The Influence of Nutrition on Muscle Strength in different Community-Dwelling Older Adults in China

By

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Dissertation submitted in partial fulfilment of the requirements for the Degree of Bachelor of Health Sciences

(NUTRITION)

CERTIFICATE

This is to certify that the dissertation entitled "The Influence of Nutrition on Muscle Strength in different Community-Dwelling Older Adults in China" is the bona fide record of research work done by Mr/Ms "Vina Tan Phei Sean" during the period from "month" 2024 to 2025 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 fulfillment for the degree of Bachelor of Health Science (Honours) (Programme).

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DECLARATION

I hereby declare that this dissertation is the results of my own investigation, except where otherwise stated and duly acknowledged. I also declare that it has not been previously or concurrently submitted as 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.

.. ..
ZHANG YI CHUN
Date:12th January 2025

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In the name of Allah, the Most Gracious, the Most Merciful

I thank Allah and bless me for completing this thesis. I would like to thank God for all the opportunities, trials and strengths that He has given me to complete this thesis.

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LIST OF SYMBOLS

H_0 Null hypothesis

H_a Alternative hypothesis

> Greater than

< Lower than g Gram

% Percentage

ABSTRAK

Kajian ini menilai hubungan antara kualiti pemakanan dan kekuatan otot dalam orang dewasa yang tinggal di komuniti negara China. Melalui tinjauan terhadap populasi warga emas, kami menapis kemungkinan sarcopenia dan menilai corak pemakanan dan tahap aktiviti fizikal untuk memberikan pandangan tentang kaitannya dengan sarcopenia. Seramai 50 orang peserta dari kalangan warga emas datang dari Wilayah Gansu, China telah melengkapkan *Dietary Quality Questionnaire* (DQQ) dan ujian kekuatan otot 5-kali duduk-dan-berdiri (5xSTS). Peserta juga melengkapkan *Physical Activity Scale for Elderly* (PASE) untuk menilai tahap PA. Keputusan kajian ini menunjukkan tiada perbezaan dalam pembolehubah antara kumpulan bandar dan luar bandar, bermakna pembolehubah kesihatan dan pemakanan secara amnya sama kecuali perbezaan umur yang signifikan antara populasi warga emas di bandar dan luar bandar di mana mereka di luar bandar adalah lebih tua sebanyak 6.1 tahun, ($p = 0.013$). Penilaian ujian korelasi mengkaji hubungan antara pelbagai kesihatan, aktiviti fizikal dan pembolehubah pemakanan dalam 50 peserta warga emas. Penemuan utama menunjukkan beberapa korelasi yang signifikan pada kedua-dua tahap 0.05 dan 0.01, tetapi hanya umur dan 5xSTS yang berkorelasi dengan ketara ($r = 1$, $p = 0.56$). Ini bermakna pembolehubah selebihnya tidak mempunyai korelasi yang signifikan dengan kekuatan otot. Seramai 28 peserta melengkapkan 5xSTS dalam lebih daripada 12 saat yang menunjukkan kekurangan kekuatan otot dan diklasifikasikan sebagai status *propable sarcopenia*. Ujian jumlah jisim otot diperlukan untuk mengenalpasti keadaan sarcopenia. Secara am, kajian ini mendapati sebanyak 56% warga emas yang telah disaring mungkin menghidapi sarcopenia dan walaupun

DDQ dan PASE tiada kaitan signifikan dengan kekuatan otot, ujian yang lebih jitu diperlukan dalam kajian pada masa hadapan.

ABSTRACT

This study assessed the relationship between dietary quality and muscle strength in Chinese community-dwelling older adults. Through a survey of the older adults, we screened for sarcopenia and assessed dietary patterns and physical activity levels to provide insights into the relation to sarcopenia.

A total of 50 participants are from Gansu Province, China completed the Dietary Quality Questionnaire (DQQ) and the 5times sit-to-stand (5xSTS) muscle strength test. Participants also completed the Physical Activity Scale for the Elderly (PASE) to assess PA levels. The results of these studies showed no differences in variables between the urban and rural groups, meaning that health and dietary variables were broadly similar except for a significant difference in age between the urban and rural older adults where the rural group were older by 6.1 y ($p = 0.013$). Correlation tables examined the relationships between various health, physical activity and dietary variables in 50 older participants. The main findings indicated several significant correlations at both the 0.05 and 0.01 levels, but only age were significantly correlated to 5xSTS values ($r = 1$, $p = 0.56$) . There were 28 individuals that completed the 5xSTS in more than 12 seconds indicating poor muscle strength and are considered as having probable sarcopenia. More tests are needed to confirm sarcopenia such as a muscle mass assessment. Overall, the study indicated that as much as 56% of older adults screened may be sarcopenic and although DDQ and PASE was not significantly correlated to muscle strength, more precise study tools are required in future studies.

