

**PREVALENCE OF SARCOPENIA AND ITS
ASSOCIATION WITH QUALITY OF LIFE
AMONG ADULTS WITH CHRONIC
RESPIRATORY DISEASES (ASTHMA, CHRONIC
OBSTRUCTIVE PULMONARY DISEASE,
TUBERCULOSIS) IN PULAU PINANG,
MALAYSIA**

RADHIYATUL AKMA BINTI MOHAMAD ZANI

UNIVERSITI SAINS MALAYSIA

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MALAYSIA**

by

RADHIYATUL AKMA BINTI MOHAMAD ZANI

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LIST OF ABBREVIATIONS

µg/day	micrograms per day
4MGS	4-meter Gait Speed
5CST	Five-times Chair Stand Test
6MWT	6-Minute Walk Test
ACO	Asthma-COPD Overlap Syndrome
ACQ-5	Asthma Control Questionnaire-5
ACT	Asthma Control Test
ADP	Air Displacement Plethysmography
AGE	Advanced Glycation End
AHEI-2010	Alternative Healthy Eating Index-2010
Akt	Protein Kinase B (PKB)
ALM	Appendicular Lean Mass
ALM/h ²	Appendicular Lean Mass per square meter
ALMBMI	Appendicular Lean Mass Body Mass Index
ALM-to-BMI ratio	Appendicular Lean Mass to Body Mass Index ratio
AMPK	AMP-activated Protein Kinase
AQLQ	Asthma Quality of Life Questionnaire
ARMQL	Age - Related Muscle Loss Questionnaire
ASM	Appendicular Skeletal Muscle Mass
ASM/m ²	Appendicular Skeletal Muscle Mass per square meter
ASMI	Appendicular Skeletal Muscle Mass Index
ATP	Adenosine Triphosphate
AWGS	Asian Working Group for Sarcopenia
BA	Bronchial Asthma
BAR	Bouchard Activity Record
BF%	Body Fat Percentage
BIA	Bioelectrical Impedance Analysis
BMI	Body Mass Index
BNP	B-type Natriuretic Peptide
CI	Confidence Interval
CI	Confidence Interval

CLD	Chronic Liver Disease
CMJ	Countermovement Jump
COPD	Chronic Obstructive Pulmonary Disease
CRDs	Chronic Respiratory Diseases
CST	Chair Stand Test
CT	Computed Tomography
CVD	Cardiovascular Disease
CVRF	Cardiovascular Risk Factors
CXR	Chest X-ray
D	Domain
DASH	Dietary Approaches to Stop Hypertension
DLW	Doubly Labelled Water
DNA	Deoxyribonucleic Acid
DOTS	Directly Observed Therapy Short-course
DXA	Dual-Energy X-ray Absorptiometry
EQ-5D	European Quality of Life - 5 Dimensions
EQ-5D-3L	EuroQol-5 Dimensions 3 Levels
EQ-5D-5L	EuroQol 5-Dimensions-5 Levels
EQ-VAS	EuroQol Visual Analogue Scale
ESPEN	European Society for Clinical Nutrition and Metabolism
EWGSOP	European Working Group on Sarcopenia in Older People
FEV1	Forced Expiratory Volume in one second
FFM	Fat-Free Mass
FFQ	Food Frequency Questionnaire
FFQs	Food Frequency Questionnaires
FNIH	Foundation for the National Institutes of Health
FOXO	Forkhead Box O protein
g/day	grams per day
GA2LEN	Global Allergy and Asthma European Network
GPAQ	Global Physical Activity Questionnaire
H. Comorbidities	History of Comorbidities
HDS	Healthy Diet Score
HF	Heart Failure
HGS	Handgrip Strength

HRQoL	Health-Related Quality of Life
ICC	Intraclass Correlation Coefficient
IGF-1	Insulin-like Growth Factor 1
IL-18	Interleukin-18
IL-1 β	Interleukin-1 beta
IL-6	Interleukin 6
InCHIANTI	Invecchiare in Chianti
IPAQ-LF	International Physical Activity Questionnaire Long Form
IPAQ-SF	International Physical Activity Questionnaire (Short Form)
IQR	Interquartile Range
JEPeM	Jawatankuasa Etika Penyelidikan (Manusia)
kcal/day	kilocalories per day
kg/m ²	kilograms per square meter
KNHANES	Korean National Health and Nutrition Examination Survey
LC	Liver Cirrhosis
LPA	Light-intensity Physical Activity
LVEF	Left Ventricular Ejection Fraction
m/s	meters per second
MANS	Malaysia Adult Nutrition Survey
MAQ	Modifiable Activity Questionnaire
MET	Metabolic Equivalent of Task
MET-minutes/week	Metabolic Equivalent of Task minutes per week
mg/day	milligrams per day
MPA	Moderate-intensity Physical Activity
MPS	Muscle Protein Synthesis
MREC	Medical Research Ethics Committee
MRI	Magnetic Resonance Imaging
mTOR	mechanistic Target of Rapamycin
mTORC1	mechanistic Target of Rapamycin Complex 1
MVPA	Moderate-to-high intensity Physical Activity
MVV	Maximum Voluntary Ventilation
n	Number
NCOPD	Non-Chronic Obstructive Pulmonary Disease
NF- κ B	Nuclear Factor kappa-light-chain-enhancer of activated B cells

NMRR	National Medical Research Register
NS	Non-Sarcopenia
OAD	Obstructive Airway Disease
OR	Odd Ratio
p38MAPK	p38 Mitogen-Activated Protein Kinase pathway
PA	Physical Activity
PAR	7-day Physical Activity Recall
PAR-Q	Physical Activity Readiness Questionnaire
PDPAR	Previous Day Physical Activity Recall
PI	Physical Inactivity
PI3K	Phosphoinositide 3-kinase
PROs	Patient-Reported Outcomes (PROs)
PS	Possible Sarcopenia
PTB	Pulmonary Tuberculosis
PWMAQ	Previous Week Modifiable Activity Questionnaire
QoL	Quality of Life
RONs	Reactive Oxygen and Nitrogen Species
ROS	Reactive Oxygen Species
RPAQ	Recent Physical Activity Questionnaire
S	Sarcopenia
SARC-CalF	Sarcopenia Risk Assessment using Calf circumference and Functional performance
SARC-F	Sarcopenia Rapid Assessment Tool - Functional
SarQoL	Sarcopenia and Quality of Life
SCIDOTS	Smoking Cessation Intervention Directly Observed Therapy Short-course
SCWD	Society for Sarcopenia, Cachexia, and Wasting Disorders
SD	Standard Deviation
SDOC	Sarcopenia Definitions and Outcomes Consortium
SF-36	Short Form 36 Health Survey
SMI	Skeletal Muscle Mass Index
SMM	Skeletal Muscle Mas
SNO	Sarcopenic Non-Obesity
SO	Sarcopenic Obesity
SPPB	Short Physical Performance Battery
SS	Severe Sarcopenia

