THE ASSOCIATION BETWEEN PHYSICAL FITNESS LEVEL WITH ANTHROPOMETRIC INDICATOR AND BODY COMPOSITIONS AMONG OLDER ADULTS WITH POSSIBLE SARCOPENIA AND SARCOPENIA IN KELANTAN

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by

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Dissertation submitted in partial fulfilment of the requirements for the degree of Bachelor of Health Science (Honours) (Dietetics)

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CERTIFICATE

This is to certify that the dissertation entitled The Association between Physical Fitness Level with Anthropometric Indicator and Body Compositions among Older Adults with Possible Sarcopenia and Sarcopenia in Kelantan is the bona fide record of research work done by Ms Lourna Tang Sing Yu during the period from October 2023 to Julai 2024 under my supervision. I have read this dissertation and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation to be submitted in partial fulfilment for the degree of Bachelor of Health Science (Honours) Dietetics.

DECLARATION

I hereby declare that this dissertation is the result of my own investigations, except where otherwise stated and duly acknowledged. I also declare that it has not been previously or concurrently submitted as a whole for any other degrees at Universiti Sains Malaysia or other institutions. I grant Universiti Sains Malaysia the right to use the dissertation for teaching, research and promotional purposes.

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ABSTRAK

Proses penuaan melibatkan perubahan dalam sistem fisiologi, seperti kehilangan jisim badan tanpa lemak (terutamanya otot) dan penurunan kekuatan serta fungsi otot yang dikenali sebagai sarkopenia, satu sindrom geriatrik baru. Sarkopenia memberi kesan besar kepada penjagaan kesihatan kerana sarkopenia menyebabkan penurunan ketumpatan mineral tulang, peningkatan risiko jatuh, pengurangan keupayaan fungsi, kebergantungan fizikal yang lebih besar, dan kadar kematian yang lebih tinggi dalam kalangan warga emas. Kajian ini bertujuan untuk meneroka hubungan antara tahap kecergasan fizikal (kelajuan berjalan dan ujian duduk dan jangkauan kerusi) dengan penunjuk antropometrik (ukuran lilitan pinggang, lilitan pinggul, lilitan lengan atas pertengahan, nisbah pinggang ke pinggul, indeks jisim badan, dan lilitan betis) dan komposisi badan (jisim lemak, lemak viseral, dan otot rangka) dalam kalangan warga emas yang mungkin mengalami sarkopenia dan sarkopenia. Kajian keratan rentas telah dijalankan dalam kalangan 92 warga emas berusia 60 tahun dan ke atas menggunakan teknik persampelan mudah di Kelantan. Prestasi fizikal pendek, kekuatan genggaman tangan, dan indeks jisim rangka digunakan untuk menentukan status sarkopenia semasa sesi temuduga. Latar belakang sosio-demografi, penunjuk antropometrik, komposisi badan, dan tahap kecergasan fizikal juga digunakan semasa temuduga. Dalam kalangan ukuran kecergasan fizikal, hanya kelajuan berjalan (*p*-value= 0.007) menunjukkan hubungan yang signifikan dengan warga emas yang mengalami sarkopenia dan

kemungkinan sarkopenia, manakala ujian duduk dan jangkauan kerusi (*p*-value= 0.841) tidak menunjukkan hubungan yang signifikan. Penunjuk antropometrik tidak menunjukkan hubungan yang signifikan dengan ujian duduk dan jangkauan kerusi. Mengenai komposisi badan, jisim lemak menunjukkan hubungan positif dan sederhana dengan kelajuan berjalan (r= 0.354, *p*-value= 0.001). Walau bagaimanapun, dicadangkan kajian intervensi masa depan dijalankan untuk menentukan keberkesanan program senaman berstruktur untuk sarkopenia.

THE ASSOCIATION BETWEEN PHYSICAL FITNESS LEVEL WITH ANTHROPOMETRIC INDICATOR AND BODY COMPOSITIONS AMONG OLDER ADULTS WITH POSSIBLE SARCOPENIA AND SARCOPENIA IN KELANTAN

ABSTRACT

The aging process involves changes in physiological systems, such as the loss of lean body mass (mainly muscle) and decreased muscular strength and function known as sarcopenia, a new geriatric syndrome. Sarcopenia significantly impacts healthcare by leading to decreased bone mineral density, increased fall risk, reduced functional ability, greater physical dependence, and higher mortality rates in older adults. The aim of this study was to explore the relationship between physical fitness level (gait speed and chair sit-and-reach test) with anthropometric indicator (waist circumferences, hip circumferences, mid-upper arm circumferences, waist-to-hip-ratio, body-mass index and calf circumference) and body composition (fat mass, visceral fat and skeletal muscle) among older adults with possible sarcopenia and sarcopenia. A cross-sectional study was conducted among 92 elderly aged 60 years old and above using convenience sampling technique in Kelantan. Short physical performance, handgrip strength and skeletal mass index were used to determine sarcopenia status during interview session. Socio-demographic background, anthropometric indicator, body composition and physical fitness level were also included during the interview. Among the physical fitness measures, only gait speed (*p*-value= 0.007) showed a significant relationship with elderly with sarcopenia and possible sarcopenia while the chair sit-and-reach test (*p*-value= 0.841) did not. Anthropometric indicator did not show a significant relationship with chair sit-and-reach test. Regarding body composition, fat mass showed a positive and moderate

relationship with gait speed (r= 0.354, *p*-value= 0.001). Nonetheless, it is suggested future intervention studies should be carried out to determine the effectiveness of structured exercise programme for sarcopenia.

