THE EFFECTS OF HIGH INTENSITY INTERVAL TRAINING AND SLOW JOGGING ON PHYSICAL FITNESS AND MENTAL HEALTH AMONG SEDENTARY FEMALES

MUHAMAD RASHIDI BIN ISHAK

SULTAN IDRIS EDUCATION UNIVERSITY

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MUHAMAD RASHIDI BIN ISHAK

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ABSTRACT

The study aimed to identify the effects of High-Intensity Interval Training (HIIT) and slow jogging on physical fitness (including cardiovascular endurance, muscular endurance, strength, flexibility, and body composition) and mental health (quality of life and self-esteem) among sedentary females. This study employed the randomised controlled trials design. A total of 30 participants from the Malaysian Statistical Training Institute (ILSM) were randomly assigned to either the HIIT group (n=15) or the slow jogging group (n=15). The intervention lasted six weeks, with both groups undergoing similar physical and mental health assessments, including fitness tests and mental health questionnaires, before and after the training. The results indicated that the HIIT group demonstrated significant improvements in physical fitness and mental health ($p<0.05$). The slow jogging group also showed significant improvements in physical fitness ($p<0.05$). The slow jogging group however did not show significant improvements in Body weight ($M = 61.74$, $SD = 15.12$, $p = 0.157$) and BMI ($M = 24.53$, $SD = 1.51$, $p = 0.179$). The data also showed that the slow jogging group showed significant improvement in self-esteem ($M = 24.00$, $SD = 2.20$, $p = 0.000$) but did not show significant improvements in quality of life ($M = 90.53$, $SD = 14.32$, $p = 0.061$). When the data from both groups were compared, significant difference was only demonstrated in handgrip test ($p = 0.04$) and self-esteem ($p = 0.04$). Overall, the data indicated that both groups improved in physical fitness and mental health. However, the HIIT group evidently improved in hand grip and quality of life as compared to the slow jogging group. The findings implicate that both exercise types are recommended for use by coaches and trainers to promote physical and mental health benefits for sedentary women.

KESAN LATIHAN INTENSITI TINGGI INTERVAL DAN JOGING PERLAHAN TERHADAP KECERGASAN FIZIKAL DAN KESIHATAN MENTAL DALAM KALANGAN WANITA SEDENTARI

ABSTRAK

Kajian ini bertujuan untuk mengenal pasti kesan Latihan Selang Intensiti Tinggi (HIIT) dan joging perlahan terhadap kecergasan fizikal (termasuk daya tahan kardiovaskular, daya tahan otot, kekuatan, kelenturan, dan komposisi badan) dan kesihatan mental (kualiti hidup dan kepercayaan diri) dalam kalangan wanita sedentari. Kajian ini menggunakan reka bentuk ujian kawalan rawak. Seramai 30 peserta dari Institut Latihan Statistik Malaysia (ILSM) telah diagihkan secara rawak kepada kumpulan HIIT (n=15) atau kumpulan joging perlahan (n=15). Intervensi berlangsung selama enam minggu, dengan kedua-dua kumpulan menjalani penilaian kesihatan fizikal dan mental yang serupa, termasuk ujian kecergasan dan soal selidik kesihatan mental, sebelum dan selepas latihan. Hasil kajian menunjukkan bahawa kumpulan HIIT menunjukkan peningkatan yang signifikan dalam kecergasan fizikal dan mental ($p<0.05$). Kumpulan joging perlahan juga menunjukkan peningkatan signifikan dalam kecergasan fizikal ($p<0.05$). Namun, kumpulan joging perlahan tidak menunjukkan peningkatan signifikan dalam berat badan ($M = 61.74$, $SD = 15.12$, $p = 0.157$) dan BMI ($M = 24.53$, $SD = 1.51$, $p = 0.179$). Data juga menunjukkan bahawa kumpulan joging perlahan menunjukkan peningkatan signifikan dalam kepercayaan diri ($M = 24.00$, $SD = 2.20$, $p = 0.000$) tetapi tidak menunjukkan peningkatan signifikan dalam kualiti hidup ($M = 90.53$, $SD = 14.32$, $p = 0.061$). Apabila data daripada kedua-dua kumpulan dibandingkan, perbezaan yang signifikan hanya ditunjukkan dalam ujian genggaman tangan ($p = 0.04$) dan kepercayaan diri ($p = 0.04$). Secara keseluruhan, data menunjukkan bahawa kedua-dua kumpulan meningkat dalam kecergasan fizikal dan kesihatan mental. Namun, kumpulan HIIT jelas meningkat dalam aspek genggaman tangan dan kualiti hidup berbanding kumpulan joging perlahan. Penemuan ini menunjukkan bahawa kedua-dua jenis senaman ini disarankan untuk digunakan oleh jurulatih bagi meningkatkan manfaat kesihatan fizikal dan mental untuk wanita sedentari.