SWA	SenseWear Armband
T2DM	Type 2 Diabetes Mellitus
TB	Tuberculosis
TCA	transitional continuing appointment
TNF- α	Tumor Necrosis Factor-alpha
TUG	Timed Up and Go test
UK	United Kingdom
UPS	Ubiquitin-Proteasome System
UPS	Ubiquitin-Proteasome System
USA	United States of America
VPA	Vigorous-intensity Physical Activity
WHO	World Health Organization

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**PREVALENS SARKOPENIA DAN KAITAN DENGAN KUALITI HIDUP
DALAM KALANGAN ORANG DEWASA DENGAN PENYAKIT
PERNAFASAN KRONIK (ASMA, PENYAKIT PARU OBSTRUKTIF
KRONIK, TUBERKULOSIS) DI PULAU PINANG, MALAYSIA**

ABSTRAK

Sarkopenia, yang dicirikan oleh kehilangan progresif jisim dan fungsi otot rangka, merupakan komorbiditi lazim dalam kalangan pesakit penyakit respiratori kronik, terutamanya Penyakit Paru Obstruktif Kronik (COPD). Walau bagaimanapun, prevalens dan faktor berkaitan dalam kalangan pesakit ini di Malaysia masih kurang dikaji. **Objektif:** Kajian ini bertujuan menentukan prevalens sarkopenia serta kesannya terhadap kualiti hidup dalam kalangan dewasa yang menghidap asma, COPD, dan Tuberkulosis (TB) di Pulau Pinang, Malaysia. **Metodologi:** Kajian keratan rentas melibatkan 469 pesakit dewasa yang didiagnosis dengan asma ($n = 180$), COPD ($n = 186$), atau TB ($n = 103$). Sarkopenia ditentukan menggunakan kriteria Kumpulan Kerja Asia untuk Sarkopenia 2019 (AWGS 2019). Faktor berkaitan dikenal pasti melalui analisis regresi logistik berganda, manakala kualiti hidup dinilai menggunakan soal selidik EQ-5D-5L dan SarQoL, dengan faktor utama ditentukan melalui regresi linear berganda. **Keputusan:** Prevalens sarkopenia adalah 18.9% dalam pesakit asma, 33.9% dalam pesakit TB, dan 35.9% dalam pesakit COPD ($p < 0.05$). Faktor risiko signifikan termasuk umur dalam pesakit asma ($OR = 1.05$, 95% CI = 1.01–1.09); etnik Cina ($OR = 0.30$, 95% CI = 0.10–0.89) dan pengambilan protein harian rendah ($OR = 0.76$, 95% CI = 0.64–0.90) dalam pesakit TB; serta jantina wanita ($OR = 103.61$, 95% CI = 3.09–3480.06), umur ($OR = 1.13$,

95% CI = 1.01–1.26), dan sejarah jatuh (OR = 725.89, 95% CI = 7.22–72939.86) dalam pesakit COPD. Sarkopenia dikaitkan dengan penurunan kualiti hidup dalam aspek penjagaan diri (asma), mobiliti, penjagaan diri, dan kesakitan/ketidakselesaan (TB), serta mobiliti dan penjagaan diri (COPD). Faktor utama yang mempengaruhi kualiti hidup ialah status pesara (β = 8.325, 95% CI = 2.98–13.68), pendidikan menengah (β = 8.546, 95% CI = 4.14–12.95), sejarah hospitalisasi (β = -5.345, 95% CI = -10.14 hingga -0.55), aktiviti fizikal (β = 0.009, 95% CI = 0.01–0.01) dalam COPD; umur (β = -0.419, 95% CI = -0.60 hingga -0.24) dan diabetes mellitus jenis 2 (β = -10.059, 95% CI = -16.69 hingga -3.43) dalam asma; serta pendidikan menengah (β = 7.129, 95% CI = 0.55–13.71) dalam TB. **Kesimpulan:** Sarkopenia adalah masalah lazim dalam kalangan pesakit penyakit respiratori kronik di Malaysia dan memberi kesan negatif terhadap kualiti hidup. Intervensi khusus seperti pemakanan yang sesuai dan pemulihan fizikal diperlukan bagi meningkatkan kualiti hidup pesakit.

**PREVALENCE OF SARCOPENIA AND ITS ASSOCIATION WITH
QUALITY OF LIFE AMONG ADULTS WITH CHRONIC RESPIRATORY
DISEASES (ASTHMA, CHRONIC OBSTRUCTIVE PULMONARY
DISEASE, TUBERCULOSIS) IN PULAU PINANG, MALAYSIA**

ABSTRACT

Sarcopenia, characterised by the progressive loss of skeletal muscle mass and function, is a common comorbidity among patients with chronic respiratory diseases, particularly those with Chronic Obstructive Pulmonary Disease (COPD). However, its prevalence and associated factors among patients with chronic respiratory diseases in Malaysia remain underexplored. **Objective:** This study aimed to determine the prevalence of sarcopenia and its impact on the quality of life of adults with asthma, COPD, and Tuberculosis (TB) in Penang, Malaysia. **Methods:** A cross-sectional study was conducted among 469 adults diagnosed with asthma (n = 180), COPD (n = 186), or TB (n = 103). Sarcopenia was defined using the Asian Working Group for Sarcopenia 2019 criteria, and independent associated factors were identified through multiple logistic regression. Quality of life was assessed using the EQ-5D-5L and SarQoL questionnaires, with key influencing factors determined via multiple linear regression. **Results:** The prevalence of sarcopenia was 18.9% in asthma patients, 33.9% in TB patients, and 35.9% in COPD patients ($p < 0.05$). Significant risk factors included age in asthma patients (adjusted OR = 1.05, 95% CI = 1.01–1.09); Chinese ethnicity (adjusted OR = 0.30, 95% CI = 0.10–0.89) and lower daily protein intake (adjusted OR = 0.76, 95% CI = 0.64–0.90) in TB patients; and female gender (adjusted OR = 103.61, 95% CI = 3.09–3480.06), age (adjusted OR =

1.13, 95% CI = 1.01–1.26), and history of falls (adjusted OR = 725.89, 95% CI = 7.22–72939.86) in COPD patients. Sarcopenia was associated with lower quality of life in self-care among asthma patients, mobility, self-care, and pain/discomfort in TB patients, and mobility and self-care in COPD patients. Factors influencing quality of life included retired status ($\beta = 8.325$, 95% CI = 2.98–13.68), secondary education ($\beta = 8.546$, 95% CI = 4.14–12.95), prior hospitalization ($\beta = -5.345$, 95% CI = -10.14 to -0.55), and physical activity ($\beta = 0.009$, 95% CI = 0.01–0.01) in COPD patients; age ($\beta = -0.419$, 95% CI = -0.60 to -0.24) and type 2 diabetes mellitus ($\beta = -10.059$, 95% CI = -16.69 to -3.43) in asthma patients; and secondary education ($\beta = 7.129$, 95% CI = 0.55–13.71) in TB patients. **Conclusion:** Sarcopenia is common among chronic respiratory disease patients in Malaysia and negatively affects their quality of life. Targeted interventions, such as nutrition and physical rehabilitation, are needed to improve patient outcomes.