Keywords: sarcopenia, gait speed, chair-sit-and-reach test, elderly

CHAPTER 1

INTRODUCTION

Background of Study

The aging process is related to physiological system changes, which includes loss of lean body mass, mainly muscle mass, and a corresponding decline in muscular strength and function (Colón et al., 2018). Sarcopenia, the term used for this occurrence, is currently being regarded as a novel geriatric syndrome (Cruz-Jentoft et al., 2019). This geriatric syndrome has a significant influence on healthcare since it causes older persons to have a decreased bone mineral density, (De Sousa Silva Araujo et al., 2016), higher risk of falling, (De Spiegeleer et al., 2016), reduction in functional ability (Veronese et al., 2019), more physical reliance, and higher mortality indices (Brown et al., 2017). Sarcopenia, as defined by the Asian Working Group for Sarcopenia (AWGS), is the progressive age-related loss of skeletal muscle mass, accompanied by an accelerated loss of strength and a reduction in physical performance (Chen et al., 2020). According to systematic reviews by Mayhew et al. (2019), approximately 10% of older persons globally have sarcopenia. According to research conducted in Hamyang Korea, older people living in the community have a sarcopenia prevalence of 18 to 41% (Chang et al., 2020). Notably, prevalence of sarcopenia was 33.6% in community-dwelling older adults 60 years of age and older who were residing in urban areas of Klang Valley (Ranee et al., 2022).

Anthropometric indicators such as calf circumferences (CC), body-mass index (BMI), waist circumferences (WC), hip circumferences (HC) and mid-upper arm

circumferences (MUAC) are recommended screening tools for diagnosing sarcopenia. This is due to the fact that anthropometric indicators provide an inexpensive substitute that makes large-scale screening easier (Pinheiro et al., 2020). As to the World Health Organisation (WHO), CC is an anthropometric measurement that represents fat-free muscle mass and is the most sensitive index to assess the decline in muscle mass in elderly populations (Wu & Chen, 2022). Due to its simplicity and ease of measurement, BMI was thought to be the best variable for screening for sarcopenia in women and the second best in men. Elderly persons with lower BMI were more likely to suffer sarcopenia than those with greater BMI, despite the fact that BMI cannot differentiate between different bodily tissues (Confortin et al., 2017). Another useful measure for screening both sexes for sarcopenia is waist circumference, with cut-off values of ≤92.0 cm for males and ≤88.0 cm for women. Sarcopenia was associated with lower WC in both men and women (Confortin et al., 2017). MUAC as a single indicator demonstrated a connection with sarcopenia, because MUAC is the area least prone to changes in circumference brought on by fluid retention, such as the oedema that develops in the lower limbs (Esteves et al., 2020).

The deleterious consequences of ageing impact nearly every organ in the human body. Ageing decreases function of muscle mass (Dodds et al., 2014). Low skeletal muscle mass is closely related to physical impairment, which highlights the significance of skeletal muscle in older people (Rangel Peniche et al., 2018). Furthermore, the accumulation of body fat in the elderly has been identified as a significant risk factor for sarcopenia in the elderly (Nasimi et al., 2019). High body fat mass can promote increase in intermuscular adipocytes and intramyocellular lipid accumulation, which can damage

skeletal muscle cells and prevent the synthesis of muscle proteins (Morales et al., 2017). In the meantime, an increase in visceral fat may lead to systemic inflammation and insulin resistance, which may ultimately result in low muscle mass (LMM) and sarcopenia in the elderly (Bano et al., 2017). These demonstrated that sarcopenia and a loss in muscular function may result from excess body fat buildup in many ways. De Mutsert et al.'s (2018) investigation also revealed that visceral fat in older individuals exhibited a stronger correlation with metabolic dysfunction than subcutaneous fat did. Visceral fat is directly connected to insulin resistance, liver disease, and inflammation, all of which have been related to sarcopenia and muscular atrophy in the elderly (Pacifico et al., 2019).

Ageing is linked to balance impairment; according to estimation, 13% of older persons 65–69 and 46% of older adults 85 years and above self-report having balance issues (Osoba et al., 2019). The three primary internal variables that raise an older adult's risk of falling are weak muscles, unsteadiness when walking, and lack of balance (Lacroix et al., 2016). People's degree of physical fitness declines with age (Rodrigues et al., 2022). Physical fitness is defined as having the energy and safety to perform daily tasks (Rikli & Jones, 1999) and with enough energy reserves to handle emergencies, engage in recreational activities, or pursue personal growth goals (Liguori G et al., 2014). Gait speed is a locomotor capacity that reflects neuromuscular quality, both morphological and neuronal (Larsson et al., 2019) is a crucial determinant of ageing in a healthy manner. In fact, the most straightforward and accurate method for identifying sarcopenia in clinical practise is an algorithm that includes gait speed measurement, which was established by the European Working Group on Sarcopenia in Older People (Cruz-Jentoft et al., 2010). The purpose of the chair sit-and-reach test is to evaluate lower limb flexibility,

particularly in the hamstrings (J. Hong et al., 2017). Ageing decreases the flexibility and joint range of motion (Fatouros et al., 2002). Flexibility in the lower body affects posture, walking, and balance (J. Hong et al., 2017).