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HIIT	High Intensity Interval Training
TIDM	Type 1 Diabetes Mellitus

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CHAPTER 1

INTRODUCTION

1.1 Introduction

This chapter presents background of the study, problem statement, research objectives, research questions, significance of the study, limitation of the study, and definition of key terms.

1.2 Background of the study

Exercise has become one of the healthy lifestyles among people nowadays. One of the types of exercise that has received growing attention among trainers and exercise practitioner is High - Intensity Interval Training (HIIT) (Atakan et al., 2020; Reljic et al., 2019; Gray et al., 2016). Short bursts of intense exercise are interspersed with rest or low-intensity exercise during HIIT. It has been demonstrated that HIIT enhances

body composition, metabolic health, and cardiovascular fitness in overweight people (Gist et al., 2014; Maillard et al., 2016). Additionally, studies on the benefits of HIIT for mental health have shown that it can lessen symptoms of depression and enhance mood (Knapen et al., 2015; Schuch et al., 2016). Many people now exercise using HIIT as part of their exercise routine whether they want to increase their physical health fitness components or become active and healthier (Atakan et al., 2020; Reljic et al., 2019; Gray et al., 2016). HIIT saves more time for everyone and can be done with various types of workout combination such as combining it with bodyweight exercises, resistance equipment or interval cardio sessions (Atakan et al., 2021; Thompson, 2018; Battacan, 2017). Shiraev and Barclay (2012) conclude that HIIT strength system is ideal for improving speed, power, endurance, and overall athletic fitness components regardless of body type. They highlighted that HIIT is suitable for any young athlete because it helps to create safe and sound lifting that prevent the overuse of overtraining injuries in all sports. HIIT has also been demonstrated in studies to significantly enhance cardiovascular fitness, muscular strength, and general physical well- being in a variety of populations, including young adults (Atakan et al., 2021; Thompson, 2018; Battacan, 2017).

Due to the highlights on the benefits of HIIT to induce several metabolic adaptations and alter body composition, it has become a promising strategy for fitness instructors and coaches. Besides, new research indicates that HIIT may be a quick and effective way to help sedentary overweight or obese people maintain good health (Atakan et al., 2021; Thompson, 2018; Battacan, 2017).

It has been reported that HIIT is safe and well-tolerated, and that it improves

cardiorespiratory fitness more than moderate-intensity continuous training (Weston et al., 2013). This might stand against what some medical professionals believe, which is that high-intensity training regimens are inappropriate for maximising fat oxidation and promoting weight loss in this population (Alahmadi, 2014).

It is well known that regular exercise is essential for preserving and enhancing both physical and mental health. Low levels of physical activity, or sedentary lifestyles, are more and more common, especially among young adult females between the ages of 24 and 34. This age group frequently encounters difficulties because of obligations to their families, their jobs, and other time restraints, which may prevent them from exercising regularly.

HIIT has drawn a lot of interest as an immediate and effective training method. Short bursts of intensive exercise alternate with rest intervals or lower- intensity activities during HIIT. HIIT has been demonstrated in studies to significantly enhance cardiovascular fitness, muscular strength, and general physical well-being in a variety of populations, including young adults.

Despite HIIT's rising popularity, little study has been done especially on how it affects inactive females between the ages of 24-34. Understanding of how HIIT may affect this group is crucial since it may be a convenient and time- saving workout option for people with busy schedules or little opportunities for physical activity.

Moreover, research on the psychological advantages of HIIT, especially in sedentary young adult females, is still scarce. Mental health is a crucial component of

total wellbeing. Investigating how HIIT affects variables related to mental health, such as stress, anxiety, and mood, may reveal its potential as a comprehensive strategy for enhancing wellbeing in this population.