CHAPTER 1

INTRODUCTION

1.1 Background of Study

The global population is aging. The number and proportion of elderly people is increasing in almost every country in the world. Population aging has the potential to be one of the most important population phenomena of the 21st century, affecting almost all areas of society (Nation 2019). Aging is often accompanied by various types of debilitating symptoms and health risks that are greatly related to the decline of various body functions. Most troubling is the age-related decline in skeletal muscle mass (sarcopenia) and strength (muscle atrophy), due to the crucial role muscle strength plays in maintaining physical function and independence in older adults (ref). However, the aging process leads to a gradual loss of muscle mass and strength, a condition known as sarcopenia, which is often accompanied by an increased risk of falls, fractures, and disability (Cruz-Jentoft & Sayer, 2019), and it is for this reason that he is considered a huge public health problem (Beaudart et al., 2014). As the global aging population and the number of older adults affected by sarcopenia and its complications continues to grow, addressing muscle loss through non-invasive and cost-effective strategies has become an important focus of research. Among these, exercise and nutrition are two of the most researched measures to alleviate sarcopenia and build muscle strength in older adults. Most studies have found that despite muscle decline with age, older adults' muscles remain plastic (Chodzko-Zajko et al., 2009), meaning that they still can adapt to exercise and nutritional interventions. Some studies have concluded that older adults who engage in regular aerobic exercise and strength training can prevent slow age-related declines in muscle mass, strength, and fitness, while, at the same time, reducing their risk of developing a

range of chronic diseases (Physical Activity Guidelines for Older Adults, 2022; Artero et al., 2012). A well-balanced diet that combines adequate protein with other essential nutrients, such as vitamins, minerals and healthy fats, contributes to muscle health and reduces the risk of sarcopenia (Bollwein et al., 2012, Bollwein et al., 2013).Ageing is now even more of a major public health challenge in China, where it is estimated that in 2023, more than 290 million people (21.1% of China's total population) will be over the age of 60. This proportion is projected to reach 38.8% by 2050 (United Nations, 2024； National Bureau of Statistics, 2024). As they age, older people face a variety of health challenges, including an increasing prevalence of sarcopenia. A meta-analysis of 35 studies from multiple countries reported that the overall prevalence of sarcopenia in adults over the age of 60 years was estimated to be 10% (Shafiee et al., 2017). In comparison, the prevalence of sarcopenia in Chinese older adults is 18 % in men and 16.4 % in women (Chen et al., 2021). Sarcopenia is a progressive, systemic loss of skeletal muscle mass and muscle strength that can lead to a variety of consequences such as functional decline, falls, fractures, physical disability, poor oncological prognosis, metabolic disorders, depression, poor quality of life, and death, and greatly increases the risk of hospitalisation (Xia et al., 2020)

Therefore, we aimed to assess the association of nutrition and physical activity level on muscle strength in China’s community-dwelling older adults.

1.2 Problem statement & study rationale

Health problems caused by aging are becoming more and more prominent, which not only seriously affects the lives of the older adults themselves, but also directly affects family members and community. The loss of muscle power caused by the health problems has become a health

issue. A specific group of people with symptoms appearing in sarcopenia has become an important issue for community work, and for the attention of medical practitioners and researchers. This study generally assessed the association of physical activity (PA) and dietary habits on muscle strength in Chinese older adults.

1.3 Research Questions

1. What is the muscle strength tested by the 5-times sit-to-stand (5xSTS) in community-dwelling older adults in urban and rural area in China?
2. What is the diet quality levels assessed by the Diet Quality Questionnaire (DQQ) in community-dwelling older adults in China?
3. Is there an association in muscle strength and diet quality between community-dwelling older adults in different gender in China?
4. Is physical activity levels related to muscle strength in community-dwelling older adults in China?