Problem Statement

One of the most common illnesses among the elderly is sarcopenia, a geriatric condition that raises serious public health concerns. It is anticipated that by 2040, 15% of Malaysia's population will be 60 years of age or older, making the country an ageing nation (*Department of Statistics Malaysia*, 2016). Sarcopenia is among the most common conditions that impede healthy ageing. Yap et al.'s (2020) study revealed that a substantial percentage (47%) of older persons residing in long-term care facilities in the Klang Valley urban area of Malaysia who are 60 years of age or older have sarcopenia. Sarcopenia is considered a new public health concern in Asia because of the sharp increase in correlation with increased life expectancy in Asian populations (Chen et al., 2020).

Physical fitness levels decline at a consistent rate as people get older. Strength and muscular mass are the primary determinants of physical fitness (Rodrigues et al., 2022). Since a decrease in muscle mass and strength is thought to be one of the risk factors for sarcopenia, it is well known that ageing accelerates the loss of muscle mass and quality associated with ageing (Chen et al., 2020). Elderly people's physical fitness is evaluated in a communal setting using the Senior Fitness Test (SFT) (Todde et al., 2016). The SFT consists of multiple tests designed to provide information regarding neuro-motor, musculoskeletal, and aerobic fitness (Moreira et al., 2020), and finally concerning intrinsic capacity and health (Chen et al., 2020).

Anthropometric measurement is a wisely used indicator in accessing sarcopenia. A recent study shows that a high BMI and/or body fat may be significantly associated with lower muscle mass and strength (Foo et al., 2023). Deterioration of muscle mass and quality which caused by aging that may cause adverse effects in daily life such as reduced muscle strength and power and problems with mobility (Deschenes, 2004). Therefore, we would like to investigate the relationship between physical fitness level (gait speed, chair sit and reach) with anthropometric indicator (waist circumferences, hip circumferences, MUAC, BMI and calf circumferences) and body compositions (skeletal muscle, fat mass and visceral fat) among older adults with possible sarcopenia and sarcopenia in Kelantan.

Research Questions

The following are the questions of this study:

i. What is the physical fitness level (gait speed, chair sit and reach) among older adults with possible sarcopenia and sarcopenia in Kelantan?
ii. Is there any relationship between anthropometric indicators (waist circumferences, hip circumferences, MUAC, BMI, and calf circumferences) with physical fitness level among older adults with possible sarcopenia and sarcopenia in Kelantan?
iii. Is there any relationship between body composition (fat mass, visceral fat, and skeletal muscle) with physical fitness level among older adults with possible sarcopenia and sarcopenia in Kelantan?
iv. Is there any relationship between anthropometric indicators with body composition among older adults with possible sarcopenia and sarcopenia in Kelantan?

1.4 Research Objectives

1.4.1 General Objectives

To investigate the relationship between physical fitness level (gait speed, chair sit and reach) with anthropometric indicator (waist circumferences, hip circumferences, MUAC, BMI and calf circumferences) and body compositions (skeletal muscle, fat mass and visceral fat) among older adults with possible sarcopenia and sarcopenia in Kelantan.

1.4.2 Specific Objectives

i. To determine physical fitness level of older adults with possible sarcopenia and sarcopenia in Kelantan

ii. To determine the relationship between anthropometric indicators (waist circumferences, hip circumferences, MUAC, BMI and calf circumferences) with physical fitness level (gait speed, chair sit and reach) among older adults with possible sarcopenia and sarcopenia in Kelantan

iii. To determine the relationship between body composition (skeletal muscle, fat mass and visceral fat) with physical fitness level among older adults with possible sarcopenia and sarcopenia in Kelantan.

iv. To determine the relationship between anthropometric indicators with body composition among older adults with possible sarcopenia and sarcopenia in Kelantan.

1.5 Research Hypotheses

1.5.1 Null Hypotheses (H_0)

i. There is no relationship between anthropometric indicators with physical fitness level among older adults with possible sarcopenia and sarcopenia in Kelantan.

ii. There is no relationship between body composition with physical fitness level among older adults with possible sarcopenia and sarcopenia in Kelantan.

iii. There is no relationship between anthropometric indicators with body composition among older adults with possible sarcopenia and sarcopenia in Kelantan.

1.5.2 Alternative Hypotheses (HA)

i. There is a relationship between anthropometric indicators with physical fitness level among older adults with possible sarcopenia and sarcopenia in Kelantan.

ii. There is a relationship between body composition with physical fitness level among older adults with possible sarcopenia and sarcopenia in Kelantan.