Based on the varied outcomes of HIIT, this study intends to investigate the effects of HIIT on the physical and mental health among sedentary females. By examining the effects of a structured HIIT programmer on the physical fitness levels and mental health status of inactive females aged 24-34 years, this study aims to fill the current research gap. The results of this study could help develop targeted exercise interventions to address the difficulties young adult females face in leading an active lifestyle. They may also offer insightful information about the potential advantages of HIIT in enhancing general health and well-being in this demographic. Furthermore, there is concern over whether long- term adherence to HIIT training will be high enough to achieve long-term goodoutcomes given that several of the HIIT regimens can cause the exerciser significant discomfort (Foster et al., 2015).

An estimated 31% of adults do not meet the minimum recommended levels of physical activity, which has led to physical inactivity becoming a major global public health concern (World Health Organisation, 2020). Long periods of sitting or inactivity are considered sedentary behaviours, and they have been related to a higher risk of obesity, cardiovascular disease, and metabolic disorders (Booth, Roberts, & Laye, 2012). It can be difficult for women, especially those with demanding jobs and family responsibilities, to exercise regularly, which leads to a rise in sedentary behaviour (Guthold et al., 2018).

Because of this, sedentary females are a vulnerable population that needs specific interventions to enhance both their physical and mental health. According to research, physical inactivity is a preventable risk factor that can be reduced by engaging in a variety of physical activities. Even modest exercise can have a major positive impact on an individual's wellness (Lee et al., 2012).

Due to its accessibility and suitability for people with limited fitness backgrounds, slow jogging, a low-intensity aerobic exercise, has gained attention (Tanaka, 2019). In contrast to conventional running or jogging, slow jogging emphasises keeping a comfortable pace, usually slower than brisk walking, making it possible for sedentary people, including women who have not exercised regularly for long periods of time (Tanaka, 2019).

More research has been done on the advantages of slow jogging for improving physical fitness, especially with regard to its effects on muscular strength, flexibility, and cardiovascular endurance. Frequent aerobic exercise, like slow jogging, has been demonstrated to enhance cardiovascular health through lipid profile improvements, blood pressure reductions, and increased aerobic capacity (Myers et al., 2002). Research focussing on slow jogging has shown comparable results, with subjects exhibiting increases in VO2 max a crucial measure of cardiovascular fitness—after a few weeks of slow jogging (Tanaka & Furukawa, 2018).

Furthermore, slow jogging has been linked to increased joint flexibility and improved muscular endurance, especially in the lower body (Ainsworth et al., 2011). Because prolonged inactivity can cause muscle weakness, joint stiffness, and decreased

endurance, these physical benefits are especially crucial for sedentary females (Fleg & Strait, 2012). Sedentary females can improve their overall physical fitness and lower their risk of musculoskeletal problems by gradually increasing their physical strength and endurance through slow jogging (Tanaka, 2019).

Apart from its physical advantages, slow jogging has been associated with enhanced mental well-being, specifically in mitigating symptoms of anxiety, depression, and stress. According to Dishman, Heath, and Lee (2013), exercise is known to cause the release of endorphins, which are neurotransmitters that reduce stress and pain and enhance feelings of wellbeing. It has been demonstrated that regular physical activity, especially low-intensity activities like slow jogging, lessens the symptoms of mental health disorders, especially anxiety and depression (Schuch et al., 2016).

In particular, slow jogging offers sedentary women a low-stress, long-lasting type of exercise that can aid in the management of mental health issues (Tanaka & Furukawa, 2018). Running's rhythmic, repetitive nature can have meditative effects over time, elevating mood and lowering stress levels (Basso & Suzuki, 2017). Slow jogging presents a useful and successful method for enhancing mental well-being, considering the increased prevalence of anxiety and depressive disorders among women, especially those who lead sedentary lifestyles (Bebbington et al., 2003).

Even though exercise has many advantages, sedentary females encounter many obstacles when trying to fit in regular exercise. Females reported reasons for not exercising include lack of motivation, time constraints, and restricted access to fitness

resources (Lovell, El Ansari, & Parker, 2010). Given these obstacles, slow jogging offers a perfect remedy because it doesn't require any special equipment, can be done at any speed, and doesn't require a gym or other special place (Tanaka & Furukawa, 2018).

The fact that sedentary females are more likely to experience the physical and mental health complications linked to inactivity, it is imperative to understand the precise effects of slow jogging on this population (Booth et al., 2012). Encouraging this population to adopt healthier lifestyles requires targeted interventions that are sustainable, affordable, and easily accessible. This study aims to close this gap by investigating how slow jogging affects sedentary females' physical and mental health and offering proof that it can be a successful public health intervention.