CHAPTER 1

INTRODUCTION

1.1 Overview

This thesis examines the prevalence of sarcopenia and its impact on the quality of life among adults with chronic respiratory diseases (CRDs) in Penang, Malaysia, specifically comparing asthma, chronic obstructive pulmonary disease (COPD), and tuberculosis (TB). Using a comparative cross-sectional study, the research aims to determine the extent of sarcopenia in these groups and its effects on daily living and overall well-being.

Sarcopenia, marked by the loss of muscle mass and function, is a growing health concern, especially among those with chronic respiratory conditions. This study seeks to identify variations in sarcopenia prevalence and its impact on quality of life in Penang, providing insights into the relationship between musculoskeletal health and respiratory disorders. This chapter cover on the background of the study specifically outlined the study objectives and the significance of conducting the current study.

1.2 Background of the Study

Sarcopenia, characterised by the loss of skeletal muscle mass and function, is prevalent among older adults and individuals with chronic diseases (Cruz-Jentoft et al., 2019). CRDs such as asthma, COPD, and TB have been associated with muscle wasting and decreased physical performance, exacerbating the severity of sarcopenia (Lim et al., 2018; Kim et al., 2019; Shin et al., 2021; Hu et al., 2022). This intersection of CRDs and sarcopenia poses a significant public health challenge,

affecting patients' quality of life and increasing healthcare burden (Beaudart et al., 2014).

Globally, the prevalence of chronic respiratory diseases is on the rise, with asthma, COPD, and TB being major contributors to morbidity and mortality (Soriano et al., 2020; Labaki & Han, 2020; World Health Organization, 2019). These conditions not only impair respiratory function but also lead to systemic manifestations, including skeletal muscle dysfunction. Sarcopenia, influenced by aging, inflammation, and physical inactivity, further exacerbates the health burden associated with CRDs, contributing to decrease functional capacity, increased disability, and reduced quality of life (Bone et al., 2017; Cruz-Jentoft et al., 2019). However, limited research has explored the prevalence of sarcopenia and its impact on the quality of life specifically among adults with respiratory conditions in Malaysia, highlighting the need for further investigation in this area.

CRDs significantly impact global health, contributing to high mortality rates, particularly in low and middle-income countries (Byrne et al., 2015). They are notably prevalent among the elderly, with COPD projected to become the third leading cause of death by 2030 (Carreiro-Martins et al., 2016; Mannino & Buist, 2007). Furthermore, these diseases are often associated with sarcopenia, which predominantly affects older populations and exacerbates physical weakness, reduces quality of life, and increases mortality risk among CRDs patients (Limpawattana et al., 2018; Beaudart et al., 2017; Sobestiansky et al., 2019).

Despite the evident connection between CRDs and sarcopenia, there is a scarcity of data regarding the impact of CRDs on patients' physical performance and quality of life, especially in regions like Malaysia. This study aims to fill this gap by

assessing the prevalence of sarcopenia and its impact on the quality of life among Malaysian patients with CRDs to inform better interdisciplinary care approaches and strategies to manage sarcopenia in CRDs patients, potentially reducing healthcare burdens and improving patient outcomes (Rosli et al., 2017; Kim et al., 2019).

1.2.1 Chronic Respiratory Diseases in Malaysia

In Malaysia, the increasing prevalence of CRDs is alarming, as these conditions are among the top three leading causes of both hospitalisation and mortality (Khoo, 2018). Asthma and COPD are prevalent among the adult population in Malaysia (Hussein et al., 2023). Concurrently, TB remains a critical public health issue, with the country recording 26,781 TB cases in 2023, a 5.47% increase from the 25,391 cases reported in 2022 (Monihuldin, 2023). These conditions not only compromise respiratory function but also have systemic effects that contribute to muscle degradation and reduced physical activity levels (Karakousis et al., 2022; Xiang et al., 2022; Ravimohan et al., 2018; Gea et al., 2015).

Loss of muscle fibre number is the principal cause of sarcopenia, including fibre atrophy particularly among type II fibres (Deschenes, 2004). Sarcopenia is increasingly recognised as a clinical syndrome, with chronic respiratory diseases being a significant contributing factor (Alibakhshi et al., 2020). Physical inactivity, malnutrition, and chronic illness associated with these respiratory conditions further exacerbate the development of sarcopenia (Alibakhshi et al., 2020).

1.2.2 Sarcopenia and Quality of Life

Sarcopenia significantly impacts quality of life by reducing mobility, increasing the risk of falls and fractures, and limiting daily activities (Cruz-Jentoft et al., 2010; Wiedmer et al., 2021). For individuals with CRDs, the compounded effects

of respiratory impairment and muscle weakness can lead to severe disability (Bone et al., 2017; Gea et al., 2018; Nagano et al., 2021). Understanding the prevalence and impact of sarcopenia in this demographic is crucial for developing targeted clinical or non-pharmacological supports for better patients' treatment experience, rehabilitation and preventive measures.

1.3 Problem Statement

Sarcopenia is increasingly recognised as a significant health concern, especially among individuals with CRDs. Globally, about 3% of the population suffers from sarcopenia (Pötsch et al., 2013), and its prevalence is notably higher in those with CRDs. For instance, research indicates that sarcopenia affects up to 17.6% of individuals with asthma, with approximately 5.5% experiencing severe sarcopenia (Hu et al., 2022). However, in Malaysia, there is a notable gap in understanding the prevalence and impact of sarcopenia on quality of life (Nawawi et al., 2021). This lack of localized data hinders the development of targeted interventions necessary to mitigate sarcopenia's adverse effects and improve overall health outcomes in this population.

Chronic respiratory diseases such as asthma, COPD, and TB are widespread, affecting an estimated 545 million people globally (Soriano et al., 2017). Sarcopenia, which refers to an age-related decline in muscle mass and function (Baumgartner et al., 1999; Cooper et al., 2012), is recognised as a systemic effect of COPD (Pacifico et al., 2020). The prevalence of sarcopenia among COPD patients ranges from 15% to 55%, significantly impacting their functional outcomes and overall health (Sepúlveda - Loyola et al., 2020). Similarly, sarcopenia prevalence among TB survivors ranges from 11.2% to 24.3% (Shin et al., 2021). Despite the extensive

research conducted outside Malaysia, there is a critical lack of local data on the prevalence of sarcopenia and its impact on quality of life and health outcomes among Malaysian patients with CRDs.