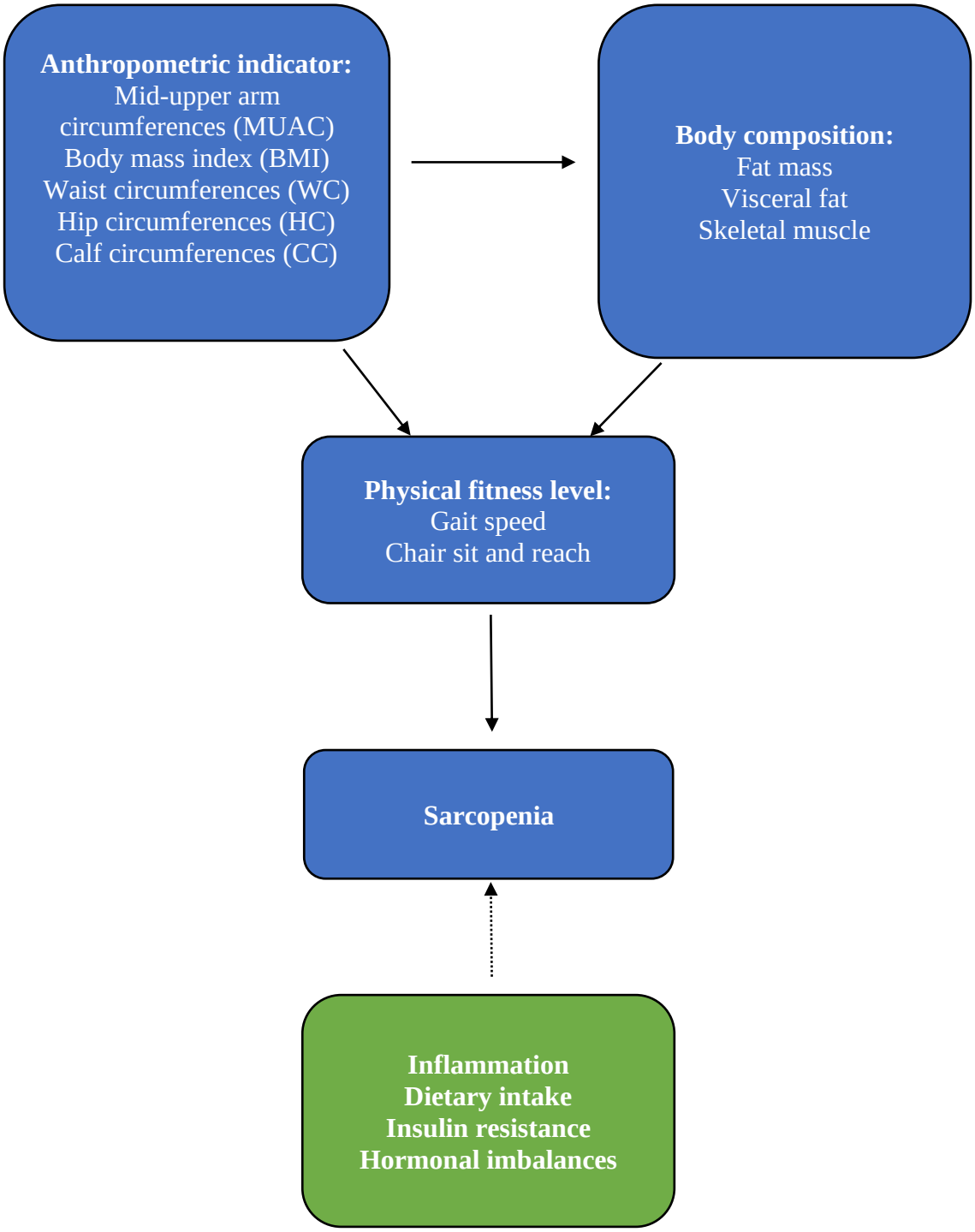
iii. There is a relationship between anthropometric indicators with body composition among older adults with possible sarcopenia and sarcopenia in Kelantan.

1.6 Justification of Study

The finding of research will provide information about the relationship of physical fitness level with anthropometric indicator and body composition among community dwelling older adults with sarcopenia and possible sarcopenia in Kelantan. One recent study on the assessment of sarcopenia and its associated factors in community-dwelling

middle-aged and older Chinese adults had been done in Kelantan. That study revealed the prevalence of sarcopenia was 12.6%. Thus, this study is emphasized on the physical fitness level with body composition and anthropometric indicator among older adults with possible sarcopenia and sarcopenia in different populations and district in Kelantan.

1.7 Conceptual Framework



*Possible factors yet no assessment will be conducted on this study

Investigated in this study

Not included in the study

Figure 1: conceptual framework of the anthropometric indicator (MUAC, BMI, CC, WC) physical fitness level (gait speed & chair sit and reach) and body composition (fat mass, visceral fat & skeletal muscle) with sarcopenia among older adults with sarcopenia and possible sarcopenia

Anthropometric measurements are useful for the screening of sarcopenia. One study done in Korean demonstrates that CC may be a good proxy marker of decreased muscle mass and may be related to physical function of individuals who represent the 70 to 85-year-olds living in the communities, suggesting that CC may be a good indicator of sarcopenia in Korean older adults who live in communities (Kim et al., 2018). An Amazonian study by Esteves et al. (2020) demonstrates that all anthropometric indicators (BMI, CC, WC, and arm circumferences) were thought to be able to distinguish between the occurrence of sarcopenia, with a focus on BMI and arm circumferences, and that these indicators could be used to screen older adults who live in the community for the condition.

According to research by Yap et al. (2020), there may be a substantial correlation between lower muscle mass and strength and a high BMI and/or body fat percentage. While it is generally accepted that sarcopenia is more common as people age, this could also be the result of a rapidly accelerating aging-related loss of muscle mass and quality, as both aspects are thought to be risk factors for sarcopenia (Chen et al., 2020). A study indicated that a higher mass of body fat is a risk factor for the development of sarcopenia

(Nasimi et al., 2019). High total fat mass may lead to the buildup of fat in the muscles, and this can have a detrimental effect on the mass of skeletal muscle by increasing pro-inflammatory cytokines (Meng et al., 2014).

Physical fitness level (gait speed and chair sit and reach) used as a parameter to identify person with sarcopenia. According to a prior study, women were more likely than males to have slow gait speed. This is due to the possibility that this illness was exacerbated by women's lower stature, smaller waist circumference, and decreased physical activity (ROSLI et al., 2017). Age is linked to the decrease of muscle mass and as a result, the slowing down of gait speed. For instance, the percentage drop in gait speed was 9.0% for women and 8.2% for males in a 4-year follow-up of elderly Chinese (Auyeung et al., 2014).

CHAPTER 2

LITERATURE REVIEW

2.1 Definition and differences of sarcopenia, possible sarcopenia, and severe sarcopenia

The word "sarcopenia" comes from the Greek "poverty of flesh." It was first proposed by Rosenberg in 1989 (Rosenberg, 1997). A new definition criterion was put forth by the European Working Group on Sarcopenia in Older People (EWGSOP1), which included the loss of muscle strength together with or without a decline in muscle function. In its update, the (EWGSOP2) shifted the critical role from muscle mass to muscle strength (Cruz-Jentoft et al., 2019). Depending on the degree of the condition, EWGSOP2 divided sarcopenia into three stages: probable sarcopenia, sarcopenia, and severe sarcopenia. A stage known as possible sarcopenia is characterised by a decrease in muscle mass but a normal range in muscle strength and physical performance. Sarcopenia is characterised by a decreased in muscular mass and either muscle strength or low physical performance compared to the preceding stage. Finally, it is regarded as the severe sarcopenia stage if all muscle-related parameters are noticeably lower than the sarcopenia stage (Cruz-Jentoft et al., 2019).

Sarcopenia is defined by the 2014 Asian Working Group for Sarcopenia (AWGS) consensus as an age-related decrease of muscular mass, together with reduced muscle strength and/or poor physical performance (Chen et al., 2014). In 2019, AWGS added a new term, "possible sarcopenia," which is characterised by reduced muscle strength or muscle mass or a decline in physical performance. Additionally, sarcopenia was divided into three severity categories by the new AWGS criteria: probable, sarcopenia, and severe

sarcopenia. Low muscle strength or muscle mass or poor physical performance was considered a sign of possible sarcopenia. Sarcopenia is characterised by decreased muscular mass and low muscle strength, or poor physical function. Low muscle mass, low muscle strength, and poor physical performance were all considered signs of severe sarcopenia. According to the guidelines set forth by the AWGS in 2019, "possible sarcopenia" in primary care settings was determined by combining case findings obtained using the low CC (<34 cm in men and <33 cm in women) or a simple five-item questionnaire (SARC-F) with a score of ≥4 and 5-CST (≥ 12s for both sexes), without taking handgrip strength measurements into account. Low handgrip strength (<28 kg for men and <18 kg for women), low muscle mass (<7.0 kg/m2 for men and <5.4 kg/m2 for women), and/or low physical performance (<1.0 m/s for 6 m gait speed, ≥12 s for the 5-times chair stand test, or ≤9 for SPPB) were considered markers for the definite diagnosis of “sarcopenia”. (Chen et al., 2020).

2.2 Prevalence of Sarcopenia

According to a systematic review and meta-analysis by Petermann-Rocha et al. (2022), the prevalence of sarcopenia varied between 10% and 27% in the research findings using different classifications and cut-off values. The lowest prevalence was found in Europe using the EWGSOP2 cut-off values (1%) and Oceania using the FNIH (5%) as the cut-off values. The highest prevalence was found in Oceania using the EWGSOP cut-off value (40%) and South America using the muscle mass cut-off value (35%). For those under 60, the prevalence varied from 8% to 36%, while for those ≥ 60, it was between 10% and 27%. A systematic review and meta-analysis carried out in China, with 21564 participants and a total of 23 publications revealed that the overall

prevalence of sarcopenia among senior Chinese individuals was 14% and 10% using the AWGS and EWGSOP, respectively (Xin et al., 2021).

Similarly, a cross-sectional study involving 393 community-dwelling older adults aged 60 and above was conducted in urban areas of Klang Valley using AWGS as cut-off points for sarcopenia screening. This study showed the prevalence of sarcopenia was 33.6% and women (35.9%) were more affected compared to men (30.1%) (Ranee et al., 2022). The study findings indicate a comparatively elevated prevalence of sarcopenia in comparison to our neighbouring countries, Singapore (20.6%) (Tey et al., 2019) and Thailand (30.1%) (Khongsri et al., 2016). Notably, the research conducted in Singapore and Thailand employed bioelectrical impedance analysis (BIA) and AWGS cut-off points that are identical to those utilised in the study about the prevalence and risk factors of sarcopenia among older adults in Klang Valley conducted by Ranee et al. (2022).

2.3 Prevalence of possible sarcopenia

The AWGS has revised its 2014 standards. The AWGS 2019 criteria define "possible sarcopenia" as either decline muscle strength or low physical performance, without requiring evaluating of skeletal muscle amount. (Chen et al., 2020). This idea was presented in order to aid in the early detection of individuals who may be at risk for sarcopenia and to enable critical action even in environments lacking sophisticated diagnostic tools. Miura et al. (2021) conducted a retrospective cross-sectional study in Kobe, Japan, with 1768 residents who were 65 years of age. Based on the AWGS 2019 algorithm, 2.9% (51 participants of the total) had a probable diagnosis of sarcopenia in this study. In the same way, a different study carried out in Kadoma City reveals that among older persons aged 60 and above, the prevalence of possible sarcopenia is 30.3%.

(Kurose et al., 2020). According to AWGS standards 2019, 38.5% of 6172 individuals in research done in China, who were aged 60-94, had probable sarcopenia. Additionally, this study found that compared to urban areas (31.1%), rural areas (41%) had a higher prevalence of probable sarcopenia (Wu et al., 2021). A cross-sectional study involving 330 senior Thai community-dwelling outpatients over 60 years of age was carried out. According to AWGS criteria in 2019, this investigation revealed that the prevalence of probable sarcopenia was 28.2% (93/330 cases) (Therakomen et al., 2020). In Malaysia, 196 older persons with stroke participated in a single cross-sectional study that was carried out in Peninsular Malaysia's East Coast area. Using AWGS 2019 cut-off criteria, this study discovered that 42.3% of older persons with stroke had possible sarcopenia (Wong et al., 2022).

2.4 Screening tools for sarcopenia (general screening tools)

The EWGSOP revised its sarcopenia diagnostic criteria in 2019 (EWGSOP-2) and emphasised the significance of physical performance. Assessing muscle mass using Dual-energy X-ray Absorptiometry (DXA), Bioelectrical Impedance Analysis (BIA), or anthropometric measurement is one of the tests included in the clinical diagnosis of sarcopenia in EWGSOP-2 (Cruz-Jentoft et al., 2019). The adoption of DXA as the default method for measuring muscle mass in all sarcopenia diagnostic tests has recently been suggested because of its affordability, practicality, accuracy, and user-friendliness (Buckinx et al., 2018). There are multiple limitations with DXA. Appendicular lean mass (ALM), which is measured by DXA, is not a reliable indicator of actual muscle mass (Bauer & Morley, 2020). Moreover, ALM does not precisely predict negative outcomes even after accounting for body size and weight. (Bhasin et al., 2020). In a bioimpedance

analysis (BIA), a low-level electric current is sent through the subject's body, and the electrical resistance to this current flow is then measured (Di Vincenzo et al., 2019). Equations of conversion are then used to translate this impedance into an estimate of fat and fat-free mass. BIA is widely used because of its affordability, mobility, and ease of use. The cellular water content and integrity can be determined by BIA phase angle (reactance/resistance value) (Di Vincenzo et al., 2019), might increase the precision of body composition measurements (Looijaard et al., 2020). According to a few, small-scale investigations by Looijaard et al. (2020), phase angle can be a good indicator of functional performance and sarcopenia.

A number of widely used objective variables are available in various clinical settings, such as body mass index (BMI), arm and leg anthropometry, including triceps skinfold (TSF), mid-upper-arm circumference (MUAC), or calf circumference (CC), as well as various derived equations. One such equation is mid-upper arm muscle circumference, also known as MAMC or MUAMC, which is calculated using MUAC and TSF (Cederholm et al., 2015). Although BMI is a widely accepted diagnostic tool for malnutrition (Cederholm et al., 2019), it cannot be used to estimate muscle mass since it cannot distinguish between muscle and fat mass (Madden & Smith, 2016). In diagnostic instruments for sarcopenia, calf circumference (CC) serves as an alternative for calf muscle mass (Bauer & Morley, 2020). The prevalence of sarcopenia is lower when using CC as part of the EWGSOP tool than when using the DXA-derived Skeletal Muscle Mass Index (SMI) (Velazquez-Alva et al., 2017). Adverse clinical outcomes, such as a loss in functional ability in hospitalised older adults are linked to CC. (Dent et al., 2015). Additionally, because anthropometric measurements are affordable, simple to use, and

accessible in most environments, they may be utilised as an alternative or as a substitute for apparatus-based measures like bioelectrical impedance analysis or costly procedures like MRI (Kiefer et al., 2018).