1.4 Objective

General

The primary objective is to evaluate the influence of diet quality on muscle strength in community-dwelling older adults in China.

Specific

- To investigate muscle strength, diet quality and physical activity levels in community-dwelling older adults from urban and rural areas in China.
- To assess differences in diet quality and muscle strength between urban and rural community-dwelling older adults in China.
- To examine the association of diet quality and physical activity on muscle strength in community-dwelling older adults in China

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1.5 Research Hypothesis

H_{O1}: There is no significant differences in diet quality between urban and rural community-dwelling older adults in China.

H_{A1}: There is a significant difference in diet quality between urban and rural community-dwelling older adults in China.

H_{O2}: There is no significant difference in muscle strength between community-dwelling urban and rural older adults.

H_{A2}: There is a significant difference in muscle strength between community-dwelling urban and rural older adults.

H_{O3}: There is no significant difference in physical activity levels between community-dwelling urban and rural older adults.

H_{A3}: There is a significant difference in physical activity levels between community-dwelling urban and rural older adults.

H_{O4}: There is no significant association in diet quality and muscle strength in community-dwelling urban and rural older adults.

H_{A4}: There is a significant association in diet quality and muscle strength in community-dwelling urban and rural older adults.

H_{O5}: There is no significant association in physical activity levels and muscle strength in community-dwelling urban and rural older adults.

H_{A5}: There is a significant association in physical activity levels and muscle strength in community-dwelling urban and rural older adults.

1.6 Significant of Study

Although there are some studies on the prevention and treatment of sarcopenia, there are fewer studies on the relationship between dietary patterns and the onset of sarcopenia, and many of them have younger samples and are not systematic enough. This study combines the increasingly serious aging background, the older adults in Gansu region. A comprehensive study is needed to assess the dietary structure of older people in Gansu through community questionnaires and personal interviews. The Global Dietary Quality Questionnaire (GDQ) will analyse dietary patterns and their potential association with NCD risk, while the Personal Activity Scale for the Elderly (PASE) will assess daily exercise and light exposure. The results of the study aim to develop targeted dietary guidelines, improve understanding of the relationship between dietary patterns and decreased muscle mass in older adults, and reduce the incidence of NCDs.

Studying the effects of exercise and nutrition on muscle mass in older adults is crucial at multiple levels: individual, family, public health, economic, and social.

Firstly, it is certain that studying the effects of exercise and nutrition on an individual's health and quality of life will not only further improve academic analyses of muscle mass in older adults, but also prevent health problems caused by sarcopenia at a physiological level, such as bone and joint health, and reduce the risk of osteoporosis and fractures (Zhang et al., 2018) Secondly, the health status of older people is a stressor for economic problems and to some extent a risk factor for family well-being(Beaudart et al., 2017) This is a great challenge to contemporary healthy family life, and active prevention and care promotion needs to find in the needs of older people's lives the need to protect muscle mass, to improve muscle mass through balanced nutrition and exercise (Iolascon et al., 2014;Anton et al., 2018) in order to increase the independence of older people's lives., Most older people's health cannot be restored by means of intervention and more often than not requires maintenance and prevention over a long period of time, which has led today's society to place great importance on the health of older people, considering that the loss of muscle mass in older people directly reduces their quality of life.(World Health Organization, 2015; Progress Report on the United Nations Decade of Healthy Ageing, 2021-2023,.)

CHAPTER 2

LITERATURE REVIEW

2.1 General Overview of Research Subject

Sarcopenia is a typical feature of human aging, characterized by loss of muscle strength, mass and function, and is associated with functional decline, frailty and increased risk of several age-related diseases and death (Larsson et al., 2019). Existing studies have mostly addressed it as a clinical disease complication, and lifestyle has a significant impact on sarcopenia and muscle strength loss in older adults (Nguyen, T. N., 2020; Sazlina et al., 2020; Umakanthan et al., 2021). Nutritional studies are mostly based on epidemiologic cross- sectional studies focusing on the role of vitamins and proteins and resistance exercise, and non-healthy lifestyles can lead to loss of muscle mass, with negative psychological and physiological effects in older adults (Watanabe et al., 2010; Masakazu Saitoh et al., 2019; Isaka, 2021). Studies have shown a direct correlation between lifestyle and muscle mass, and that balanced and accurate nutritional supplementation and exercise are important for the prevention of sarcopenia (Sayer et al., 2013), but that the intensity of nutritional supplementation and diet varies according to individual differences. Although current research suggests treatment recommendations and strategies, muscle loss in older adults is primarily targeted at improving nutritional intake and exercise, and the results of past studies have not been validated (Sun et al., 2017).

