethic and humanity and gracefully granted me an approval letter for my research to proceed.

Next, I would like to convey my gratitude to all the lecturers and staff from Exercise and Sport Science, School of Health Sciences and Sport Science Unit, School of Medical Sciences for their concerns and informative guidance about this study. Thank you to Madam Mazra Othman, and Madam Ema for providing me assistance in

laboratory setting and arrangement for blood test, aerobic session and etc. I would also like to thank Dr. Srilekha Saha, the course coordinator of GTS 402 Research Project, for giving assistance and compromising with me.

In addition, I would like to express special thanks to my fellow course mates and friends who lifted me up from troubles and depression especially Mr. Loh Tze Chien, Mr. Marry Eyu, Mr. Teddy Wong, Miss Norsuriani Suli, Miss Siti Hanisah Linggi Binti Mohd Azam, Miss Tang Shuh Huey, Miss Wong Pei Ying, Mr. Simon Hoi, Mr. Yew and many more. Their concerns make me felt warm in this cold lonely one-way uphill road in completing my study.

I am deeply indebted to all participants who willingly participated in my study even though they were busy with their works. Their commitment and full cooperation from the beginning until the end of the study was highly appreciated throughout the three months interventions.

Last but not least, I am thankful to my beloved family for their supports and helps, encouragement and understanding in which strengthen me throughout the study. Thank you every single person who made this research a success.

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KESAN LATIHAN BERSTRUKTUR TERHADAP KECERGASAN BERKAITAN DENGAN KESIHATAN DALAM KALANGAN PESERTA PEREMPUAN MELAYU YANG OBES DAN BERAT BADAN BERLEBIHAN

ABSTRAK

PENGENALAN: Mengambil bahagian dalam aktiviti fizikal secara kerap dapat meningkatkan kecergasan fizikal seperti kecergasan berkaitan kesihatan dan kecergasan berkaitan kemahiran. Banyak kajian telah dilakukan dengan pelbagai cara senaman termasuk senaman dumbbell, latihan rintangan, latihan litar, senaman aerobik dan lain-lain tetapi kajian dalam latihan berstruktur terutamanya populasi berat badan berlebihan dan obes adalah sukar didapati. Tujuan kajian ini adalah untuk mengkaji kesan latihan berstruktur terhadap kecergasan berkaitan kesihatan dalam kalangan wanita Melayu yang mempunyai berat badan berlebihan dan obes.

METODOLOGI: Tiga belas (n=13) orang peserta wanita yang berbangsa Melayu yang berusia 21 tahun ke atas telah mengikuti kajian ini. Setiap peserta dikehendaki untuk menjalani satu set ujian kecergasan berkaitan kesihatan pra-intervensi (PR) termasuk kekuatan otot, ketahanan otot, kecergasan kardiovaskular, kelenturan, komposisi badan, dan ujian tambahan seperti kadar jantung dalam keadaan rehat, tekanan darah sistolik dan diastolik. Kemudiannya, semua peserta mengikuti satu rutin senaman berstruktur yang telah ditetapkan dan diselia oleh penyelidik bermula pada hari selepas ujian kecergasan berkaitan kesihatan PR. Senaman berstruktur ini terdiri daripada tiga sesi senaman dumbbell (45 minit / sesi), dan satu sesi aerobik (1 jam / sesi) berselang hari serta sesi kaunseling yang berkaitan dengan pemakanan, pendidikan kesihatan, dan gaya hidup (15 minit / sesi)

selepas setiap sesi senaman dumbbell. Rutin senaman ini dilakukan setiap minggu dalam jangka masa tiga bulan. Setiap peserta juga dikehendaki untuk merekodkan pengambilan makanan harian dan aktiviti fizikal mereka. Selepas tiga bulan intervensi senaman berstruktur, semua peserta dikehendaki untuk menjalani ujian kecergasan berkaitan kesihatan seperti PR. Keputusan daripada ujian kecergasan berkaitan kesihatan pasca-intervensi (PA) kemudiannya dibandingkan dengan ujian kecergasan berkaitan kesihatan PR untuk mengenalpasti sama ada terdapat sebarang perubahan yang signifikan atau tidak dalam parameter yang diuji.

KEPUTUSAN: Keputusan kajian ini menunjukkan bahawa kecergasan kardiovaskular (PR: 36.26 ± 8.87; PA: 39.21 ± 6.64 mL O_2 kg^{-1} min^{-1}), lilitan pinggang (81.50 ± 13.1; 80.00 ± 11.0 cm), anggaran peratusan lemak badan (36.65 ± 3.9; 35.30 ± 3.8 %), tekanan darah sistolik dan diastolik (120 ± 17 / 80 ± 14; 117 ± 22 / 73.50 ± 13 mm Hg) menunjukkan statistik yang signifikan dalam perbezaan ($p < 0.05$) antara ujian kecergasan berkaitan kesihatan pasca-intervensi dan pra-intervensi. Sebaliknya, tidak ada perbezaan yang signifikan ($p > 0.05$) dalam kekuatan otot (kekuatan belakang dan kaki [45.00 ± 45; 60.00 ± 60 kg]; kekuatan genggaman tangan: kiri [26.00 ± 14; 28.00 ± 13 kg]; kanan [28.00 ± 10; 28.00 ± 14 kg]), daya tahan otot (bangkit tubi seminit [17.00 ± 11; 16.00 ± 10 kali seminit]; tekan tubi seminit [16.00 ± 8; 17.00 ± 6 kali seminit]), fleksibiliti (7.50 ± 8.3; 8.50 ± 6.6 cm), kadar jantung dalam keadaan rehat (81.00 ± 15; 79.50 ± 15 denyutan seminit), lilitan pinggul (100.00 ± 12.8; 102.50 ± 10.8 cm), nisbah pinggang-pinggul (0.78 ± 0.07; 0.77 ± 0.08), berat badan (65.80 ± 19.3; 65.45 ± 16.2 kg), ketinggian (1.55 ± 0.09; 1.55 ± 0.09 m) dan indeks jisim badan (27.70 ± 5.5; 28.00 ± 5.5) antara ujian kecergasan berkaitan kesihatan pasca-intervensi dan pra-intervensi.