The evaluation of muscular strength using grip strength is one of the clinically diagnostic criteria for sarcopenia that has been revised in EWGSOP-2 (Cruz-Jentoft et al., 2019). Reduced hand grip strength is linked to a worse nutritional status and is thought to be a prognostic indicator of morbidity and death (Cederholm et al., 2019). According to research by Cederholm et al. (2019), inadequate grip strength is linked to poor health, surgical problems, extended hospital stays, and an increased risk of readmission. Consequently, grip strength is suggested as a supporting measure in the Global Leadership Initiative on Malnutrition (GLIM) criteria and the EWSGSOP guidelines for the diagnosis of malnutrition and as an evaluation of muscle mass because of its uncomplicated application (Cederholm et al., 2019). Muscle strength may be evaluated using an evaluation technique called leg strength (knee extensor force). Leg strength is a predictor of functional mobility, falls, and balance (Menant et al., 2017). Since handgrip strength can be measured using standardised techniques and normative standards, it is typically used instead of leg strength measurements for diagnosing sarcopenia. However, there is only a low to moderate degree of agreement between the two assessments, indicating that handgrip strength and leg strength are not always strongly correlated (Yeung et al., 2018).

Using gait speed, the Short Physical Performance Battery (SPPB), or Timed Up and Go (TUG), physical performance is the third evaluation for the clinically diagnostic

criteria for sarcopenia modified in EWGSOP-2 (Cruz-Jentoft et al., 2019). In older individuals, gait speed is associated with survival and appears to be a good indicator of overall health. Walking involves not just the musculoskeletal system but also the circulatory, respiratory, cardiac, and neurological systems as well as energy. Consequently, a decreased function of (one of) these systems can be linked to decreased gait speed (Studenski et al., 2011). Balance, gait speed (above 4 m), and a chair-stand test are the three components of the SPPB, which assesses lower limb function (Guralnik et al., 1994). The greatest function is 12 and the lowest function is 0. Low SPPB is defined by EWGSOP-2 as ≤8 (Cruz-Jentoft et al., 2019). When it comes to all-cause mortality in older persons, lower SPPB scores (≤3) are linked to a higher risk than high scores (≥10) (Pavasini et al., 2016). TUG compares the highest and lowest quartiles to predict mortality in older adults (Chua et al., 2020).

2.5 Anthropometric status and body composition among sarcopenic patients

Pinheiro et al. (2020) undergone an observational, cross-sectional design which involve 173 older adult women (≥60 years) to examine the relationship between sarcopenia and various anthropometric indicators (BMI, calf circumferences, and corrected arm muscle area, or CAMA). This study design using EWGSOP definition on sarcopenia as their diagnosis criteria. According to the study's findings, women with sarcopenia had lower BMI (BMI cut-off point used is 22.9 kg/m^2) than women without the condition. When taken as a whole, the findings support the notion that older adult women with lower BMI are more likely than those with higher BMI to experience sarcopenia. Additionally, the research by Pinheiro et al. (2020) demonstrates that CC was the most accurate measure of sarcopenia (cut-off point 31cm). The same results with the

same cut-off point are shown in another similar study among older Mexican women (Velazquez-Alva et al., 2017). The results of this study indicate that, among older adult women living in the community, BMI is the most sensitive screening tool for sarcopenia, but calf circumference may be the most accurate marker due to its higher specificity (Pinheiro et al., 2020).

The most notable of these typical changes in body composition that come with age is the loss of muscular mass and the growth of fat tissue. In elderly persons above the age of fifty, there is an annual loss of 1-2 percent in muscle mass and strength, and this rate of decline tends to accelerate in the following years (Dawson & Dennison, 2016). One cross-sectional study, carried out in the Klang Valley, examined the prevalence and risk factors of sarcopenia among 393 older persons aged 60 and above. The results revealed a substantial difference between participants with sarcopenia and non-sarcopenic older adults in terms of skeletal muscle mass, skeletal muscle index, body fat mass, and percentage body fat, with lower measurements in the subject with sarcopenia. Hence, corroborating the notion that an inevitable decline in muscle mass and strength occurs with ageing (Ranee et al., 2022).

The co-occurrence of obesity with sarcopenia is known as sarcopenic obesity. It is characterised by age-related changes in body composition, including decreased muscle mass and increased fat mass as well as decreased physical performance and muscle strength (Batsis & Villareal, 2018). Other factors also link sarcopenic obesity to the deterioration of muscular function. Aging raises fat content, lowers skeletal muscle mass, and lowers daily activity levels. By blocking adiponectin and leptin and promoting the

release of cytokines, fat buildup causes inflammation. Insulin resistance is brought on by a reduction in daily activity, while inflammation is increased by vascular fatty mass. Similar to how it occurs in the skeletal muscle, the generated inflammation affects the loss of skeletal muscle mass and function, which leads to a decrease in physical activity. The development of sarcopenic obesity is significantly influenced by these numerous connections between muscle and fat mass. (Zamboni et al., 2008).

2.6 Senior fitness test with sarcopenia

Physical fitness declines with age (Rodrigues et al., 2022), and may endanger a person's health as well as their intrinsic capacity in the second (Patrizio et al., 2021). One of the updated EWGSOP-2 clinically diagnostic criteria for sarcopenia is gait speed (Cruz-Jentoft et al., 2019). Additionally, it has been utilised to identify dependency and functional impairment in senior citizens (LOPEZ-TEROS et al., 2014). Chair sit-and-reach test is used to measure hamstring flexibility. One randomised, controlled trial on the impact of tele-exercise at home on sarcopenia and its influence on improving functional fitness and body composition in older adults with sarcopenia was carried out in Korea. Without increasing muscle strength, the results demonstrated that the video conference-based supervised resistance training significantly increased the chair sit-and-reach score (lower body flexibility) (J. Hong et al., 2017). Research on the chair-sit-and-reach technique in sarcopenia is rare. Hence, this study will investigate how chair-sit-and-reach and gait speed relate to sarcopenia.

2.7 Body composition and physical fitness level

Slow gait speed was found to be independently correlated with increased subcutaneous fat in women's lower extremities in the Health, Aging, and Body Composition Study (Beavers et al., 2013). Similar sex-specific differences in mean gait speed were reported in the study population by Kim et al. (2023) because women made up a greater proportion of slow gait speed. This finding might indicate that a greater proportion of our female population's subcutaneous fat is deposited in the lower extremities. Body fat mass has a substantial correlation with gait speed. A cross-sectional study examining the frequency and risk factors of sarcopenia among 202 senior citizens living in Malaysian long-term care (LTC) facilities was carried out in the Klang Valley. The results demonstrated that male older individuals without sarcopenia who had a greater range of appendicular skeletal muscle (ASM) (16.7–29.2) kg had a higher gait speed (0.3–1.4) m/s, while male older adults with severe sarcopenia had a smaller ASM (9.4–20.9) kg and a lower gait speed (0.3–0.7) m/s. Among older female individuals without sarcopenia, those with higher ASM (11.4–31.7) kg had faster gait speeds (0.3–1.4 m/s), while those with severe sarcopenia have lower ASM (5.2–14.3) kg and slower gait speeds (0.2–0.7 m/s) (Yap et al., 2020). There have limited study on the relationship between body composition with chair-sit-and-reach. Thus, this study will investigate the relationship between body composition with chair-sit-and-reach and gait speed.

2.8 Anthropometric indicator with physical fitness level

The physical performance of older adults with and without sarcopenia will be impacted by changes in the anthropometry indicator. In a study of senior citizens living in long-term care facilities in Malaysia, it was found that those without sarcopenia had

higher body mass index (BMI) and waist circumference (WC) than older adults with possible sarcopenia or sarcopenia (WC= 94.1cm, BMI= 25.6kg/m^2 older adults without sarcopenia; WC= 83.6cm, BMI 20.4kg/m^2 older adults with possible sarcopenia and sarcopenia). The BMI of older male adults without sarcopenia is 26.3 kg/m^2, and their gait speed range is (0.3–1.4) m/s. The BMI of older male adults with possible sarcopenia is 20.8 kg/m^2, and their gait speed range is (0.8–1.3) m/s. The lowest BMI (19.5 kg/m^2) and the lowest gait speed range (0.3–0.7) m/s are found in the category of severe sarcopenic male adults (Yap et al., 2020). Limited research has been done on the association between gait speed with CC, HC and MUAC, as well as the relationship between chair-sit-and-reach and other anthropometric indicators (MUAC, CC, HC BMI, and WC) in older persons with possible sarcopenia and sarcopenia. Our research will thus investigate the relationship between BMI, CC, HC, MUAC and WC with gait speed and chair-sit-and-reach among older persons with sarcopenia or suspected sarcopenia.

CHAPTER 3

METHODOLOGY

3.1 Research Design

The cross-sectional study methodology used in this investigation enabled the researcher to thoroughly collect, compile, organise, and interpret data. The physical fitness level of older persons was assessed, and any sarcopenia parameters were discovered using a survey consisting of standardised questions. Due to the cross-sectional study design allowing for the efficient assessment of numerous variables at once and providing a picture of the population at a certain point in time, it was the preferred method. With the help of this design, researchers can obtain important data regarding the distribution and prevalence of different parameters of interest, which made it easier to find patterns and associations within the population. Furthermore, cross-sectional studies can yield significant preliminary data for additional research and were rather rapid and inexpensive.

3.2 Study location

Several villages in Kelantan districts were the location of this study's conduct. The districts of Tumpat, Pasir Mas, Kota Bharu, and Bachok in Kelantan were the specific regions of investigation.

3.3 Study population

Target Population

Sarcopenia and possible sarcopenia in older persons 60 years of age and above who live independently in a community setting in Kelantan.

Source of population

Senior residents visited the data collecting station at the closest community centre, such as a community hall, or mosque, or prayer hall, which was situated in the chosen study site.

Sampling Frame

Name list of senior residents with sarcopenia and possible sarcopenia.

3.4 Research subject

3.4.1 Inclusion criteria

i. Senior citizens aged ≥60 years.
ii. Senior citizens with possible sarcopenia and sarcopenia
iii. Community dwelling older adults.
iv. Capable of carrying out daily tasks.
v. Recognize either English or Malay.
vi. Accept take part in this research.

3.4.2 Exclusion criteria

i. Individuals who are incapable of standing alone.
ii. Dysarthria or dysphasia
iii. Hip or knee replacement.