1.3 Problem Statement

World Health Organisation (WHO) (World Health Organisation, 2020) suggested that adults aged 18-64 years old should practice around two hours and thirty minutes to five hours of moderate exercise per week with the measurement of forty to sixty percent heart rate per minute to increase their stamina. As for adults who practice more intense physical exercise with sixty to eighty-five percent hear rate per minute, they need to spend about seventy-five minutes to three hours of exercise in a week to retain their stamina.

Nonetheless, according to Hallal et al. (2012), 31.1% of adults globally do not

meet these recommended minimum levels of physical activity. Moreover, inactivity rises with age. The difficulties in engaging in physical activity are often cited as being time constraints, low motivation, and disregard for established guidelines (Hoare, Stavreski, Jennings, & Kingwell, 2017; Rech et al., 2016).

At present, physical inactivity is becoming more and more common worldwide, and it has been connected to a few chronic conditions, including diabetes mellitus Type 2, hyperlipidemia, hypertension, and coronary heart disease (4-5). The National Health and Morbidity Survey (2015) found that 33.5 % of all Malaysians were physically inactive overall, which is comparable to high-income countries' 33% rate.

Additionally, 58% of these individuals were overweight or obese (Grey et al., 2018). Approximately 25% of adults globally do not engage in physical activity, as per a 2018 study published in The Lancet Global Health. In the majority of countries, women are less active than men; 31.7% of inactive women compared to 23.4% of inactive men (Regina et al., 2018).

Numerous studies have demonstrated that women who are sedentary or physically inactive have an increased risk of diabetes (112%), heart disease (147%), stroke (89%) and many other cardiovascular diseases (including heart attacks and strokes) (Rahayu et al., 2019; Wilmot et al., 2012). Studies also indicated an increased in sedentary lifestyles, especially among women, which has led to an increase in mental and physical health problems (Rahayu et al., 2019; Schuch et al., 2016; Booth, Roberts, & Laye, 2012). Even though consistent physical activity has been shown to have numerous advantages, sedentary women frequently encounter obstacles to exercising,

including lack of time, low motivation, and restricted access to fitness resources (Lovell, El Ansari, & Parker, 2010). As a result, they continue to be more vulnerable to the harmful consequences of inactivity.

One of the exercise sessions suggested for someone with little time to spare and a sedentary lifestyle is high-intensity interval training (HIIT). HIIT is more preferred to provide similar or greater health benefits than the recommended physical activity because it requires less time than low- to moderate-intensity training or continuous training (Norton et al., 2010; Ramos et al., 2015).

According to research by Reichert et al. (2007) and Syamsudin et al. (2021), HIIT can overcome the obstacle of not having enough time to engage in physical activity, making it the third most popular sport in the world (Thompson, 2018). Additionally, studies have shown that HIIT enhances cardiovascular health, insulin sensitivity, atherosclerosis prevention, and fitness (Kong et al., 2016; Lanzi et al., 2015). Because of this, high-intensity interval training (HIIT) is extremely popular and it presents advantageous for enhancing cardiovascular health and fitness (Atakan et al., 2020; Reljic et al., 2019; Grey et al., 2016). However, HIIT was found to be less enjoyable, although it has been demonstrated to be more time-efficient (Wedartana et al., 2019; Foster et al., 2015). This suggests that HIIT might not be the best option for promoting psychological well-being.

At present, studies on HIIT are still restricted to a mixed gender population (Kriel, Askew, & Solomon, 2019; Viana et al., 2019). Even though women are more likely than men to be obese, it has not focused on female subjects (World Health

Organisation, 2016). Furthermore, there aren't many reviews that particularly address sedentary behaviour or physical inactivity. Thus, the purpose of this study was to examine how HIIT affected the mental and physical well-being of young, sedentary females as well as health-related fitness components like muscular endurance, strength, flexibility, and body composition.

Besides HIIT, low-intensity aerobic exercise like slow jogging has also been found to be a potentially useful and accessible intervention for enhancing mental and physical health (Tanaka, 2019). A low-barrier, sustainable form of exercise may be especially beneficial for sedentary females, a population for which there is a dearth of research. There is a knowledge gap regarding slow jogging's possible effects on females who lead sedentary lifestyles because the majority of studies on the practice have been conducted on general populations (Tanaka & Furukawa, 2018).

Exploring interventions that can enhance physical and mental health outcomes is critical given the pressing need to address the health risks associated with female sedentary behaviours. In order to close this research gap, this study examines how HIIIT and slow jogging affects the physical and mental well-being of sedentary females. The findings should support the creation of approachable exercise programs that encourage healthier lifestyles.

1.4 Research objective

Objective for Physical Fitness:

1) To assess the effects of HIIT on physical fitness components, including

cardiovascular endurance, muscular endurance, strength, flexibility, and body composition, in sedentary females.

2) To assess the effects of slow jogging on physical fitness components in sedentary females.
3) To compare the effects of HIIT and slow jogging on physical fitness components in sedentary females.

Objectives for Mental Health:

4) To evaluate the effects of HIIT on mental health components, specifically self – esteem and quality of life, in sedentary females.
5) To evaluate the effects of slow jogging on mental health components in sedentary females.
6) To compare the effects of HIIT and slow jogging on mental health components in sedentary females.

1.5 Research question

RQ1: What are the effects of High-Intensity Interval Training (HIIT) on physical fitness components, including cardiovascular endurance, muscular endurance, strength, flexibility, and body composition, in sedentary females?

RQ2: What are the effects of slow jogging on physical fitness components in sedentary females?

RQ3: How do the effects of HIIT and slow jogging compare regarding physical fitness components in sedentary females?

RQ4: What are the effects of HIIT on mental health components, specifically self-esteem and quality of life, in sedentary females?

RQ5: What are the effects of slow jogging on mental health components in sedentary females?

RQ6: How do the effects of HIIT and slow jogging compare regarding mental health components in sedentary females?

1.6 Research hypothesis

The followings are the hypotheses in the research.

Null Hypotheses for Physical Fitness:

H01: HIIT has no significant effect on cardiovascular endurance, muscular endurance, strength, flexibility, and body composition (BMI, weight, body fat percentage, and skeletal muscle mass) in sedentary females.

H02: Slow jogging has no significant effect on cardiovascular endurance, muscular endurance, strength, flexibility, and body composition in sedentary females.

H03: There is no significant difference between HIIT and slow jogging on cardiovascular endurance, muscular endurance, strength, flexibility, and body composition in sedentary females.

Null Hypotheses for Mental Health:

H04. HIIT has no significant effect on self-esteem and quality of life in sedentary females.

H05. Slow jogging has no significant effect on self-esteem and quality of life in

sedentary females.

H06. There is no significant difference between HIIT and slow jogging on self-esteem and quality of life in sedentary females.

1.7 Significance of the study

This study will contribute to the existing literature on the effects of HIIT and slow jogging interventions on physical fitness and mental health outcomes among sedentary females. The findings may have practical implications for exercise prescription and interventions aimed at improving the health outcomes of sedentary females. The focus on mental health outcomes is particularly important as mental health issues are common among sedentary individuals and are often overlooked in exercise interventions. The study will provide insights into the potential predictors of response to HIIT and slow jogging interventions, which may help in tailoring interventions to individual needs.

This study is significant in giving input to health and fitness professionals regarding the use of HIIT and slow jogging in increasing the health-related components besides helping sedentary females to become physically active, lose weight and improve mental health. Furthermore, studies on HIIT and slow jogging are very limited in the Malaysian context specifically involving sedentary females participating in training programs. Hence, this study will add to the body of literature that shows the effects of HIIT and slow jogging in aspects related to physical or mental health and as a suitable exercise protocol for sedentary females.

This study is very valuable in addressing the growing public health issue of physical inactivity, especially among female sedentary populations, who are more susceptible to various risks to their physical and mental health. This study looks into the effects of slow jogging, a low-intensity, easily accessible type of aerobic exercise, with the goal of offering a workable, long-term solution to enhance the health outcomes of this population. The research advances our knowledge of how slow jogging can improve mental health conditions like stress, anxiety, and depression while also improving muscular strength, flexibility, and cardiovascular fitness.

Since the research conclusions will provide an evidence-based strategy for combating sedentary lifestyles, it is anticipated that they will have wider implications for public health interventions. Because slow jogging is low-barrier to entry, it's a viable option for females who struggle with motivation, time constraints, or lack of access to fitness resources. This helps females stick to a regular exercise regimen over the long term. This study also closes a gap in the literature by concentrating on sedentary females, a group that has received little attention in earlier studies on slow jogging.

In the end, the findings of this study may help shape the creation of focused exercise regimens and public health regulations that promote healthier lifestyles and lessen the prevalence of chronic illnesses and mental health issues linked to inactive lifestyles.