KESIMPULAN: Keputusan daripada kajian ini menunjukkan bahawa intervensi latihan berstruktur jangka pendek (3 bulan) membantu dalam meningkatkan kecergasan kardiovaskular, mengurangkan lilitan pinggang, anggaran peratusan lemak badan, tekanan darah sistolik dan diastolik. Sebaliknya, ia kurang efektif dalam meningkatkan kekuatan otot, daya tahan otot, fleksibiliti, kadar jantung dalam keadaan rehat, lilitan pinggul, nisbah pinggang-pinggul, berat badan, ketinggian dan indeks jisim badan. Kajian lanjut perlu dilakukan untuk mengesahkan keputusan dan mendapat tinjauan ke dalam mekanisme bagaimana senaman berstruktur dan faktor-faktor sekitar berinteraksi.

EFFECTS OF STRUCTURED EXERCISE AMONG OVERWEIGHT AND OBESE FEMALE MALAY PARTICIPANTS ON HEALTH RELATED FITNESS

ABSTRACT

INTRODUCTION: Regular participation in physical activity can improve physical fitness such as health-related fitness and skill-related fitness. A lot of studies were conducted with various mode of exercise including dumbbell exercise, resistance training, circuit training, aerobic exercise and so on but study into structured exercise especially on overweight and obese population is scarce. The purpose of this study is to investigate the effects of structured exercise among overweight and obese female Malay participants on health related fitness.

METHODOLOGY: Thirteen (n=13) female Malay-ethnic participants with age above 21 years old were recruited in this study. Participants were required to undergo a pre-intervention (PR) health-related fitness testing which included muscular strength, muscular endurance, cardiovascular fitness, flexibility, body composition with additional of resting heart rate, systolic and diastolic blood pressure. All participants followed a prescribed and supervised exercise starting from the day after the PR health-related fitness testing of three sessions of dumbbell exercise (45 minutes / session), and one sessions of aerobic exercise (1 hour / session) on alternate day each week for the duration of three months and dietary, health and lifestyle educational counseling (15 minutes / session) after each session of dumbbell exercises. In addition, all participants were required to record their daily dietary intake and physical activity other than the prescribed exercises. After three months of intervention with structured exercise, all participants were required to undergo a post

health-related fitness testing, which is identical to the PR health-related fitness testing. The post-intervention (PO) health-related fitness testing results is then compared with PR health-related fitness testing results to see whether there is any improvement in any measures.

RESULTS: The results of this study indicated that cardiovascular fitness (PR: 36.26 ± 8.87; PO: 39.21 ± 6.64 mL O_2 kg^{-1} min^{-1}), waist circumference (81.50 ± 13.1; 80.00 ± 11.0 cm), estimation of body fat percentage (36.65 ± 3.9; 35.30 ± 3.8 %), systolic and diastolic blood pressure (120 ± 17 / 80 ± 14; 117 ± 22 / 73.5 ± 13 mm Hg) were found to be statistically significant in difference ($p<0.05$) between the post-intervention and pre-intervention of health-related fitness testing. On the other hand, there was no significant difference ($p>0.05$) statistically in muscular strength (back and leg strength [45.00 ± 45; 60.00 ± 60 kg]; handgrip strength: left [26.00 ± 14; 28.00 ± 13 kg]; right [28.00 ± 10; 28.00 ± 14 kg]), muscular endurance (sit-up per minute [17.00 ± 11; 16.00 ± 10 times per minute]; push-up per minute [16.00 ± 8; 17.00 ± 6 times per minute]), flexibility (7.50 ± 8.3; 8.50 ± 6.6 cm), resting heart rate (81.00 ± 15; 79.50 ± 15 beats per minute), hip circumference (100.00 ± 12.8; 102.50 ± 10.8 cm), waist-hip ratio (0.78 ± 0.07; 0.77 ± 0.08), weight (65.80 ± 19.3; 65.45 ± 16.2 kg), height (1.55 ± 0.09; 1.55 ± 0.09 m) and body mass index (27.70 ± 5.5; 28.00 ± 5.5) between the post-intervention and pre-intervention of health-related fitness testing.

CONCLUSION: The results revealed that intervention of short term (3 months) structured exercise helps in improving cardiovascular fitness, decreasing waist circumference, estimation of body fat percentage, systolic and diastolic blood pressure while it might be less effective in improving muscular strength, muscular endurance, flexibility, resting heart

rate, hip circumference, waist-hip ratio, weight, height and body mass index. Further study should be done to confirm the results and to gain a more insightful into mechanism of how structured exercise and surrounding factors interacts.

CHAPTER 1

INTRODUCTION

1.1 Background of the Study

Malaysia is a country with high prevalence of obesity among South East Asia countries as National Health and Surveys has shown. 15.1% of Malaysians aged 18 were suffering from obesity as of 2011, which had increased from 14% of the same demographic in 2006. It was also reported that over 2.6 million of adults were obese while over 477,000 children below the age of 18 years old were overweight out of 29,628,392 (July 2013 est.) Malaysians. 14% of obesity rate prevalence in adult populations based on The World Factbook by Central Intelligence Agency.