2.2 Limitations and Strengths of Previous Study

The study of Exercise and Nutrition for Muscle Mass in Older Adults based on nutrition-related literature, reveals that we know little about the importance of diet for muscle mass and strength in older adults compared to the obvious benefits of exercise, and that most of the research in this area is relatively new. A 25% decline in food intake between the ages of 40 and 70 puts older adults at risk for inadequate nutritional intake (van den Heuvel et al., 2019).

A growing body of literature suggests that diet may have important modifiable effects on sarcopenia (Moreland et al., 2020), with the most consistent evidence being the role of protein, vitamin D and antioxidant nutrients (Semba et al., 2007; Phillipis & Martinson, 2018). Relatively few studies have been conducted on the relationship between dietary patterns and sarcopenia, and most have focused on the diet (Willett et al., 1995; Granic et al., 2019; Karlsson et al., 2020).

In recent years, nutrition has been widely used as a control variable for several aspects of muscle health research, including muscle mass, strength, and physical condition performance; and while there is currently little research on sarcopenia, observational studies are emerging that examine the role of diet and show a lower risk of sarcopenia compared to a healthy diet. In turn, there are large individual differences in physical condition and response in older adults, which may lead to greater variability in study results between individuals. From the meta-analyses, it is unclear whether single diets, for example, long-term vegetarians, are prone to deficiencies in nutrients such as protein and, in the case of exercise, whether those who are inactive experience faster muscle ageing due to slower regeneration of cell division because of inactivity (Sobiecki et al., 2016).

CHAPTER 3

METHODOLOGY

3.1 Research design

The is a cross-sectional study to assess the association between dietary quality, physical activity levels and muscle strength in urban and rural area community-dwelling older adults in Gansu, China.

3.2 Research Subjects

Inclusion criteria for this study were individuals who were at least 60 years of age and able to perform daily activities independently; who did not have an unstable chronic disease or other acute medical condition that might contraindicate exercise or dietary changes in the past 3 months; and who had no specific preference for food and whose cognition was clear enough to allow them to communicate with the researcher in English or Mandarin.

3.3 Research Procedure

Participants in this cross-sectional study were drawn from older adults from different communities in Gansu, an observational study focusing on the relationship between (nutritional) diet quality, physical activity level and muscle strength status in older adults. This study commenced on 8 September 2024 after obtaining human research ethical approval Participants were recruited from major communities such as mosques and villages.I introduced my research by visiting and

interviewing older people in mosque areas, parks, community exercise, chess and chatting, and rural community activities, taking height, weight and 5xSTS measurements with consent, and completing questionnaires. They all completed questionnaires on leg strength assessment as well as diet quality. In addition, the researchers administered a detailed physical activity level questionnaire (which collected information about daily activities, work, physical activity, and dietary habits) to the participants. The study protocol was approved by the Humanities and Ethics Review Committee of Universiti Sains Malaysia. All participants provided signed written informed consent. Physical measurements (including height and weight) were measured by trained personnel using standard protocols, and BMI was calculated as weight (in kg) divided by height squared (in m).

The 5-times sit-to-stand test (5xSTS) test, Physical Activity Score for Elderly (PASE, activity level questionnaire for older adults) and Global Dietary Quality Questionnaire (DDQ) were used in this cross-sectional study spanning from 8 September 2024 to 1 October 2024. The study was conducted with participants aged 60 years or older who underwent a health screening, leg strength test and questionnaire (n 80). I excluded participants who were unable to complete DDQ data collection or muscle mass leg strength measurements (n 30). Due to these exclusions, the final cross-sectional study population consisted of 50 participants.

Assessment of Muscle Strength

Muscle strength was assessed using 5xSTS. The 5xSTS protocol is designed to measure the time it takes for an individual to stand up from a sitting position and sit down five times as quickly as possible. It assesses lower limb strength, which is essential for maintaining mobility and independence (Tae Sung Park & Shin, 2024).