Muscle weakness is recognised as part of the wasting syndrome associated with TB (Skupien et al., 2018), indicating a potential link between sarcopenia and TB. Socioeconomic disadvantages, such as poor hygiene, may contribute to both sarcopenia and an increased risk of infections like TB (Swan et al., 2022; Bakhsh et al., 2023). Additionally, inadequate health education strategies could hinder efforts to manage both sarcopenia and TB effectively (Valencia-Aguirre et al., 2022; Rogeri et al., 2021). Therefore, it is essential to further investigate the association between these conditions and understand their combined impact on health outcomes, particularly in the Malaysian context.

1.4 Rationale of the Study/ Research Gaps

Chronic respiratory diseases (CRDs) encompass a range of serious conditions that present significant global public health challenges (Burney et al., 2015). These include both communicable diseases, such as TB, and non-communicable diseases such as asthma and COPD. CRDs contribute substantially to the global burden of disease (Soriano et al., 2020). Despite their significant impact, CRDs often receive less attention compared to other non-communicable diseases, even though they are preventable and manageable with cost-effective interventions. Understanding the current epidemiological trends for each CRD is essential for guiding policy decisions on resource allocation and healthcare workforce training.

TB is a communicable disease and remains one of the leading causes of mortality among adults worldwide, with over 10 million new cases reported annually

(Furin et al., 2019). Although TB is known to be associated with muscle weakness and sarcopenia, there is a critical shortage of research specifically addressing sarcopenia in TB patients. Existing literature indicates that TB can lead to muscle wasting (Skupien et al., 2018), yet comprehensive studies exploring the prevalence, mechanisms, and impacts of sarcopenia in TB patients are limited. Sarcopenia is well-defined with established diagnostic criteria and management strategies (Cruz-Jentoft et al., 2019), but these criteria are seldom adapted for TB patients. This research gap is significant as TB treatment may exacerbate muscle weakness and potentially worsen TB outcomes. Additionally, socioeconomic factors, which influence both TB and sarcopenia, are often overlooked (Natarajan et al., 2020; Swan et al., 2022; Bakhsh et al., 2023). The combined impact of these socioeconomic disadvantages on sarcopenia among TB patients remains largely unexplored.

Recent analyses have highlighted a higher prevalence of sarcopenia among TB survivors, particularly those with visible pulmonary TB scars on chest X-rays (Karakousis et al., 2023). TB and HIV co-infection also correlate with indicators of reduced lean body mass in adult TB patients. Older individuals with sarcopenia and physical inactivity face an increased risk of TB infection, and adequate protein and energy intake have been associated with a reduced risk of sarcopenia in TB survivors (Karakousis et al., 2023). Despite these findings, in-depth studies on the interplay between sarcopenia and TB beyond the context of Korea are lacking (Shin et al., 2021; Choi et al., 2017). Addressing this gap is crucial for improving patient outcomes and developing more effective management strategies.

In addition, research has shown that patients with non-communicable CRDs, such as asthma and COPD, also experience significant declines in quality of life. For example, 71.4% of asthmatic patients in Karachi, Pakistan, reported poor quality of

life (Ali et al., 2020), and COPD patients in Aligarh, Uttar Pradesh, exhibited markedly lower health-related quality of life. However, there is a scarcity of data on how CRDs affect physical performance and quality of life in Malaysia. While studies from various countries explore sarcopenia prevalence in COPD patients, Malaysia has limited research on sarcopenia prevalence in asthma, COPD, and TB patients.

This study aims to address these gaps by investigating the prevalence of sarcopenia in patients with both communicable and non-communicable CRDs, such as asthma, TB, and COPD, and evaluating the quality of life of those affected. It will explore factors associated with sarcopenia, including nutritional deficiencies, psychological factors, physical inactivity, clinical history, unhealthy lifestyle, and sociodemographic variables. Conducting this research in Penang is particularly valuable due to its high prevalence of CRDs patients in the northern region. In 2016, Penang reported the highest TB incidence rate among northern Malaysian states, with 80.56 cases per 100,000 people (Malaysian Healthcare Performance Unit, 2018). In comparison, TB incidence rates in neighboring states were lower: Perlis (52.99 per 100,000), Kedah (60.50 per 100,000), and Perak (67.10 per 100,000) (Malaysian Healthcare Performance Unit, 2018). This elevated TB incidence in Penang underscores the need for targeted research in this region to develop effective management strategies and improve patient outcomes for those affected by both communicable and non-communicable CRDs and sarcopenia.

1.5 Research Questions

1. What is the prevalence of sarcopenia in adults with asthma, COPD, and TB in Penang?

2. What is the prevalence of quality of life in adults with asthma, COPD, and TB in Penang?
3. Are there significance differences between the prevalence of sarcopenia and quality of life in adults with asthma, COPD, and TB?
4. What factors are associated with sarcopenia and quality of life in adults with asthma, COPD, and TB?

1.6 Research Objectives

1.6.1 General Objective

To determine the prevalence of sarcopenia and assess the quality of life among adults with chronic respiratory diseases (asthma, COPD, and TB) in Penang

1.6.2 Specific Objective 1

To determine the prevalence of sarcopenia among adults with asthma, COPD, and TB

1.6.3 Specific Objective 2

To assess the quality of life among adults with asthma, COPD, and TB

1.6.4 Specific Objective 3

To compare the prevalence of sarcopenia among adults with asthma, COPD, and TB, and to assess their quality of life

1.6.5 Specific Objective 4

To identify sociodemographic, lifestyle, nutritional, anthropometric, and clinical history factors associated with sarcopenia and quality of life among adults with asthma, COPD, and TB

1.7 Study Hypothesis

Sarcopenia is expected to be highly prevalent among adults with asthma, COPD, and TB, with COPD and TB patients exhibiting higher prevalence rates. Additionally, sarcopenia is expected to be associated with lower quality of life in these patient groups.

1.8 Significance of the Study

This study holds considerable importance for several key reasons. CRDs such as asthma, COPD, and TB are significant public health concerns both globally including Malaysia (Soriano et al., 2017). These diseases greatly affect patients' quality of life, making localised data essential for a comprehensive understanding of these health issues.

By examining the prevalence of sarcopenia among CRDs patients, the study highlights an additional health burden faced by these individuals. Sarcopenia is associated with reduced muscle strength, impaired mobility, and decreased exercise capacity (Bone et al., 2017), which in turn negatively impact overall quality of life. This study explores how sarcopenia contributes to limitations in physical function and daily activities, further compounding the quality of life challenges already faced by CRD patients.

Assessing quality of life is a critical component, as it reveals the comprehensive impact of CRDs and sarcopenia on physical, emotional, and social well-being, informing more holistic treatment plans. The study's findings have significant public health implications, guiding healthcare providers to include sarcopenia screening and interventions in CRDs management and promoting multidisciplinary approaches to enhance overall patient well-being.

For policymakers, the study offers evidence-based data to inform resource allocation and healthcare policy, emphasising the need for targeted funding and support services. In conclusion, this study deepens the understanding of the relationship between sarcopenia and CRDs, highlighting the compounded health challenges faced by patients and underscoring the need for comprehensive management strategies to improve their quality of life.

1.9 Conceptual Framework

In this study, we investigated the relationships between the dependent and independent variables. The dependent variables include sarcopenia status and quality of life. The independent variables consist of sociodemographic characteristics, nutritional status, physical activity, lifestyle factors, anthropometric measurements, and clinical history.

Prevalence of Sarcopenia and Quality of Life in Adults with Chronic Respiratory Diseases

Asthma, COPD, and TB patients

Risk Factors of Sarcopenia

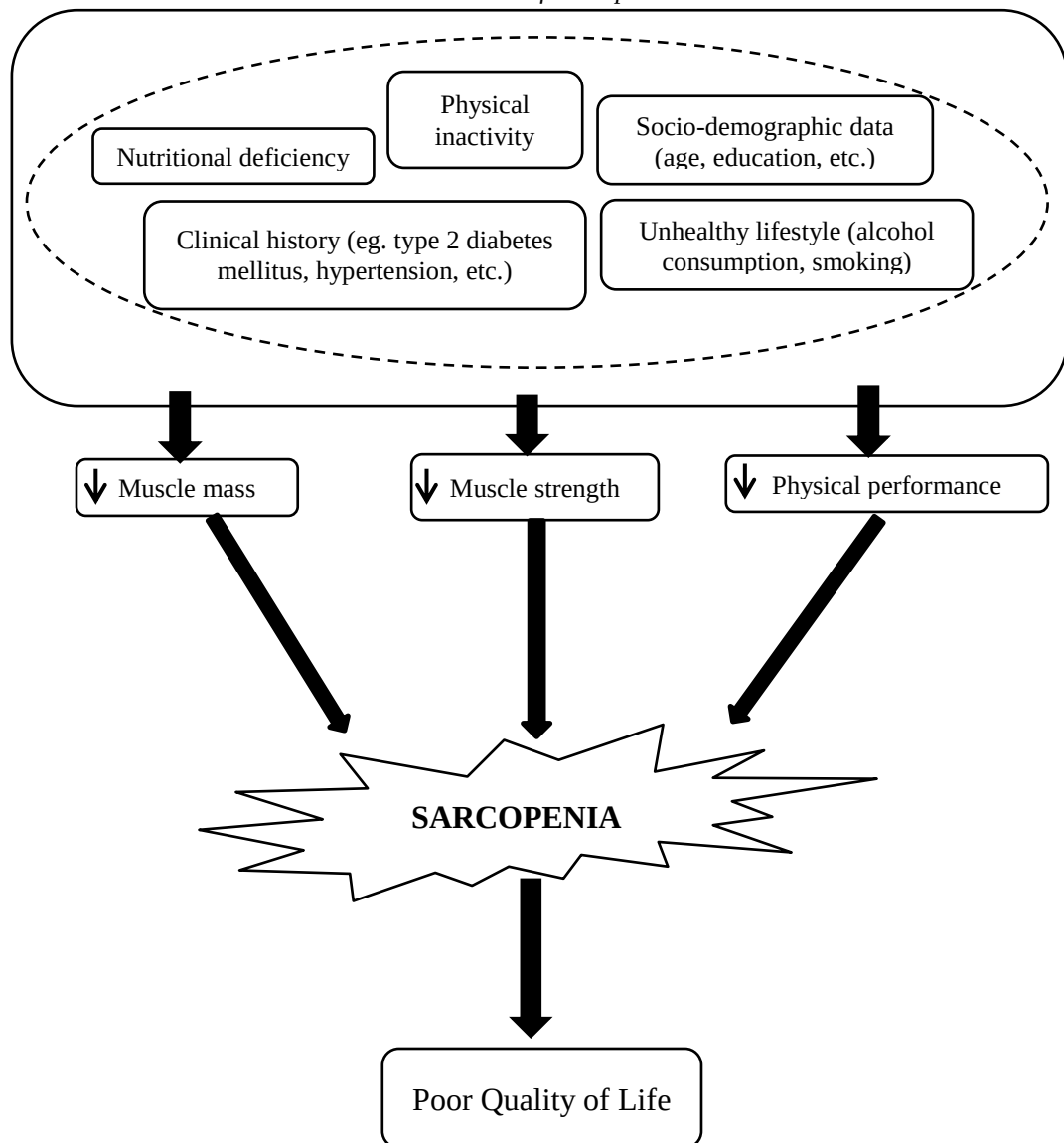


Figure 1.1 Conceptual Framework illustrating the relationships among chronic respiratory diseases, risk factors, sarcopenia, and quality of life.

1.10 Operational Definition

Table 1.1 provides operational definitions for key terms and measurements used in this study. It specifies how sarcopenia is defined and assessed, including the tools and methods used for diagnosis and categorisation. The table also details the various factors evaluated in the study, such as nutritional status, physical activity, lifestyle, and clinical history, as well as how quality of life is measured.

Table 1.1 Operational Definitions

Category	Terms	Operational Definitions
Guideline Utilisation	AWGS 2019 (Asian Working Group for Sarcopenia 2019)	Defines sarcopenia as an age-related condition characterised by low muscle mass, low muscle strength, and/or low physical performance (Chen et al., 2020).
Sarcopenia Measurement and Categorisation	Muscle Mass	Measured using Bioelectrical Impedance Analysis (BIA) with cut-offs: < 7.0 kg/m ² (men) and < 5.7 kg/m ² (women) (Chen et al., 2020).
	Muscle Strength	Evaluated using handgrip strength (handgrip dynamometer), with specific cut-offs: < 28 kg for men and < 18 kg for women (Chen et al., 2020).
	Physical Performance	Assessed by gait speed testing: walking speed $\leq$ 0.8 m/s suggests impaired mobility (Chen et al., 2020).
	Probable/possible Sarcopenia	Individuals have low muscle strength with or without reduced physical performance (Chen et al., 2020).
	Severe Sarcopenia	Individuals have low muscle mass, low muscle strength, and low physical performance simultaneously (Chen et al., 2020).

Sarcopenia Screening Tools	SARC-F	SARC-F is a screening tool used to assess the risk of sarcopenia by evaluating five key domains: Strength (S), Assistance (A), Rise (R), Climb (C), and Falls (F). Each domain is scored from 0 to 2, with a total score ranging from 0 to 10. A score of ≥ 4 indicates a positive screening for sarcopenia (Barreto de Lima et al., 2023).
	SARC-CalF	SARC-CalF is a screening tool that includes the same five domains as the SARC-F, with an additional assessment of calf circumference (CalF). The total SARC-CalF score ranges from 0 to 20, with a score of ≥ 11 indicating a positive screening for sarcopenia (Barreto de Lima et al., 2023).
Quality of Life Assessment	QoL Measurement Tools	Quality of Life (QoL) was assessed using the following questionnaires: EQ-5D-5L (EuroQol 5-Dimensions 5-Levels) and SarQoL (Sarcopenia and Quality of Life).
	EQ-5D-5L (EuroQol 5-Dimensions 5 Levels)	<u>EQ-5D-5L utility index</u> : Measures overall health from 1 (perfect health) to 0 (death), with scores below 0 indicating worse-than-death states. It evaluates five domains: mobility, self-care, usual activities, pain/discomfort, and anxiety/depression (Iskandar et al., 2021; Shafie et al., 2019).
	SarQoL (Sarcopenia and Quality of Life)	<u>EuroQol-Visual Analogue Scale (EQ-VAS)</u> : Participants self-evaluate their overall health on a scale from 0 (worst imaginable health state) to 100 (best imaginable health state) (Iskandar et al., 2021; Shafie et al., 2019). Measures the quality of life in sarcopenia across seven domains, including physical health, mental health, locomotion, body composition, functionality, activities of daily living, and leisure activities. Scores range from 0 to 100, with higher scores indicating better quality of life (Beaudart et al., 2023).
Nutritional Factors	Nutritional Status, Dietary Intake, Vitamin Supplement History	<u>Nutritional Status</u> : Variables related to dietary intake and vitamin supplement history. <u>Dietary Intake</u> : Measured using the Food Frequency Questionnaire, assessing nutrients like energy, protein, calcium, and vitamins. <u>Vitamin Supplement History</u> : Recorded history of vitamin supplement use.
	FFQ (Food Frequency Questionnaire)	Evaluates dietary intake by having participants report the frequency and portion sizes of consumed foods. It then calculates nutrient intake based on these reports to assess overall diet quality and nutrient consumption (Institute for Public Health, 2014; Moy et al., 2020).
Physical Activity Factor	Physical Activity	Refers to the amount and intensity of exercise or physical movement. Measured using the International Physical Activity Questionnaire Long Form (IPAQ-LF).

	IPAQ-LF (International Physical Activity Questionnaire – Long Form)	The IPAQ-LF assesses physical activity levels (Chaskar et al., 2017). It records time spent on activities, calculates Metabolic Equivalent of Task-minutes per week (MET-minutes/week), reports exercise frequency, and categorizes activity intensity as low, moderate, or high.
Lifestyle Factors	Smoking Status, History of Drug Abuse, History of Alcohol Intake	<u>Smoking Status</u> : Recorded through self-report questionnaires, categorized as Non-smoker, Passive smoker, Active smoker, Ex-smoker. <u>History of Drug Abuse</u> : Recorded through self-report questionnaires, including any past or current substance use issues. <u>History of Alcohol Intake</u> : Recorded through self-report questionnaires, categorised as Non-alcoholic, Occasional alcoholic, Ex-alcoholic, Active chaser, Ex-chaser.
Clinical History Factors	Clinical History, History of Comorbidities, Anthropometric Measurements	Clinical History: Includes medical conditions like hospitalisation and falls. Comorbidities: Documented from records or self-reports, including conditions like Hypertension, Type 2 Diabetes, and Heart Failure. Body Mass Index (BMI): Calculated as weight in kg divided by height in meters squared (Nuttall, 2015).

1.11 Conclusion

In order to answering all the study objectives outlined in this chapter, thorough literature has been carried out on relevant topics and discussed in the next chapter.

CHAPTER 2

LITERATURE REVIEW

2.1 Overview

Chapter 2 provides a comprehensive review of the literature on sarcopenia, beginning with its burden and challenges. It explores definitions and diagnostic criteria established by key consensus groups, including European Working Group on Sarcopenia in Older People (EWGSOP), Asian Working Group for Sarcopenia (AWGS), and Foundation for the National Institutes of Health (FNIH). The chapter discusses early detection tools such as SARC-F and SARC-CalF, and reviews diagnostic methods including Dual-Energy X-ray Absorptiometry (DXA) and Bioelectrical Impedance Analysis (BIA). It also covers tools for assessing muscle strength and physical performance, such as dynamometers, chair stand tests, gait speed, and the Timed Up and Go (TUG) test. Additionally, it examines circulatory biomarkers and their role in diagnosing sarcopenia.

The chapter provides an analysis of the prevalence and epidemiology of sarcopenia, detailing its frequency and distribution across different populations, as well as its associated risk factors. The impact of physical activity and nutrition is evaluated using various measurement tools and dietary assessments. Furthermore, it addresses the prevalence and pathophysiology of sarcopenia in chronic respiratory diseases. Quality of life is assessed with the EuroQol-5 Dimensions (EQ-5D) for general health and the Sarcopenia Quality of Life (SarQoL) questionnaire, which specifically evaluates the impact of sarcopenia on affected individuals.

2.2 Sarcopenia

The term "sarcopenia," introduced by Irwin Rosenberg, combines the Greek words "sarco" (muscle) and "penia" (loss) (Rosenberg, 1997; Rosenberg, 1989). Rosenberg first described sarcopenia in 1988 as the age-related loss of skeletal muscle mass and function (Rosenberg, 1997). Ten years later, Baumgartner developed a method to measure sarcopenia by assessing appendicular lean mass adjusted for height (kg/m^2) (Baumgartner et al., 1999).

Sarcopenia is characterised by the gradual loss of muscle mass, strength, and function associated with aging (Volpi et al., 2004). Although muscle mass decline is more common in older adults, it can begin as early as age 40 (Petermann-Rocha et al., 2022). This decline is linked to increased physical disability, higher risks of falls and fractures, reduced quality of life, greater dependence on others for daily activities, and higher mortality rates (Rodrigues et al., 2022; Santilli et al., 2014).