Obesity can lead to numerous complication and disease, being morbidly obese can seriously compromise your health, your locomotion, and your Disabilities-Adjusted Life Year (DALY). The more you are overweight, the more probability of you developing cardiovascular disease, diabetes, high blood pressure and so on. Hypertension or more commonly known as high blood pressure develops as one person store excessive fat or obese. Research shown that obese patients displayed an increase in blood volume and arterial resistance. Losing as little as 8 pounds can help reduce blood pressure of these patients to safe level. Besides that, obesity is one of the most significant factors in the development of insulin resistance which lead to type 2 diabetes; a weight loss of 15-20 pounds can help reduce the risk of developing type 2 diabetes. According to American Heart Association, obese individual have a greater chance of having a heart attack before the age of 35 than non-obese adolescent. Losing of 10-15 pounds can reduce the risk of developing

heart disease. Other complication includes higher cholesterol level, cancer, infertility, back pain, skin infections, ulcers, and gallstones (American Heart Association, 2000). All are preventable with intervention of guided weight loss program. If obesity can be curbed, quality of life can be improved greatly and better life means more comfort which leads to higher productivity for the nation, less medical cost and off-day, less distress, more self-confidence, longer life expectancy, and many more benefits. Under American Medical Association (AMA), obesity is now officially considered a disease given that obesity can be prevented and the patient can lead a healthier life through intervention of planned physical activities and structured exercise. A sedentary life-style is associated with an increased risk for acute myocardial infarction and death from coronary heart disease (CHD) (Kokkinos et al., 1995).

Numerous studies have shown that South Asian have a higher tendency in developing central obesity compared to other race like Caucasian, and African. At similar BMI, the Waist-Hip Ratio of South Asians is greater than whites' populations. Theories have been put up to explain the phenomena. One of the theories includes the adipose tissue overflow theory. It explained that South Asian have a reduced capacity to store fatty acids in the primary adipose tissue compartment, which results in earlier utilization of the secondary compartments. As a result, South Asian is more susceptible to abdominal obesity. If the phenomena persist, large waist circumference caused by central obesity and dyslipidemia substantially increases the health risk to cardiovascular diseases.

1.2 Objective of the Study

General Objective

This study aims to study the effects of structured exercise among overweight and obese female Malay participants on health-related fitness.

Specific Objectives

- ✓ To measure the effects of structured exercise on cardiovascular fitness on female overweight and obese Malay participants.
- ✓ To measure the effects of structured exercise on muscular strength on female overweight and obese Malay participants.
- ✓ To measure the effects of structured exercise on muscular endurance on female overweight and obese Malay participants.
- ✓ To measure the effects of structured exercise on flexibility on female overweight and obese Malay participants.
- ✓ To measure the effects of structured exercise on body composition on female overweight and obese Malay participants.
- ✓ To investigate the magnitude of effects of structured exercise on health related fitness on female overweight and obese Malay participants.

1.3 Hypothesis

Null hypothesis, H_O : There is no significant effects of structured exercise intervention among overweight and obese female Malay participants on cardiovascular fitness.

Alternate hypothesis, H_A : There is significant effects of structured exercise intervention among overweight and obese female Malay participants on cardiovascular fitness.

Null hypothesis, H_O : There is no significant effects of structured exercise intervention among overweight and obese female Malay participants on muscular strength.

Alternate hypothesis, H_A : There is significant effects of structured exercise intervention among overweight and obese female Malay participants on muscular strength.

Null hypothesis, H_O : There is no significant effects of structured exercise intervention among overweight and obese female Malay participants on muscular endurance.

Alternate hypothesis, H_A : There is significant effects of structured exercise intervention among overweight and obese female Malay participants on muscular endurance.

Null hypothesis, H_0: There is no significant effects of structured exercise intervention among overweight and obese female Malay participants on flexibility.

Alternate hypothesis, H_A: There is significant effects of structured exercise intervention among overweight and obese female Malay participants on flexibility.

Null hypothesis, H_0: There is no significant effects of structured exercise intervention among overweight and obese female Malay participants on body composition.

Alternate hypothesis, H_A: There is significant effects of structured exercise intervention among overweight and obese female Malay participants on body composition.

Variables

Dependent variable: Health-related fitness of the overweight and obese participants.

Independent variable: Structured exercise intervention.

1.4 Significance of the Study

Each year Malaysia government spent about 4.4% of Gross Domestic Product (GDP) as of 2010 to expedite on health related issues like immunization, hospitals running costs, and health screening. The medical cost spent on curative medicine can be channel to preventive medicine and reach a larger population and more coverage. Change in attitude is the best option. Based on statistic, Malaysia has physician ratio of 0.94 per 1000 populations as of 2008, which means there is only one doctor to take care of 1000 people in the community. Medical cost also include the prescription of free medicine to the public especially expensive medicine such as diuretics for treatment of high blood pressure, and blood sugar control pill for type 2 diabetes patients. Hospitalisations also become a burden not only to the patient family but also the company that hire the patient and the government who is subsidising the hospital stays in general hospital. More off day means lower productivity to the company and less economic vibrant to the nation.

We need to understand the danger posed by obesity in hindering society development and shortening expected lifespan of Malaysian. According to Prof Dr Mohd Ismail Noor, president of the Malaysian Association for the Study of Obesity (MASO), obesity has not been high on the public health agenda in developing countries as the prevalence, defined as BMI>30, appeared very low while governments focused on eradicating under-nutrition. Furthermore, actions to act decisively to help combat the increasing prevalence of obesity globally and in Malaysia has been few and overall rather uncoordinated. We have to work together to eradicate these dangers and help Malaysia become not only a developed country

by year 2020, but also a healthy, productive, and disease-free community of Malaysian.

CHAPTER 2

LITERATURE REVIEW

2.1 Benefits of Exercise

Exercise is defined as the physical activity that is planned, structured, repetitive, and purposive with the objective of improvement or maintenance of physical fitness. United States of America guidelines recommended that healthy adults take part in aerobic activity of moderate intensity for at least 150 minutes a week or vigorous intensity for 75 minutes a week (U.S. Department of Health and Human Services, 2008). Research findings also unanimously agreed that some physical activity is better than none while extra health benefits can be gained by increasing the duration and intensity of exercises and the time of each session. There is also strong evidence that physical activity helps in prevention of weight gain, improve cardiovascular and muscular fitness, prevention of falls, and reduced depression (U.S. Department of Health and Human Services, 2008). Exercise makes demands on the body systems over and above normal every day activities and as result the systems adapt anatomically and physiologically (Rosser, 2001). Available experience and scientific evidence showed that regular physical activity provide people, both male and female, of any conditions including disabilities, with a wide range of physical, social and mental health benefits (WHO, 2003). Most benefits of exercise are produced by movement requiring the dynamic and rhythmic use of large muscles for an extended period of time. This exercise is most effective when it is performed frequently (daily to at least every third day) and at a moderate intensity relative to the individual's capacity (Haskell, Montoye, & Orenstein, 1985).

2.2 Dumbbell exercise

Dumbbell exercise was developed by Professor Masashige Suzuki from Japan back in year 1983. When the 20-min Dumbbell Exercise was performed every day for 12 weeks, a decreased body weight and body fat while maintaining body fat weight was observed (Suzuki, 2008). It is an appropriate exercise for middle-aged and old people because of its easy performance using very light dumbbell weighing 300g to 2kg. In addition, the dumbbell exercise has the resistance (anaerobic) effect to increase the amount of muscle and also the aerobic effect to increase metabolic rate producing aerobic energy in muscle (Suzuki, 2008). Several scientific papers were published concerning the health benefits resulting from the Dumbbell Exercise. The most remarkable result is its influence on weight control. The Dumbbell exercise is also helpful in reducing the risk of health problems occurring in middle-age. Middle-aged people with metabolic syndromes such as obesity, hypertension, hyperlipemia, diabetes, and myocardial disease demonstrated improvement in health problems after performing Dumbbell exercise for one year during the rehabilitation period (Suzuki, 2008). Experienced athletes frequently adopt conditioning and strengthening programs involving exercises with dumbbell, barbell and cable equipments. Such equipments allow high levels of loads and the highest degree of freedom for the movement; therefore, they can be used in a number of different ways to target different muscle groups (Biscarini et al., 2005). These equipments also help to develop balance, coordination and kinaesthetic awareness, since rods, cams, and leverage mechanisms do not guide the load. Thus, stabilising and synergistic muscles are properly stimulated in addition to the ones the exercise is designed to work with. As a result, dumbbell, barbell and cable equipment can be

profitably used to set up exercises biomechanically similar to some specific athletic movements (Enoka, 2002; Haff, 2002). Additional health benefits are provided by heavy resistive exercise that develop strength and increase flexibility (Haskell et al., 1985).

Basic principle of the dumbbell exercise and aerobic dance class involve promoting protein synthesis in the body and repair basal metabolic rate by building and utilising the muscle. Dumbbell exercise uses high repetition low intensity to promote the utilization of fat as primary energy source. Aerobic respiration of the muscle at moderate intensity of exercise breaks down the adipose tissue to fuel the energy expenditures without accumulating lactate acid which causes the user to feel fatigue and cramp. The use of dumbbell is more effective than callisthenic exercise given that the added weight helps expedite more calories from lifting. Aerobic dance class involve the use of all large muscle on the body and continuous movement at moderate intensity. The utilisation of large muscle burn out more calories and break down more adipose tissues to fuel the movement. It also helps to tone up muscle.

2.3 Aerobic exercise

Many physiological changes are determined by daily aerobic exercises (Shahana, Usha, & Hasrani, 2010). Arazi, Farzaneh, & Gholamian (2012) showed that 8 week of aerobic training in the morning (six days in a week) at 60-70% of target heart rate can cause changes in lipid Profile, Waist-Hip Ratio and VO_{2max}, significantly in overweight females. Improvements found in health-related parameters of overweight and obesity females participants as a result of aerobic exercise program (Roohi & Niknam, 2008; Vatansev & *Çakmakçi*, 2010). 12 weeks of aerobic training improved flexibility, sit-ups, hand grip for both hands, VO_{2max} and impaired Low-Density Lipoprotein, total cholesterol in obese girls (Saygın & Öztürk, 2011). Moderate aerobic exercise has positive effect on cardiovascular endurance, muscular strength, and flexibility of sedentary female communities (Hosiso, Rani, & Rekoninne, 2013). Improved cardiorespiratory endurance, flexibility, muscular strength endurance and decreased skin fold thickness (body fat percentage) among the experimental group of middle-aged women after 12 weeks of aerobic training (Shahana et al., 2010). Aerobic exercise performed at a moderate intensity (more than 50 percent of VO_{2max} or heart rate reserve) for a duration that results in an energy expenditure of more than 4 kilocalories per kilogram of body weight per session at least every other day should be the minimum goal of adults who are otherwise sedentary (Haskell et al., 1985).

2.4 Structured Exercise

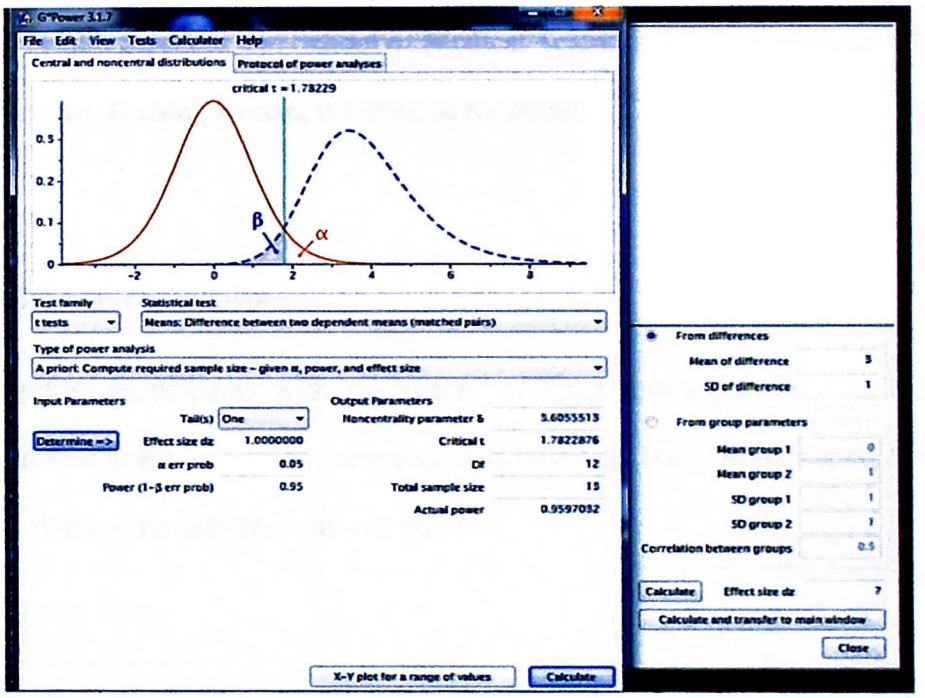
Structured exercise is a holistic approach to exercise regime. A good exercise program includes three types of exercise: a) Stretching - to improve flexibility and prevent injury, b) Endurance (aerobic) - to improve the fitness of your heart and lungs, lowering your risk of heart and other chronic diseases and c) Strength training (weight training) - to strengthen muscles and increase your endurance (The University Of Georgia And Ft. Valley State University, The U.S. Department Of Agriculture And Counties Of The State Cooperating, 2013). A 12-week structured exercise programme has positive significant effect ($P<0.05$) on haemotologically related variable- haematocrit and Hb (increased from 39.9 ± 3.30% to 42.64 ± 4.81% and Hb – 12.64 ± 0.27g% to 14.20 ± 1.61g%) and resting systolic and diastolic blood pressures (reduced from 114.40 ± 10.03 mmHg to 103.60 ± 8.10 mmHg/ 78.80 ± 8.33 mmHg to 70 ± 7.64 mmHg). This study also revealed that significant positive changes ($P<0.05$) existed in health-related fitness variables – cardio-respiratory endurance (time to cover 1.5 miles, reduced from 14.55 ± 1.58min/secs to 6.55 ± 6.35 min/sec), percent body fat (8.9 ± 1.65% to 6.33 ± 1.07%), abdominal muscular strength (number of sit-ups increased from 18.68 ± 7.01/ min to 30.72 ± 7.64/min), and flexibility (sit and reach test increased form 31.64 ± 4.24cm it 35.48 ± 6.28cm). (Otinwa, 2014). Based on my observation, research on the effects of aerobic exercise and dumbbell exercise is plentiful while research on structured exercise of combination exercise of dumbbell exercise and aerobic exercise together is scarce and research on effect of structured exercise on overweight and obese population especially on overall health related fitness only a handful. Hence, we narrow down our focus to research on effects of short term (12 weeks) structured exercise among overweight and obese population.

CHAPTER 3

METHODOLOGY

3.1 Samples

Plate 3.1 Picture above shows the print screen shot of the calculation of G*Power 3.1.7 in computing the minimal total sample size for this topic in order to reject null hypothesis.



Using software G*Power 3.1.7, with Type I error estimated at level $p<0.05$ while power is set at 0.95. We computed that a minimal of 13 participants was needed to include in this study in order to reject or accept null hypothesis. In order to contrast off the possibility of dropout, improve the credibility and assure the valid analysis of the research in accordance to central limit theorem, we set a sample size of 16 participants.

Participants

The 16 participants will be selected from Health Campus, Universiti Sains Malaysia to specifically understand the effect of structured exercise program among overweight and obese female Malay participants on health-related fitness. We choose to carry out the recruitment of participants in health campus so that participants can comply with our training programs that span through the weeks with no excuse.

The participants are all self-volunteered staff recruited from School of Linguistic, School of Health Sciences and School of Medical Sciences of Universiti Sains Malaysia Health Campus, Kubang Kerian, the state of Kelantan.

3.1.1 Participants recruitment

Healthy participants with no history of heart attack, myocardiac infarction, stroke or major health condition were recruited based on Body Mass Index, Waist-Hip Ratio and Waist Circumference cut-off point.

3.1.1.1 Inclusion criteria

-Working adult individuals defined as overweight and/or obese based on reading on Body Mass Index, and defined as high risk in Waist-Hip Ratio and waist circumference based on Asian populations.

Overweight in this context is defined as an excess amount of body weight that may come from muscles, bone, fat, and water while obese means an excess amount of body fat. (Weight-control Information Network, 2012)

The cut-off point selected is based on recommendation of World Health Organisation (WHO) expert consultation international classification cut-off point. BMI of more than or equal to 25 $\frac{kg}{m^2}$ will be considered overweight. The BMI from 25.0 to 29.9 $\frac{kg}{m^2}$ will be pre-obese stage. For BMI more or equal to 30 $\frac{kg}{m^2}$ will be considered obesity. Obesity is divided into three divisions, 30-39.9 $\frac{kg}{m^2}$ is Obese Class I, 35-39.9 $\frac{kg}{m^2}$ is Obese Class II while more or equal to 40 $\frac{kg}{m^2}$ is Obese Class III.

For waist circumference and Waist-Hip Ratio, we adopted the cut-off points based on World Health Organization recommendation to screen participants. Female with more than 80 cm for waist circumference is included in this research. For Waist-Hip Ratio, more or equal to 0.85 for women is screened for inclusion.

-Non-smoker for the past three months.

-Not taking any medication including supplement, for example, diet pill, fat burner or protein powder and etc.

-Each participant signed an informed consent form approved by the Human Research Ethics Committee (HREC) of Universiti Sains Malaysia (USM) before participation and were informed of all possible experimental risks and discomforts on participating in this study.

3.1.1.2 Exclusion criteria

-Participants who could not give full cooperation in the following will be excluded.

-Physical disabled or mentally challenged.

-Physical momentarily disabled or medically deemed unfit for participation, for example, pregnant ladies, participants with past history of stroke or cardiovascular diseases, and participant with injured extremities.

3.2 Procedures

In the initial recruitment of participants, the researcher together with the supervisor gave an introduction to all of the office in the above-mentioned school. Anyone who volunteered to be participant for this study will be recruited. All participants is then put into a screening session. Unsuitable participants will be excluded. Next, the successful participants will undergo a pre-intervention health-related fitness testing (Appendix D) and after that, enter the phase of briefing. The briefing will explain to the participants on the purpose, aim of the study, and the structured exercise program together with the aerobic classes. The participants will then be given option to participate by filling in a consent form (Appendix A). After the consent is obtained, food diary and physical activity diary (Appendix E) will be handed to all participants and they are requested to fill it up the diary starting on that day till the end of the programme. The participants also will be given adherence log to keep up with their progress and also engage in buddy system to make sure that their motivations do not fade. To ensure that there will be no complication in the future or concurrently, each participant will be requested to fill in a Physical Activity Readiness Questionnaire (PAR-Q) (Appendix C). The dumbbell exercise and the aerobic classes will commence the next day.

The design of the structured exercise programme consisted of three sessions of dumbbell exercise and one session of aerobic dance class per week with each session spanning 45 minutes to 1 hour. All participants were encouraged to complete 10,000 steps at brisk walking pace per day and honestly self-reporting it on the physical activity diary. All the participants also will be given a fitness counselling that will cover through

nutrition, knowledge of exercise programs and continuous motivation after each session of dumbbell exercise for 15 minutes.

All participants will follow a sequence of dumbbell exercises and sufficient rest in between for three days a week. The dumbbell exercise will be carried out in Exercise and Sport Science lab, School of Health Sciences, Universiti Sains Malaysia or any venue deemed appropriate and comfortable by participants so that to ease their time-strained schedule to go to the laboratory. All workouts start with a general warm-up and include a cool-down periods (e.g. stretching) of approximately 5-10 min. The researchers monitored all participants so that all exercise is correctly carried out. Specifically, researchers are responsible for witnessing that exercise prescriptions were properly carried out and achieved during a workout (e.g. appropriate spotting, appropriate safety considerations, and prescribed rest periods). Also, it has been recently demonstrated that direct supervision of resistance training is vital to optimize strength performance adaptations (Mazzetti et al., 2000). The exercise program will last for 3 full months (90 days from December 2013 until February 2014). For dumbbell exercise, all participants perform 12 exercises with 10 to 15 repetitions in 1 sets of each exercise with pairs of 500g dumbbell.

Next, all participants will be asked to join an aerobics class per week conducted by an aerobics instructor. The venue will be in Exercise and Sport Science lab, School of Health Sciences, Universiti Sains Malaysia. All dumbbell exercises and aerobics class are arranged on alternate days so that the participants get sufficient rest. The aerobics class last for an hour at moderate intensity.

By the end of the structured exercise program, all participants will do post-intervention health-related fitness test, which is identical to pre-intervention health-related fitness test. All data collected will be compiled with pre-intervention health-related fitness test, a non-parametric Wilcoxon Signed Rank Test will be conducted between the pre- and post-intervention health-related fitness data to investigate the degree of changes in all health-related fitness measures.

Figure 3.1: Dumbbell exercise flow

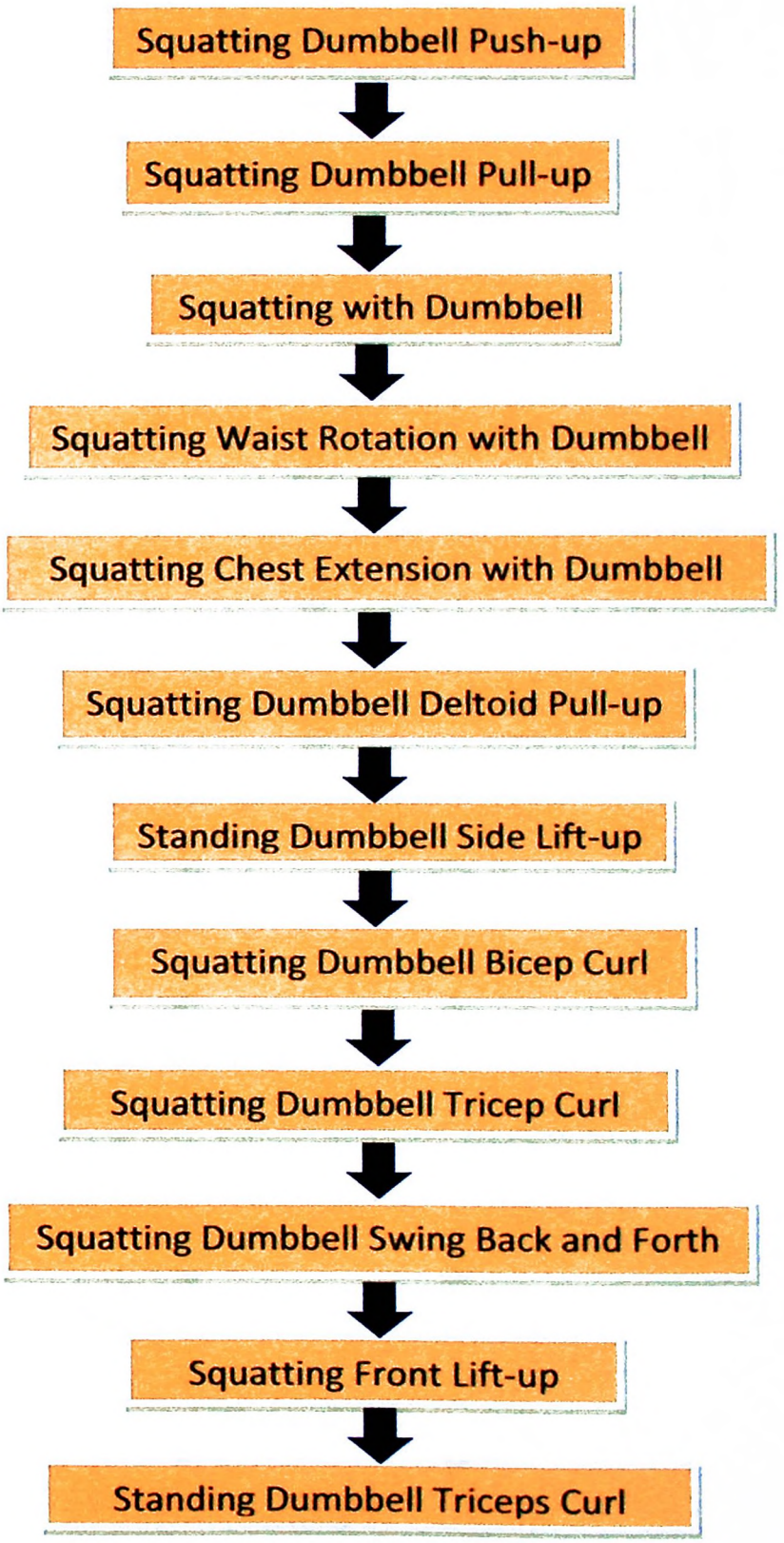
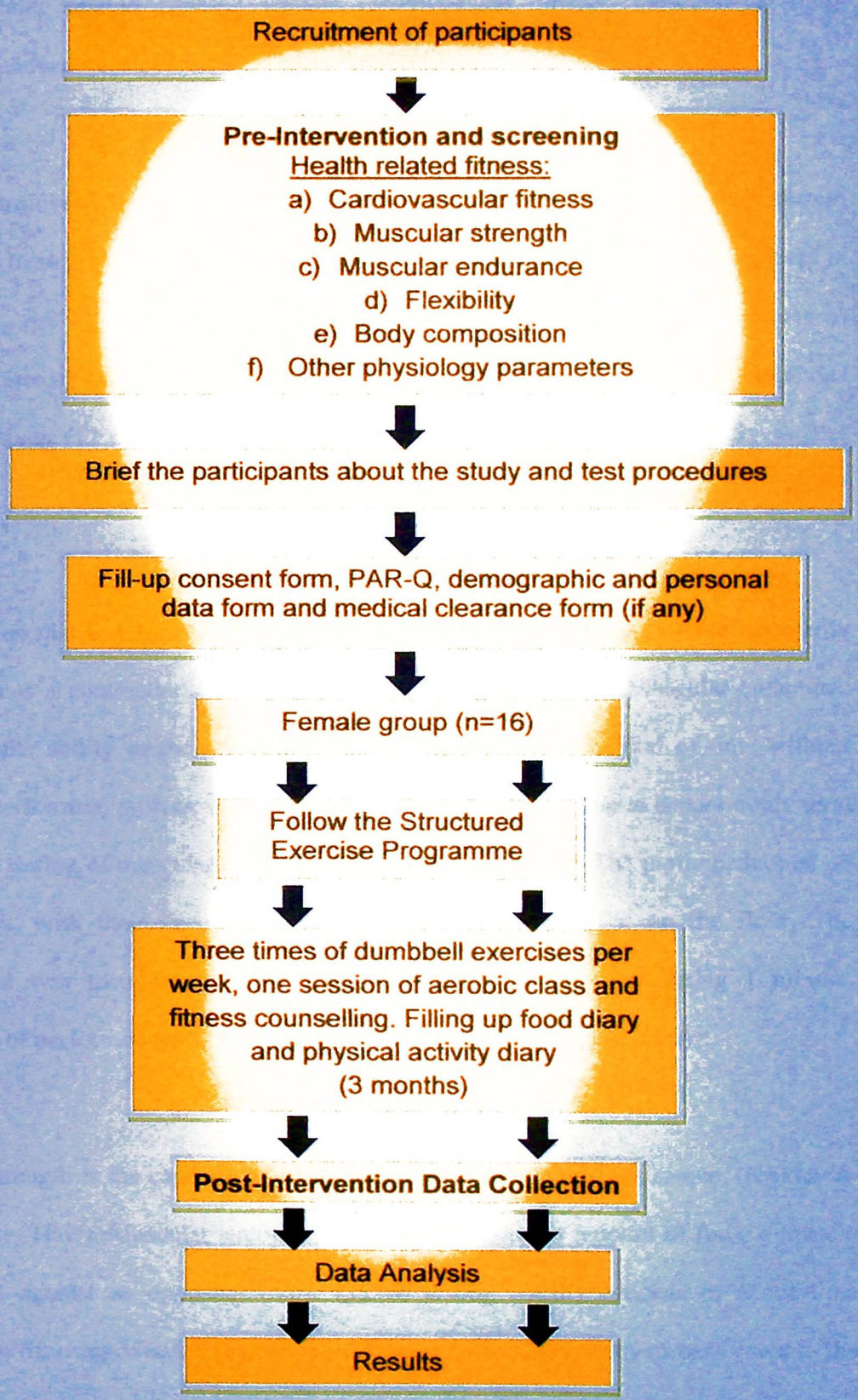


Figure 3.2: Flow chart of the Study



3.3 Measurements of variables

Health related fitness includes cardiovascular fitness, muscular strength, muscular endurance, flexibility and body composition.

Cardiovascular fitness is the ability of the heart (cardio) and circulatory system (vascular) to supply oxygen to muscles for an extended period of time. It is calculated in mL of O_2 per kg body mass per minute time. Cardiovascular is also known as cardiorespiratory (lungs) fitness. Usually the mile run or some other type of continuous fitness activity (12 minute run, cycling, step-test, etc.) is used to assess cardiovascular fitness.

Muscular endurance is defined as the ability to muscle to apply force repeatedly into sustains a contraction for a period of time (Hockey, 1973). Muscular endurance refers to the ability of the muscle to work over an extended period of time without fatigue. Performing push-ups and sit-ups or crunches for one minute is commonly used in fitness testing of muscular endurance (McGraw-Hill, 2013). The participants lied on their back, with their knees at right angles (90°) and feet flat on the floor. The participant was then attempted to perform one complete sit-up during 1 minute. Numbers of performed sit- up was counted (Sparling, 1997; Zorba, 2000).

Strength is the capacity of muscles to exert force against resistance, (Kirkley & Goodbody, 1969). Muscular strength refers to the maximum amount of force a muscle can exert against an opposing force. Fitness testing usually consists of a one-time maximum lift using weights (bench press, leg press, etc.). The test was performed in the

standing position. The participant held the dynamometer in the hand to be tested with the arm at right angles and the elbow by the side of the body. Participant was then asked to squeeze the dynamometer with her maximum isometric effort for a 5 s period. Test was repeated 2 times with both hands. 30 s resting intervals were provided between measurements and the highest score was recorded (American College of Sport Medicine [ACSM], 2000).

Flexibility is the range of motion available in a joint (Corbin & Lindsey, 1978). Flexibility is the ability to move a body part through a full range of motion at a joint (ROM). The sit-and-reach is commonly used to determine flexibility. Flexibility was measured by the "sit-and-reach" test (Clark et al., 1989). After a warm-up, the participants sat on the floor with their legs straight out in front of them, heels touching the side of a box. Their fingertips were positioned on the 0 cm edge of the box that was marked in centimetres towards the opposite edge. They were then asked to bend forward with arms outstretched towards their toes. The farthest test score of the three trials was recorded. The sit-and-reach test was conducted to measure flexibility of the hamstrings and lower back.

Body composition is the ratio of body fat to lean body mass (including water, bone, muscle, and connective tissue). Having too much fat tissue is a risk factor for cardiovascular diseases, diabetes, cancer, and arthritis.

Body mass index (BMI) is measure of relative weight and easy to obtain. It is acceptable proxy for thinness and fatness and has been directly related to health risks

and death rates in many populations. The formula for calculation is weight in kilograms divided by height in metres squares($\frac{kg}{m^2}$). It is highlighted that the need for for other indicators to complement the measurement of BMI, to identify individuals at increased risk of obesity-related morbidity due to the accumulation of abdominal fat (World Health Organization [WHO], 2000).

Waist-hip Ratio (WHR) was suggested as an additional measure of body fat distribution. The formula to calculate Waist-Hip Ratio is the waist circumference divided by the hip circumference. As recommended by the 2002 WHO Expert Consultation, where possible, waist circumference should be used to refine action levels based on BMI.

Seidell (2010) concluded that:

- Waist circumference and waist-hip ratio are both related to increased risk of all-cause mortality, throughout the range of adult BMIs;
- Waist circumference and waist-hip ratio are strongly predictive in young and middle-aged adults compared to older people and those with low BMI;
- Waist circumference alone could replace waist-hip ratio and BMI as a single risk factor for all-cause mortality.

Huxley, Mendis, Zheleznyakov, Reddy, & Chan (2010) concluded that:

- measures of abdominal obesity are better than BMI as predictors of CVD risk, although combining BMI with these measures may improve their discriminatory capability;