1.8 Limitations of the study

The study will only focus on sedentary female aged between 24 – 34 years old, which can restrict how widely the results can be applied to other populations. Due to the short research duration, longer-term impacts of the therapies on outcomes related to physical and mental health will not be evaluated. Besides that, this study used self-reported outcomes measures for mental health, which may not be as accurate as clinical evaluations.

1.9 Operational definition of terms

In this study, the definition of the terms used are as follows:

1.9.1 High Intensity Interval Training (HIIT)

High-intensity interval training, also known as HIIT training, refers to intense exercises that are done repeatedly but alternated with less intense exercise or rest of different recovery time. The physical activity may take a duration of five to eight minutes with recovery time that varies, and the exercise is conducted within twenty to sixty minutes (Campbell, 2018). The criteria outlined by Weston et al. (2014) were used to define HIIT. According to Weston et al. (2014), high-intensity interval training (HIIT) can be identified when a person conducted an intense exercise with ≥85% HRpeak/≥80% VO2peak/≥80% heart rate reserve (HRR) and the person alternate it with around five minutes recovery time. This includes all types of exercise (body-weight, cycling, and treadmill activity).The definition of HIIT in this study is a workout regimen that

alternates short rest periods for recuperation with bursts of intense exercise (Shepherd et al., 2015).

1.9.2 Slow Jogging

Slow jogging is characterized as a low-intensity aerobic activity in which an individual runs at a pace slower than brisk walking, generally sustaining a speed of approximately 4 to 6 kilometers per hour (around 2.5 to 3.7 miles per hour). This type of jogging prioritizes a leisurely, unhurried pace with limited physical strain, enabling individuals to sustain extended activity without considerable exhaustion. In contrast to conventional jogging or running, slow jogging emphasizes a soft foot strike (landing on the mid-foot) to reduce joint impact, rendering it suitable for individuals of all fitness levels, including those who have been sedentary for extended durations (Tanaka et al., 2018; Hasegawa et al., 2020).

In this study, slow jogging is a pace slower than brisk walking and the participants need to sustain this diminished pace for a minimum of 20-30 minutes per session, three times weekly, over a specified duration. The exercise intensity will be assessed using perceived exertion scales, maintaining the heart rate between 50-60% of the participant's maximum heart rate, categorizing it as "light" physical activity (Borg, 1998).

The ability of an exercise protocol to precisely measure what it is supposed to measure is referred to as its validity. This could involve assessing endurance or cardiorespiratory fitness in the context of slow jogging. Numerous field-based fitness

tests, including the 12-minute run/walk test and the 1.5-mile run, have shown strong evidence for their validity in estimating adults' cardiorespiratory fitness, according to a systematic review (Castro-Piñero et al., 2021). This implies that comparable slow-jogging protocols might also yield reliable fitness level estimates.

1.9.3 Sedentary Females

A sedentary female practices sedentary lifestyle whereby the person is physically inactive (Muhamad Aliuddin et al., 2021). Throughout the day, these people typically do little to no moderate or vigorous physical activity. Spending a lot of time sitting at a desk, binge-watching TV, or using a computer or smartphone without moving your body are all examples of sedentary behaviour. In this study, sedentary females refer to young women aged 24-34 who are physically inactive and do not include regular physical activity in their daily schedules. In this research, participants will be labelled and categorized as sedentary females based on the IPAQ questionnaire results. Participants in this study were female sedentary respondents who had been classified according to their responses on the IPAQ questionnaire. They were selected from the Malaysian Statistical Training Institute (ILSM), which is in Sungkai, Perak.

1.9.4 Cardiovascular Endurance

The capacity for sustained aerobic exercise at moderate to high exercise intensities is referred to as cardiovascular endurance. Cardiovascular endurance is closely tied to how well the heart, lungs, and circulatory system work as well as how well skeletal

muscle can absorb oxygen and maintain performance. The maximal oxygen uptake, or V02max, is the main indicator of cardiovascular endurance or aerobic capacity. For endurance athletes, having a moderately high to high Vo2max is essential, and having a strong aerobic base (>44 and 37 mL. kg1. min1 for men and women, respectively, under the age of 39) can help with anaerobic workout recovery. Cardiovascular endurance is crucial to maintaining health, lowering disease risk factors, and enhancing mood, cognitive function, and stress management (Ratamess, 2012).

In this study, cardiovascular endurance refers to the participants' ability to perform in the fitness test given during the intervention period. The test given to measure cardiovascular endurance in this study is the Beep Test or known as Multistage Fitness Test (MSFT).

According to research, the beep test tends to overstate VO_2 max when compared to gold-standard laboratory tests such as the Cardiopulmonary Exercise Test (CPET), even though it can give a good estimate. According to one study, the beep test underestimated VO_2 max by roughly 26.8% for men and 33.7% for women (Senanayake et al., 2024).

1.9.5 Muscular Endurance

The capacity of a muscle to maintain performance while fending off tiredness. A factor is the strength of the muscle contraction. The capacity to maintain low- intensity muscle contractions for a lengthy amount of time is a sign of submaximal muscular endurance.

The capacity to sustain prolonged, intense muscular contractions is known as high-intensity (or strength) endurance. Generally, possessing adequate muscular endurance contributes to having a better posture, well-being and helps to reduce injury as well as support the development of an individual's physical being (Ratamess, 2012).

In this study, muscular endurance refers to the ability of the abdominal muscle endurance to perform more repetitions within the 1- Minute period. The muscular endurance is measured using 1 minute curl up test in this study.

1.9.6 Muscular Strength

Ratamess (2012) mentioned that muscular strength is the maximum force that a person can produce during a certain movement pattern at a given contraction velocity. In this study, muscular strength refers to the participants' muscular strength in the handgrip strength test.

1.9.7 Flexibility

A joint's flexibility refers to its range of motion (ROM). According to Ratamess (2012), increased joint flexibility can lower the risk of injury, improve muscle balance and function, boost performance, correct posture, and lessen the occurrence of low back discomfort. In this study flexibility focuses on measuring hamstring flexibility. The test that will be conducted to measure hamstring flexibility is Sit and Reach Test. Numerous studies have thoroughly assessed the validity and reliability of the Sit and Reach (SR)

Test. The SR test is frequently used to gauge lumbar and hamstring flexibility.

1.9.8 Body composition

The percentage of mass that is made up of both fat and lean tissue is referred to as body composition. The portion of body mass made up of water, muscle, bone, and other non-fat components is known as lean body mass or fat-free mass. Reducing body fat while preserving or increasing lean body mass is the goal of a healthy body composition. An individual who possesses an excessive quantity of body fat may be classified as obese and is at a higher risk of developing major illnesses and diseases.

In sports like wrestling and weightlifting where weight classes are employed, where competitors must overcome their own body mass to succeed, or where athletic competition is focused on physique development, body composition is crucial (bodybuilding) (Ratamess, 2012). In this study participants' body composition is measured using Inbody Analysis 270. The Inbody Analysis comprises of measuring body fat, body mass and muscle mass and other anthropometry measurements. In this study, researcher only focus on the four main measurements indicator which is participants Bodyweight in Kilogram (KG), Body Mass Index (BMI), Percentage Body Fat % (PBF), and Skeletal Muscle Mass (SMM).

1.9.9 Mental Health

World Health Organization (WHO) defines that a person in good mental health is one who recognises their own potential, can manage daily stressors, can work effectively and efficiently, and can give back to their community. Well- being, or mental health, varies throughout life. In this research, mental health is being measured by using two types of questionnaires which is Rosenberg Self-Esteem Scale and Quality of Life Scale (QOLS).

1.9.10 Self – Esteem

The opinions one has of oneself, whether they be favourable or unfavourable (Rosenberg, 1965), and they represent an assessment of one's own worth (Branden, 2001). In this study, Rosenberg Self Esteem Scale (RSE) has been used to measure participants self - esteem in form of questionnaire and the total score will be analyze and will be interpret for each individual and the score will be collected before intervention program start (pre - test) and after intervention ends after 6 weeks (post - test). Both groups will answer the same questionnaire.

1.9.11 Quality of Life

In simple terms, quality of life refers to an individual's assessment of the overall "goodness" of various aspects of their life. These evaluations address emotional reactions to life's experiences, personality, feeling of fulfilment and contentment, job satisfaction, and interpersonal relationships (Diener, Suh, Lucas, & Smith, 1999). A

"wide range of human experiences related to one's overall well-being" is referred to as quality of life (Revicki, 2000). It suggests a value that is compared to personal expectations and is based on subjective experiences, feelings, and perceptions. Quality of life is unique to each individual by nature, but most people can intuitively recognize and comprehend its significance (Revicki, 2000).