Sarcopenia, characterised as a geriatric condition, involves more than mere muscle loss, as it is linked with several health issues including metabolic disorders, weakened immune function, and increased mortality (Liu & Zhu, 2023; Papadopoulou, 2020). It contributes to insulin resistance, thereby playing a role in the development of diabetes and other metabolic diseases (Dhillon & Hasni, 2017). There is substantial epidemiological evidence indicating a significant correlation between sarcopenia and insulin resistance (Cruz-Jentoft & Sayer, 2019). Research suggests that sarcopenia promotes insulin resistance through mechanisms such as abnormal lipid accumulation and lipotoxicity in skeletal muscles, increased catabolites of amino acids in muscle branch chains, and a reduction in type I skeletal muscle fibers (Liu & Zhu, 2023).

Moreover, muscle loss weakens the immune system, rendering older adults more susceptible to infections (Nelke et al., 2019). For example, sarcopenia serves as a predictor of post-surgical infections, such as that following colorectal cancer surgery (Nakanishi et al., 2018). Hospitalised patients with sarcopenia face a twofold increased risk of nosocomial infections after three weeks (Gaëlle Cosquéric et al., 2006). Furthermore, sarcopenia predicts the risk of community-acquired pneumonia in the elderly (Altuna-Venegas et al., 2019) and 90-day mortality in patients with aspiration pneumonia (Maeda & Akagi, 2017). The significant prevalence of sarcopenia, coupled with the heightened risk of infections in elderly patients, emphasizes its profound implications. Sarcopenia may serve as a clinical predictor for infection-related morbidity in older adults. Thus, addressing sarcopenia is crucial not only due to its association with muscle loss but also because it contributes to various other serious health issues, ultimately impacting overall health and longevity in older adults.

Sarcopenia, once thought to be solely age-related, has been found to affect younger individuals with various chronic diseases. Recent research highlights its broader impact beyond the elderly, linking it to conditions like cancer and chronic respiratory diseases (Xu et al., 2022; Khajali et al., 2021; Rezende et al., 2020; Santilli et al., 2014; Bone et al., 2017). Moving forward, research should focus on understanding its prevalence across age groups and diseases, assessing its impact on quality of life and health outcomes, and developing targeted interventions. By addressing these priorities, we can improve prevention and management strategies for sarcopenia, benefiting individuals of all ages.

2.2.1 Sarcopenia: Burden and Challenges

Sarcopenia, associated with adverse outcomes that significantly affect health and quality of life (Beaudart et al., 2014; Shafiee et al., 2017), has been extensively researched. It links to physical disability, heightened risk of nursing home admissions, susceptibility to depression, increased hospitalisation rates, and elevated mortality (Guralnik et al., 2000). Those with sarcopenia often display poor physical performance, functional decline, and reduced independence in daily activities (Guralnik et al., 2000; Tanimoto et al., 2012). Moreover, sarcopenia correlates with declines in gait speed and regularity, further compromising mobility (Janssen et al., 2004; Tanimoto et al., 2013).

The impact of sarcopenia extends beyond skeletal muscle, influencing comorbidities that worsen with age, such as osteoporosis, intensifying fracture risks through complex muscle-bone interactions (DiGirolamo et al., 2013; Kim et al., 2014; Brotto & Johnson, 2014; Cianferotti & Brandi, 2013). This interconnectedness underscores the systemic burden of sarcopenia and emphasizes the need for integrated healthcare approaches addressing its multiple dimensions simultaneously.

Economically, sarcopenia exerts a substantial influence, primarily through increased disability and healthcare resource utilization. This includes higher hospital admissions, nursing home placements, and augmented home healthcare spending (Beaudart et al., 2014). Despite limited comprehensive economic data, a U.S. study estimated direct healthcare costs related to sarcopenia at approximately \$18.5 billion in 2000 (Janssen et al., 2004), highlighting the urgency for cost-effective interventions and targeted policies to reduce its societal impact.

Despite growing recognition of its profound implications, several challenges hinder effective management of sarcopenia, including limited economic studies and

data gaps that complicate resource allocation and policy development efforts (Ye et al., 2022). Addressing these challenges demands continued research, healthcare innovation, and policy advocacy to combat this escalating public health concern.

In conclusion, sarcopenia poses a significant burden on individuals and society, impacting physical health, quality of life, and healthcare expenditures. Addressing these challenges requires concerted efforts in research, healthcare policy, and clinical practice to develop effective prevention strategies, optimize management protocols, and allocate resources efficiently. Enhancing our understanding of sarcopenia's complexities and advancing interdisciplinary approaches can mitigate its societal impact and improve outcomes for affected individuals.

2.2.2 Prevalence and Epidemiology of Sarcopenia

Sarcopenia, characterised by the progressive loss of muscle mass and function, poses significant challenges to aging populations worldwide. Understanding its prevalence and epidemiology is crucial for developing effective healthcare strategies and interventions to mitigate its impact on health outcomes.

The global prevalence of sarcopenia among older adults varies widely, ranging from 10% to 40% across different populations and diagnostic criteria (Mayhew et al., 2019). According to a recent study by Petermann-Rocha et al. (2022), which utilised diverse classification systems and cut-off points, the prevalence of sarcopenia showed a wide range: from 0.2% to 86.5% in the narrative review and from 10% to 27% in the meta-analysis. The majority of data came from European and Asian populations, with less information available from African populations. These discrepancies highlight the complexity of defining and diagnosing sarcopenia, influenced by factors such as age, gender, ethnicity, and geographic location.

Studies in Korea and Malaysia highlight varying sarcopenia prevalence rates influenced by genetic predispositions, lifestyle factors, and healthcare practices (Cho et al., 2020; Ranee et al., 2022; Sazlina et al., 2020; Rosli et al., 2017). In Malaysia, sarcopenia prevalence ranges from 28.5% to 33.6% (Ranee et al., 2022; Sazlina et al., 2020), while recent research in Korea reveals diverse rates across different age groups: 19.2%, 29.1%, and 42.3% among individuals aged 20–39, 40–64, and over 65 years, respectively (Bae & Kim, 2017). Additionally, a recent study in Korea reported a total sarcopenia prevalence of 13.1-14.9% in elderly men and 11.4% in elderly women (Choo & Chang, 2021).

Studies from other countries further underscore this variability. Du et al. (2018) surveyed 2,458 elderly individuals (≥ 65 years old) in the United States and reported a sarcopenia prevalence of about 15.51%. In Santiago, Chile, Lera et al. (2017) found a prevalence of 19.1% among individuals aged 60 years and older, while Liu et al. (2020) reported a prevalence of 19.3% in elderly populations (> 60 years old) across various regions in China (Yunnan, Guizhou, Sichuan, and Xinjiang). Overall, sarcopenia tends to have a lower prevalence in Korea compared to many other countries. Variations in eating habits, environmental factors, cultural influences, and genetics specific to different populations contribute significantly to these differences (Barbieri et al., 2015; Guthold et al., 2018; Lee et al., 2013). Understanding these factors is crucial for comprehending the complex global landscape of sarcopenia prevalence.

This table 2.1 provides an overview of studies conducted in Malaysia focusing on sarcopenia prevalence among older adults. Each study is categorised by its location, diagnostic criteria, management strategies, associated comorbidities, participant demographics, sample size, and the prevalence rates of possible

sarcopenia, sarcopenia, and severe sarcopenia. This summary allows for a comparative analysis of sarcopenia prevalence across different regions in Malaysia, highlighting the methodologies used and the health implications for older populations in these areas.

This table 2.2 provides an overview of sarcopenia epidemiology in Southeast Asian countries, synthesizing findings from recent studies. Details include study authors, publication years, countries studied, diagnostic methods employed (e.g., BIA, DXA), management strategies, associated comorbidities, participant demographics (average age and sample size), and prevalence rates of possible sarcopenia, sarcopenia, and severe sarcopenia. The table aims to facilitate understanding of regional trends and variations in sarcopenia prevalence and management practices across Southeast Asia.

The AWGS 2019 consensus update reveals that sarcopenia affects between 5.5% and 25.7% of elderly Asian populations aged 60 years and above (Chen et al., 2020). This prevalence underscores the significant impact of age on sarcopenia rates, as studies consistently show an increase with advancing age. Research by Johansson et al. (2020) further illustrates this trend, noting that while the prevalence of probable/possible and confirmed sarcopenia remains relatively stable at 0.6-0.7% for individuals aged 40-69, it rises to 1.2% in those aged 70-74, 2.5% in the 75-79 age group, and exceeds 8% among individuals aged 80 years and older. These findings highlight the pressing need for targeted interventions aimed at preventing and effectively managing sarcopenia in older populations.

Gender disparities also play a role in sarcopenia prevalence, with research indicating higher incidence rates among males in certain regions. For example, Chen et al. (2020) found a prevalence range of 5.1% to 21.0% in Asian countries for males

compared to 4.1% to 16.3% for females. These findings suggest potential biological and cultural factors influencing gender differences in muscle mass preservation and sarcopenia development.

The impact of sarcopenia extends beyond individual health outcomes to encompass broader healthcare utilisation, morbidity, and mortality rates. Sobestiansky et al. (2019) demonstrated that sarcopenia-related muscle weakness significantly correlates with increased mortality rates and poorer quality of life. This association underscores the urgent need for early detection and intervention strategies aimed at improving outcomes and reducing healthcare costs associated with sarcopenia-related complications.

Understanding the demographic variations in sarcopenia prevalence is crucial. This knowledge informs targeted strategies aimed at promoting healthy aging and improving the quality of life for older adults affected by sarcopenia. Additionally, insights into the impacts on healthcare utilization and mortality rates guide effective interventions and healthcare policies.

Table 2.1 Overview of Sarcopenia Studies in Malaysian Older Adults

Author, year	Country	Consensus Group	Assessment of Sarcopenia	Comorbidity Disease	Age (years)	Sample Size	Prevalence Possible Sarcopenia/ Sarcopenia/ Severe Sarcopenia (%)
Rosli et al., 2017	Cheras, Malaysia	EWGSOP (2010)	BIA, handgrip strength (Jamar), gait speed (4 meter)	None	Mean age of 68.4 ± 6.2	426 (Men, women)	Sarcopenia = Men: 28.7; Women: 34.4; Overall: 32.2
Ramoo et al., 2022	Kuala Pilah, Malaysia	AWGS (2019)	BIA, handgrip strength (Jamar), gait speed (4 meter)	None	Older adults (age 60 and above)	2404 (Men, women)	Sarcopenia = Men: 8.5; Women: 2.8; Overall: 5.0 Severe sarcopenia = Men: 5.7; Women: 2.3; Overall: 3.6 Possible sarcopenia = Overall: 42.3
Wong et al., 2022	East Coast region of Peninsular Malaysia	AWGS (2019)	Calf circumference, handgrip strength (Takei)	Stroke	Mean age of 67.60 ± 5.70	196 (Men, women)	
Sazlina et al., 2020	Selangor, Malaysia	AWGS (2014)	BIA, handgrip strength (Jamar), gait speed (6 meter)	T2DM	Mean age of 67.6 ± 6.8	506 (Men, women)	Sarcopenia = Overall: 28.5
Iskandar et al., 2021	Selangor, Malaysia	AWGS (2019)	SARC-F questionnaire	None	Mean age of 67.73 ± 5.95	201 (Men, women)	Possible sarcopenia = Overall: 20.4
Mir et al., 2024	Perak, Malaysia	EWGSOP2 (2018)	BIA, handgrip strength (Jamar), gait speed (6 meter)	None	Older adults (age 60 and above)	65 (Men, women)	Sarcopenia = Overall: 7.7; Women: 13.2
Yap et al., 2020	Klang, Malaysia	EWGSOP (2010) AWGS (2014)	BIA, handgrip strength (Jamar hydraulic), TUG, gait speed (6 meter)	None	Mean age of 74.3	202 (Men, women)	Possible sarcopenia = Men: 4.7; Women: 3.6; Overall: 4.0 Sarcopenia = Men: 43.8; Women: 48.6; Overall: 47.0
Megasari et al., 2023	Malaysia	Cut-off value sarcopenia; - Gait speed: ≤ 0.7 m/s - TUG: ≥ 11.5 sec - Functional	SARC-F, gait speed (10 meter), handgrip strength (Jamar), TUG, functional reach test	None	Mean age of 68.13 ± 7.13	774 (Men, women)	Sarcopenia = Overall: 11.1

									Reach: < 22.5 cm - Handgrip Strength: (Men: < 22 kg; Women: < 17 kg)
Moorthy et al., 2023	Johor, Malaysia	AWGS (2014)	BIA, handgrip strength (Jamar), gait speed (6 meter)	Chronic kidney disease	Median age: 250				Sarcopenia = Overall: 5.2
Norshafarina et al., 2013	Cheras, Malaysia	Cut-off values from Janssen et al. (2002)	BIA, handgrip strength (Jamar)	None	Mean age of 66.4 ± 5.7	388	(Men, women)		Sarcopenia = Men: 89.0; Women: 40.3; Overall: 59.8 Severe sarcopenia = Men: 16.1; Women: 12.4; Overall: 13.9
Foo et al., 2023	Kelantan, Malaysia	AWGS (2019)	BIA, handgrip strength (Lafayette)	None	Mean age of 58.2 ± 6.7	230	(Men, women)		Sarcopenia = Overall: 12.6

Abbreviation: AWGS = Asian Working Group for Sarcopenia; EWGSOP = European Working Group on Sarcopenia in Older People; BIA = Bioelectrical Impedance Analysis; TUG = Timed Up-and-Go.