The participant sat in a standard height chair (approximately 43-45 cm high) with arms crossed over the chest with back straight and feet flat on the floor with knees at approximately 90 degrees. The participant was instructed to stand up completely and sit down in the first single sit-stand trial. If they are able to stand without the use of arms to help them get up, they will then proceed to complete the sit-stand action as quickly as possible for five times in a row. Timing starts when the tester says 'start' and stops when the participant sits down after the fifth time standing up, and the total time taken to complete the five repetitions is recorded in seconds. (What was used to capture the time? You need to list it down here as a researcher so that other researchers may use the same tool – type of equipment, model, brand)

A time of 12 seconds or more is usually considered to indicate impaired lower extremity strength and suggests probable sarcopenia from the AWGS2 (Chen et al., 2020)). The Asian Working Group on Sarcopenia (AWGS) 2014 consensus defined sarcopenia as 'age-related loss of muscle mass, combined with low muscle strength and/or low physical performance' and specified thresholds for each diagnostic component. AWGS 2019 retains the previous definition of sarcopenia but modifies the diagnostic algorithms, protocols, and some criteria: low muscle strength is defined as grip strength <28 kg for males and <18 kg for females; and low physical performance is defined as a 6-metre walk of <1.0 m/s, a score of ⩽9 on the Short-Time Physical Performance Test, or ⩾12 seconds on the 5-repetitions Chair Stand Test (Chen et al., 2020). The STS test is a functional test that is often used to assess physical ability, balance, and strength in older adults because it is a simple, free test that is suitable for use in community-based assessments (Tae Sung Park & Shin, 2024; Teo et al., 2013).

Assessment of dietary intake

Dietary intake was assessed through face-to-face interviews with the Global Diet Quality Questionnaire (GDQQ), which contains 29 food groups. Participants were instructed to indicate their past dietary habits in the last 24h by ticking whether or not they consumed a particular food (from ‘yes’ or ‘no’). Corresponding indicators were calculated using a computer programmed developed to analyze the questionnaire. The Chinese Diet Quality Questionnaire was used as the Lower limb muscle strength is a major predictor of fall risk in older adults, as direct squatting or immediate rising increases their risk of falling due to substantial loss of muscle strength. In the sit-to-stand manoeuvre, force is mainly generated by the lower limb muscles, and it has been found that the hip, knee and ankle joints are the most powerful.

It has been found that the maximum moment of force at the hip, knee and ankle joints occurs at or after the moment of leaving the seat of the chair, at which time the contraction of the hip extensors and knee extensors reaches almost maximum strength. According to the results published by Weng Changshui, Wang Na and Liu Liming in the Chinese Journal of Rehabilitation Medicine, Issue 10, 2012, the 5 times sit-to-stand test was proved to be effective by a large amount of data（The effectiveness of the 5-sit-stand test in predicting fall risk in the elderly - Baidu Scholar, 2025）source of dietary data. A total of 50 participants from different community were interviewed for dietary intake data in the last week to assess dietary habits. Participants were also asked whether they had changed their dietary habits in the past month. Calculation of appropriate indicators based on DDQ responses in conjunction with a computer programme.

Assessment of Physical Activity levels.

Socio-demographic variables including age, gender, and physical activity status were collected using face-to-face interviews. Physical activity levels were evaluated based on responses to relevant questions in PASE.

3.4 Data collection methods

In order to ensure comprehensive and high-quality data collection on the effects of nutrition and exercise on muscle strength in older adults in this study, the following methods were used:

1. Recruitment of participants

Time and Methods:

Selected communities were visited at three different times of the day: morning (8:00-11:00 am), midday (12:00-2:00 pm), and afternoon (3:00-6:00 pm). This ensures access to older adults with varied daily lives and schedules, thereby increasing representation and inclusiveness.

Face-to-face interactions:

Face-to-face interaction with older people in public places (e.g. community centres, parks, activity centres or other areas where older people congregate).

Briefly explain the study objectives, significance, and expected time commitment in simple, clear language to ensure understanding.

Willingness to Participate:

To ensure informed participation, the researcher will verbally explain the purpose of the study and confirm that they understand the process. Individuals' willingness to participate will be assessed through direct questioning. Those who agree to participate provided written informed consent.

3. Data collection procedures

Once participants have agreed to participate and confirmed understanding, the following procedures are systematically carried out: