



**UNIVERSITI PUTRA MALAYSIA**

***DIETETIC OUTCOMES OF NUTRITION INTERVENTION  
AMONG ELDERLY PATIENTS IN DIETETIC CLINIC  
HOSPITAL PENGAJAR UNIVERSITI PUTRA MALAYSIA***

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2021/2022**

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PATIENTS IN DIETETIC CLINIC HOSPITAL PENGAJAR UNIVERSITI PUTRA  
MALAYSIA**

BY  
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A project paper submitted as partial fulfillment of the requirement for the degree  
of Bachelor of Science in Dietetics with Honours from the Faculty of Medicine  
and Health Sciences, Universiti Putra Malaysia.

This project entitled “Dietetic Outcomes of Nutrition Intervention among Elderly Patients in Dietetic Clinic Hospital Pengajar Universiti Putra Malaysia” was prepared by Nur Dhamirah binti Khairuddin and submitted to the Faculty of Medicine and Health Sciences as a partially fulfilment of the requirements for the Degree of Bachelor of Science in Dietetics with Honours from Faculty of Medicine and Health Sciences, Universiti Putra Malaysia

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Date: **13 September 2022**

## ACKNOWLEDGEMENT

I would like to thank myself for believing in my own abilities and kept pushing through even in the toughest times in life. I also trust that I would not be able to complete this thesis without the guidance and encouragement from my supervisor, Assoc Prof Dr Siti Nur'Asyura Adznam throughout this journey. Her passion in gerontology area has inspired me to dive further into this research topic. The challenges I have faced throughout completing this project were always accompanied with support and affection. I am deeply grateful for my friends, my family and my cat who were always there to keep me motivated. Special thanks to my research partner, Nur Aqila Yusri who gave her all in completing our project together. I am also wholeheartedly indebted to my roommates Nurin Adlyn and Siti Nursyafiqah who are my constant cheerleaders that ease my struggles.

My gratitude also goes to the assessors of this study, especially Prof Dr Chan Yoke Mun, who provided me with insights to improve this study. I have learned a lot from their wisdom and advices. Aside from that, I am thankful for the opportunity that Hospital Pengajar Universiti Putra Malaysia has given me to conduct this study at their facility. Without their authorization, I would not be able to experience doing my own research that has provided me with a lot of new knowledge and skills.

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## ABSTRACT

### DIETETIC OUTCOMES OF NUTRITION INTERVENTION AMONG ELDERLY PATIENTS IN DIETETIC CLINIC HOSPITAL PENGAJAR UNIVERSITI PUTRA MALAYSIA

NUR DHAMIRAH KHAIRUDDIN

Dietetic outcomes in this study referred to the outcomes of anthropometric measurements and biochemical data as well as blood pressure readings. Non-communicable diseases (NCD) affect many elderly and responsible for 71% of global death. They have a higher risk of developing NCD due to the detrimental effects of aging in certain aspects such as endocrine and cardiovascular systems. Some of the most common NCDs among elderly in Malaysia are obesity, diabetes, hypertension and hyperlipidemia. Unfortunately, the number of cases rise throughout the year and will cause burden to the healthcare sector. While dietitians play an important role in managing their conditions through nutrition care, there are limited number of research on dietetic outcomes. Therefore, the study aims to determine the dietetic outcomes of nutrition intervention among elderly patients in Dietetic Clinic Hospital Pengajar Universiti Malaysia. This study was a retrospective study that recorded the changes in blood pressure, serum fasting lipid, HbA1c and body weight among 165 samples of elderly who received dietary intervention in the dietetic clinic from January 2019 to May 2022. Sociodemographic profile of the patients were also recorded which shown the mean age of  $66 \pm 5$  years, ranging from 60 to 83 years old. Anthropometric measurements of the subjects shown 52.1% with healthy body weight. There were 39.4% of the participants who had multimorbidities. Upon receiving nutrition intervention, there were changes found in the parameters; blood pressure (systolic:  $t=-0.299$ ,  $p=0.767$ ; diastolic:  $t=-0.136$ ,  $p=0.893$ ), total cholesterol ( $t=3.754$ ,  $p<0.001$ ), triglycerides ( $t=2.242$ ,  $p=0.029$ ), LDL cholesterol ( $t=2.951$ ,  $p=0.005$ ) HDL cholesterol ( $t=-0.103$ ,  $p=0.918$ ), HbA1c ( $t=1.757$ ,  $p=0.086$ ) and body weight ( $t=1.623$ ,  $p=0.111$ ). To conclude, nutrition intervention provided by dietitians is able to improve the biomarkers of diseases among patients and thus delaying the progression of the chronic diseases. Therefore, nutrition care is a crucial part of non-communicable diseases treatments.

## ABSTRAK

### HASIL DIETETIK DARI INTERVENSI PEMAKANAN DALAM KALANGAN PESAKIT WARGA EMAS DI KLINIK DIETETIK HOSPITAL PENGAJAR UNIVERSITI PUTRA MALAYSIA

NUR DHAMIRAH KHAIRUDDIN

Hasil dietetik dalam kajian ini merujuk kepada hasil pengukuran antropometri dan data biokimia serta pembacaan tekanan darah. Penyakit tidak berjangkit (NCD) mempengaruhi ramai warga tua dan bertanggungjawab atas 71% kematian global. Mereka mempunyai risiko yang lebih tinggi untuk mempunyai NCD kerana kesan penuaan yang memudaratkan dari segi tertentu seperti sistem endokrin dan kardiovaskular. Beberapa NCD yang paling biasa di kalangan warga tua di Malaysia adalah obesiti, diabetes, darah tinggi dan hiperlipidemia. Malangnya, jumlah kes meningkat sepanjang tahun dan akan menyebabkan beban kepada sektor penjagaan kesihatan. Walaupun pakar diet memainkan peranan penting dalam menguruskan keadaan mereka melalui penjagaan pemakanan, penyelidikan mengenai hasil dietetik adalah terhad. Oleh itu, kajian ini bertujuan untuk menentukan hasil diet intervensi pemakanan di kalangan pesakit tua di Klinik Dietetik Hospital Pengajar Universiti Malaysia. Kajian ini adalah kajian retrospektif yang mencatat perubahan tekanan darah, profil lipid, HbA1c dan berat badan di antara 165 sampel orang tua yang mendapat intervensi pemakanan di klinik dietetik dari Januari 2019 hingga Mei 2022. Profil sosiodemografi pesakit juga direkodkan dan menunjukkan usia rata-rata  $66 \pm 5$  tahun, antara 60 hingga 83 tahun. Pengukuran antropometri subjek menunjukkan 52.1% dengan berat badan yang sihat. Terdapat 39.4% peserta yang mempunyai 'multimorbiditi'. Setelah mendapat intervensi pemakanan, terdapat perubahan yang dicatat dalam parameter tersebut; tekanan darah (sistolik:  $t = -0.299$ ,  $p = 0.767$ ; diastolik:  $t = -0.136$ ,  $p = 0.893$ ), jumlah kolesterol ( $t = 3.754$ ,  $p < 0.001$ ), trigliserida ( $t = 2.242$ ,  $p = 0.029$ ), kolesterol LDL ( $t = 2.951$ ,  $p = 0.005$ ), kolesterol HDL ( $t = -0.103$ ,  $p = 0.918$ ), HbA1c ( $t = 1.757$ ,  $p = 0.086$ ) dan berat badan ( $t = 1.623$ ,  $p = 0.111$ ). Kesimpulannya, intervensi pemakanan yang diberikan oleh pakar diet dapat menambah baik *biomarker* penyakit di kalangan pesakit dan dengan itu menunda perkembangan penyakit kronik. Oleh itu, penjagaan pemakanan adalah sebahagian penting dalam rawatan penyakit tidak berjangkit.

## CHAPTER 1

### INTRODUCTION

#### 1.1 Background

According to the World Health Organization (WHO), elderly are those aged 65 years old and above. However, in Malaysia, the Public Service Delivery and Local Government stated that individuals of 60 years old and above are considered elderly or senior citizens. Additionally, the Department of Statistics Malaysia revealed that 11.2% or 3.6 million of the Malaysian population in 2021 are elderly. Older people have a higher risk of having non-communicable diseases (NCD) due to the aging process among other factors. Some of the most common NCDs among elderly in Malaysia are obesity, diabetes, hypertension and hyperlipidemia and there are rises in its pattern throughout the year (NoorAni et al., 2018). It is long known that NCDs is the main cause of mortality and responsible for 71% of global death (WHO, 2021). Some of the risk factors contributing to NCDs include genetics, obesity, smoking, physical inactivity and unhealthy diet. However, some of these factors are modifiable, which if prolonged, can eventually result in undesirable consequences. For example, the unhealthy diet. As nutrition contributes largely towards bodily function, it is especially important to have a proper eating habit. Although many policies have been introduced to tackle unhealthy eating and reduce the development of chronic diseases, the cases of NCDs are still on the rise. As a consequence, it challenges sustainable human development whereby

improving population health is one of the main goals (NCD Alliance, 2017). Since NCD increases with age, it is typical to observe a high prevalence of the diseases among elderlies. However, older adults with chronic diseases may have a lower quality of life. Therefore, it is important to prevent the development or complications of NCDs as well as to look into the management of the diseases as a tertiary prevention measure according to the Center for Disease Control (CDC). In regards to the tertiary prevention measure, dietitians are among the healthcare professionals who play an important role in slowing the disease progression. Their major role is to manage nutrition care according to individual needs, establish dietary plans, and promote health and disease prevention (Academy of Nutrition and Dietetics, 2013; European Federation of Associations of Dietitians (EFAD), 2016). Dietitians provide Nutrition Care Process (NCP) through medical nutrition therapy (MNT) which is an evidence-based practice. NCP comprises nutrition assessment, nutrition diagnosis, nutrition intervention and nutrition monitoring and evaluation. In the context of Malaysia, clinical dietitians can be found in every hospital. They see patients by referral from physicians, regardless of inpatient or outpatient settings.

Hospital Pengajar Universiti Putra Malaysia (HPUPM) is a hospital which is newly established under the Ministry of Higher Education (MOHE) Malaysia. The hospital provides medical care with several medical niches including gerontology. Along with providing a research platform, HPUPM is also a teaching hospital for the Faculty of Medicine and Health Sciences of Universiti Putra Malaysia (UPM). HPUPM has a Department of Dietetics which provides nutritional care and clinical teaching. Some of the services offered are in-patient food service, clinical dietetics services for patients in wards and dietary consultation for outpatients.

## **1.2 Problem statement**

As the population ages, it is expected that NCD cases will rise in the future. It will cause a burden to healthcare especially because financial resources are limited due to the complexity of diseases and the altering demographics, thus it must be appropriately used. In context of Malaysia, the Ministry of Health has found research gaps on the outcome of nutritional care in preventing and managing diet-related NCDs. It is recommended that this topic be delved deeper in order to improve the effectiveness of nutritional care system in the country. In fact, this is one of the research priority areas for the 12<sup>th</sup> Malaysia Plan (MOH, 2020). The European and Nutrition Action Plan of the World Health Organization (WHO) has also recommended that dietetic discipline to monitor and evaluate diet-related activities, initiatives, and policies in various situations to verify their success and disseminate good practice (WHO, 2015). Thus, responsibility for nutritional care effectiveness is essential for the future of healthcare and the dietetic profession (Frejier et al., 2015). Ultimately, the findings in this research scope will contribute in reducing morbidity, disability and preventable deaths (MOH, 2020).

## **1.3 Significance of the study**

This study was conducted with the purpose of determining the dietetic outcomes among elderlies with NCDs in dietetic clinic HPUPM. It revealed the pattern of patients' blood pressure, HbA1c, fasting serum lipid and body weight before and after receiving nutrition care from dietitians. The measurements of the parameters at their first, second, and third visits to the dietetic clinic were recorded then compared. The purpose was to observe the changes between each visit, after they receive dietary interventions. Consequently, it will indirectly contribute to the findings of the factors influencing the outcome of the nutrition intervention provided. As this was the first study to explore

dietetic outcomes in HPUPM, it can provide baseline information for future use. Authorities of HPUPM will be able to strategize on delivering the best nutrition care for the patients, in parallel with the government's ultimate goal of providing a strengthened nutrition care system.

#### **1.4 Research objectives**

##### **1.4.1 General objective**

To determine the dietetic outcomes of nutrition intervention among elderly patients in Dietetic Clinic HPUPM.

##### **1.4.2 Specific objectives**

1. To observe the sociodemographic, anthropometric and clinical status of elderly patients in dietetic clinic HPUPM.
2. To observe the parameters of blood pressure, fasting serum lipid, HbA1c and body weight among elderly patients in dietetic clinic HPUPM.
3. To determine the changes in parameters of blood pressure, fasting serum lipid, HbA1c and body weight on the second and third visit among elderly patients in dietetic clinic HPUPM.
4. To determine the mean changes in parameters of blood pressure, fasting serum lipid, HbA1c and body weight between interventions among elderly patients in dietetic clinic HPUPM.

#### **1.5 Research hypothesis**

There are significant changes in the parameters of blood pressure, fasting serum lipid, HbA1c and body weight among elderly patients in the second and third visit to a dietitian.

## 1.6 Conceptual framework

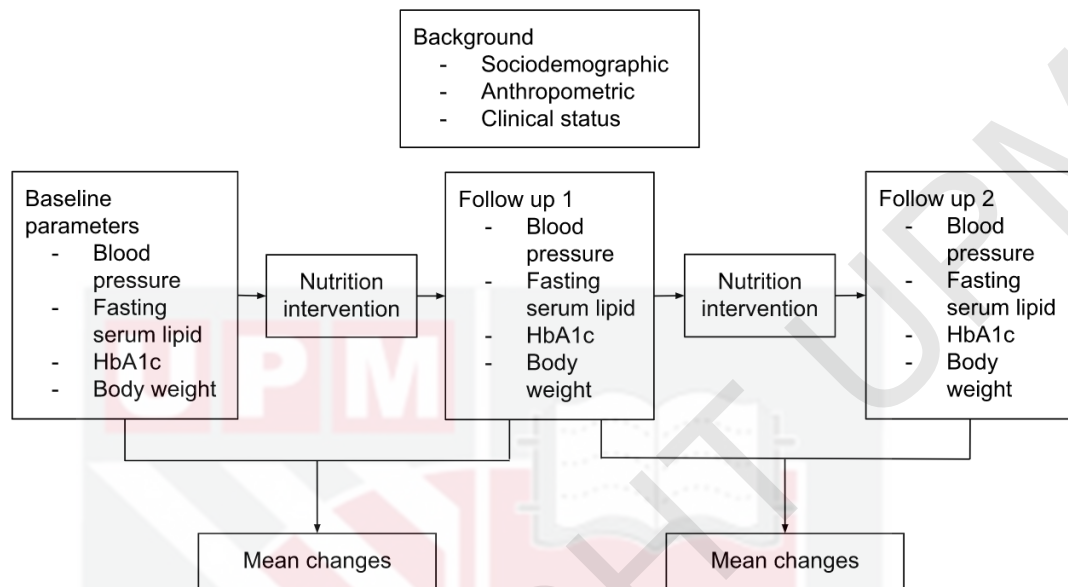


Figure 1.1 Conceptual framework of dietetic outcomes among elderly in dietetic clinic HPUPM

## **CHAPTER 2**

### **LITERATURE REVIEW**

#### **2.1 Definition of dietetic outcomes**

According to the British Dietetic Association (2019), dietetic outcome can be defined as "a measured change/resolution of the nutritional 'problem' at the end of treatment. This could include, but is not limited to health, for example, the problem could be knowledge or behaviour focused". To relate with the Nutrition Care Process Terminology (NCPT), a dietetic outcome may include the domains from the Nutrition Assessment NCPT, as the evaluated outcome of an NCP comes from the nutrition-related issue upon the initial assessment. Therefore, it includes anthropometric measurement, biochemical data, food and nutrition-related history and nutrition-focused physical findings (Colin, 2021; Hickman et al., 2015). Nonetheless, this study only focused on the outcome of anthropometric measurements and biochemical data along with blood pressure readings.

#### **2.2 Non-communicable diseases (NCD) among elderly**

##### **2.2.1 Hypertension**

Because of the negative repercussions it can cause, such as cardiovascular disease and chronic kidney disease, hypertension has become a prevalent health condition and one of the public health issues around the world (Mills et al., 2016). Clinical Practice Guidelines (CPG) for Management of Hypertension (MOH, 2018) defined

hypertension as persistent elevation in systolic blood pressure of 140mmHg or greater and/or diastolic blood pressure 90mmHg or greater which are measured twice or more, on two different occasions. National Health and Morbidity Survey (NHMS) (2019) reported that hypertension is the highest among those aged 75 years old and above with the prevalence of 81.7% compared to other age groups. As hypertension has been linked to increased age, it is not uncommon to observe the occasion of high blood pressure among older adults. Abdul-Razak and colleagues (2016) also found that the prevalence of hypertension among those aged 60 years and above (68.2%) is the highest compared to the other adult age groups in their study. Anti-hypertensive medicine is one of the most popular sorts of treatments that researchers have looked into treating people with hypertension. Although anti-hypertensive medication has been demonstrated to be helpful, the best type of treatment for hypertensive seniors is still up for debate (Buonacera et al., 2018). The unique physiological and functional changes that result in high blood pressure in older persons, such as neurohormonal and autonomic dysregulation, as well as hemodynamic mechanical abnormalities, make controlling hypertension difficult (Oliveros et al., 2019). As a result, there are disagreements over how to manage patients and ambiguous guidelines, particularly when it comes to the ideal blood pressure range for seniors.

#### 2.2.2 Type 2 Diabetes Mellitus

Type 2 diabetes mellitus (T2DM) is represented by the raised blood glucose level which can cause macrovascular and microvascular complications over time. The diagnostic criteria as described by Clinical Practice Guidelines (CPG) on management of T2DM 6th edition are fasting blood glucose of  $\geq 7.0$  mmol/L, random blood glucose of  $\geq 11.0$  mmol/L, oral glucose tolerance test of  $\geq 7.0$  mmol/L and HbA1c of  $\geq 6.3\%$ . T2DM has become one of the leading causes of global mortality. The rapid economic growth

and urbanization resulted in the rise of T2DM prevalence (Khan et al., 2020). In Malaysia, the prevalence of T2DM among elderlies was 27.7%, where it is higher compared to other nations (Ab Majid et al., 2020). With older age as one of the contributing factors, the increase in T2DM cases becomes predictable as the population ages and is expected to double over the next 20 years (Yakaryılmaz & Öztürk, 2017). Aging itself plays a part in the pathological process of T2DM such as increasing insulin resistance, impairing beta-cell function and changing the body composition. The latter suggests that higher adiposity in older adults is the main cause of insulin resistance which can be worsened with physical inactivity and poor dietary habits (Bellary et al., 2021). Managing diabetes in elderlies has certain obstacles as there are inconsistencies in their clinical manifestation, psychosocial environment and the availability of resources. Thus, many factors such as age-related conditions and living situation should be taken into consideration when providing treatment for them (Leung et al., 2018).

### 2.2.3 Hyperlipidemia

The American Heart Association defines hyperlipidemia as high lipid level in the blood. This includes low-density cholesterol (LDL) and triglycerides (TG). Individuals with hyperlipidemia have a higher risk of fat deposition in their arteries, especially when accompanied with a low level of high-density cholesterol (HDL), they are more susceptible to atherosclerosis and blockages. The 5th edition of CPG for management of dyslipidemia explained the desirable lipid profile, in which total cholesterol (TC) is less than 5.2 mmol/L, TG is lower than 1.7mmol/L, HDL cholesterol (HDL-C) of more than 1.0 mmol/L and LDL cholesterol (LDL-C) is less than 2.6 mmol/L. A study conducted locally by Chan et al. (2021) found that the prevalence of hyperlipidemia among elderly in Malaysia was 35.6%. As high cholesterol in blood is a known contributing factor to cardiovascular diseases (CVD), it urges screening among the public to determine their

risks and receive the necessary treatment before cardiovascular episodes occur (Nelson, 2013). It is especially significant as hyperlipidemia is not presented with a certain symptom and often goes undiagnosed. The concern goes further for the elderly population. This is because older adults are more susceptible to hyperlipidemia due to environmental and genetic factors as well as co-morbidities. In terms of management, lipid-lowering treatment for elderly includes medications and lifestyle modification such as smoking cessation and physical activity (Felix-Redondo et al., 2013).

#### 2.2.4 Obesity

Obesity is characterised as a Body Mass Index (BMI) of 30 kg/m<sup>2</sup> or above (WHO, 2021). However, there is no precise BMI classification for senior people, as there is mounting evidence that the WHO BMI cut-off is unsuitable for those aged 65 and up (NEMO, 2019). Although, according to CPG 2004, elderly obesity is defined as having a BMI  $\geq 27.5$  kg/m<sup>2</sup>. Obesity, defined as a BMI of 30 kg/m<sup>2</sup> or higher, affects 17.4 percent of Malaysians aged 60 and up, according to the National Health and Morbidity Surveys 2019 (NHMS). A local study by Ariaratnam and colleagues (2020) had also found one-third of elderly in their sample population had obesity (30.2%). Obesity management among the elderly has become a challenge due to concerns about older persons losing weight. This is because weight reduction can have unfavourable or even dangerous consequences, such as insufficient nutrient intake and loss of lean body mass (Porter Starr et al., 2016). The inconsistency leads to a phenomenon known as the "Obesity Paradox," in which elderly people with a higher BMI have certain protective effects such as increased energy reserves and reduced malnutrition risk, but they also have a higher risk of developing metabolic syndrome (McKee & Morley, 2021). Nonetheless, research is being performed to determine the best therapies for senior obesity. According to Bales & Porter Starr (2018), therapies that involve both an exercise programme and a weight-

loss diet can benefit the elderly, particularly in terms of their physical function. As a result, treatments provided by dietitians or clinicians should be investigated further in order to better understand the most common type of intervention used by obese older people.

## **2.3 Factors associated with hypertension, T2DM and hyperlipidemia and the parameters; blood pressure, HbA1c, fasting serum lipid**

### **2.3.1 Sociodemographic**

As previously mentioned, older adults have a higher risk of having NCDs such as hypertension, T2DM and hyperlipidemia. It is partly because the aging process itself can be detrimental in certain aspects. For instance, aging contributes to inflammation and oxidative stress, which relates to vascular dysfunction in hypertension. As a matter of fact, the association of mechanisms between the three is called the “Vascular Health Triad” (Buford, 2017). Apart from that, aging impairs lipid metabolism which affects the release of free fatty acids (FFA) as a result of reduced lipolysis (Suastika et al., 2012). On the other hand, advanced age also induces insulin resistance as stated earlier. In regards to gender, the Ministry of Health (2020) revealed that disease burden of CVD, cancer and T2DM in Malaysian population 2017 is higher among men but higher in women for other forms of NCD. Nonetheless, in the context of the diseases that will be explored in this study, there is a higher prevalence of women with T2DM and hyperlipidemia compared to men. Meanwhile, the proportion of men with hypertension is more than its counterpart. As for ethnicity, each disease is dominated by a different ethnicity in Malaysia. Bumiputera Sarawak had the highest prevalence of hypertension, whereas the prevalence of T2DM is the highest among Indians and Malays had the highest prevalence for hyperlipidemia (NHMS, 2019).

Advanced age also known to be one of the contributing factors of having a below par biomarkers of the diseases. Reducing blood pressure readings become challenging as arterial stiffening and endothelial deterioration from a heightened inflammatory mediators take place (Dai et al., 2015). HbA1c level is also associated with the increasing age, as there is a reduced red blood cell count found among elderly (Wu et al., 2017). Aging may also influence the atherogenic lipid profile as there were findings that it is elevated among female of menopausal age, although male in general tend to have a higher atherogenic lipid profile (Anagnostis et al., 2015). The gender male also inclined to have a higher level of blood pressure compared to its counterpart (Alhawari et al., 2018). As for HbA1c, there are inconclusive findings on the effect of gender. Ethnicity may also influence HbA1c level, as a meta-analysis revealed that Asians tend to have a higher measurement compared to Caucasians (Cavagnoli et al., 2017).

### 2.3.2 Anthropometric

Anthropometric measurements are used to determine an individual's body size. It includes weight and height among other measurements. Body Mass Index (BMI) is one of the methods to measure the body size of an individual through the measurement of weight divided by height, squared. BMI of 25-29.9 kg/m<sup>2</sup> is classified as overweight and 30 kg/m<sup>2</sup> onwards, obese. Obesity is defined as high fat accumulation which results in health risks (WHO, n.d.). It is long known that having excessive body weight is a contributing factor for most NCDs. In regards to hypertension, BMI has shown to be one of the important determinants of high blood pressure. Rabkin et al. (1997) found that the prevalence of hypertension rises as the BMI increases among their study population. The group of the highest BMI has 2 to 3 times greater prevalence compared to its counterpart. It may be explained by the fact that having accumulated adiposity increases the sympathetic nervous activity, thus raising the blood pressure level (Leggio et al., 2017).

Obesity also causes changes in metabolism such as increased hormone, pro-inflammatory and nonesterified fatty acids (NEFAs) secretion by adipose tissues. These in turn, promote beta-cell dysfunction and insulin resistance which eventually develop into T2DM (Al-Goblan et al., 2014). Gupta & Bansal (2020) also found that those with a higher BMI have a higher risk of having an increased blood glucose level. In addition, obesity has been linked with a poor glycemic control which is represented by a higher level of HbA1c (Sheth et al., 2015). An excessive body weight or obesity also induces alterations in adipose tissue composition. It has been linked with adiposopathy which can be described as structural and functional changes in the adipose tissues (Vekic et al., 2019). Other than that, obesity contributes to the impairment in the metabolism of lipoprotein. As a consequence, fasting and postprandial TG level is increased, thus causing other lipid anomalies (Klop et al., 2013).

Nonetheless, there are many other factors that contribute to the development of hypertension, T2DM and hyperlipidemia. For instance, sedentary lifestyle and inappropriate dietary habits. Although, due to limited resources, only two factors; sociodemographic and anthropometric were being observed in this study.

#### **2.4 Role of nutrition intervention in NCD management**

NCD management entails treating the diseases which often include improving the biomarkers such as blood pressure, HbA1c, body weight and fasting serum lipid. Nutrition interventions are a part of the Nutrition Care Process (NCP) that is delivered by dietitians with the sole purpose of enhancing a nutritional problem through education and advice. The counseling provided by dietitians is according to the Medical Nutrition Therapy (MNT) to manage diseases by using individualised nutrition interventions. It is one of the

vital form of treatment in controlling NCDs because nutrition provides a huge impact on an individual's health status.

In relation to managing T2DM, nutrition interventions can aid in controlling glycemic level. With the main goal of lowering glucose level to the near-normal or normal range, monitoring carbohydrate intake and its consistency is one of the most important approaches in MNT. In a systematic review by McArdle and colleagues (2018), they found that there are beneficial effects on HbA1c when carbohydrates are consumed at 50-130g per day. In other studies, weight loss could also contribute to improving HbA1c (Evert et al., 2019). Ramadas et al. (2018) found that HbA1c levels of their participants reduced by 0.5 to 1.5% after receiving dietary intervention. Although, there is not one dietary plan or management that could be applied for all T2DM patients, it indeed can help control glycemic level and delay the development of diabetic complications.

Reducing blood pressure level through nutrition is known to be beneficial especially because it can prevent the adverse outcome of cardiovascular episodes. Dietary Approach to Stop Hypertension (DASH) is one of the well-established dietary interventions in managing hypertension, regardless of age. With the principle of increasing fruits and vegetables intake, low-fat dairy products and limiting saturated fat intake, DASH has proven to be effective in lowering blood pressure level (Appel et al., 1997). Another approach that has shown success in reducing systolic blood pressure (SBP) by 11.4 mm/Hg and diastolic blood pressure (DBP) by 5.5 mm/Hg in older adults is limiting sodium consumption along with reducing body weight, specifically for those with excessive body weight (Whelton et al., 1998). In addition, consistent physical activity could also improve SBP and DBP of an elderly (Acelajado, 2010).

MNT is also widely applied in hyperlipidemia management. Prescription of low-fat diets has shown to be beneficial and able to reduce LDL cholesterol level and total cholesterol. Limiting saturated fat and increasing monounsaturated fat intake are also encouraged to improve HDL-C level (Kelly, 2010). Academy of Nutrition and Dietetics recommends fiber intake through whole grains, fruits and vegetables, nuts and legumes as it is also vital in reducing the risk of cardiovascular diseases that could arise from having undesirable lipid profile (Dahl & Stewart, 2015). On the other hand, a study by Schumacher et al. (2016) found that dietary counseling by dietitians is able to reduce the total cholesterol ( $-0.51$  mmol/L), total:HDL ratio ( $-0.27$  mmol/L), triglycerides ( $-0.38$  mmol/L), although the sample size is small.

In the context of elderly obesity, as previously discussed, the effect of weight loss may cause detrimental effects. Nonetheless, there are findings that show beneficial effects of caloric restriction for older adults. For instance, improve physical function and the quality of life, though most of it does not represent the whole elderly population as they only explored the intervention among younger seniors (Goisser et al., 2020). Despite the well-known “obesity paradox”, The European Society for Clinical Nutrition and Metabolism (ESPEN) developed an updated guideline for managing elderly obesity according to the literature as of 2016. They recommend that weight loss intervention be prescribed for elderly with more than  $30 \text{ kg/m}^2$  and present with morbidity related to excessive weight (Volkert et al., 2018).

With regards to dietary interventions in managing NCDs in general, evidences have shown that it can be beneficial for the patients. More studies have also found that it is also clinically and cost effective. Meta-analyses and a position paper by the Academy of Nutrition and Dietetics have revealed that nutrition care provided by dietitian are able

to improve lipid profile, body weight, BMI, HbA1c, malnutrition, quality of life, aside from delaying the progression of diseases as well as reducing the use of medications and cut costs of hospitalization (Briggs Early & Stanley, 2018; Howatson et al., 2015; Sikand et al., 2018).



## CHAPTER 3

### METHODOLOGY

#### 3.1 Study design

This study was a retrospective study which utilised data from January 2019 until May 2022 among elderly outpatients in dietetic clinic HPUPM. The aim was to observe changes in parameters of blood pressure, HbA1c, fasting serum lipid and body weight during their second and third visit to the dietetic clinic.

#### 3.2 Study location

This study was conducted at Dietetic Clinic Hospital Pengajar Universiti Putra Malaysia (HPUPM), a newly established facility with gerontology niche area.

#### 3.3 Participants

Participants were elderly outpatients of dietetic clinic HPUPM. Those who fulfilled the inclusion were selected for this study.

##### 3.3.1 Inclusion criteria

1. Malaysian citizen
2. Aged 60 years and above
3. Had at least one condition; Hypertension, Type 2 Diabetes Mellitus or Hyperlipidemia

4. Elderly patients who were referred to dietitian from January 2019 until May 2022

### 3.4 Sample size

This study used the paired t-test sample size formula for clinical research in order to determine its own sample size (Kohn & Senyak, 2022).

Formula:

$$N = [(Z_{\alpha} + Z_{\beta}) / C]^2$$

where

$$C = (E/S_{\Delta})^2$$

$S_{\Delta}$  = Standard Deviation of the change in the outcome

E = Effect size (Cohen's d)

$Z_{\alpha}$  = Standard normal deviate for  $\alpha = 1.9600$

$Z_{\beta}$  = Standard normal deviate for  $\beta = 0.8416$

**Table 3.1 Sample size calculation**

| Studies                                                                                                                                                                                                                                                                                       | $S_{\Delta}$                                                  | E                                    | Sample size, n           |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------|--------------------------------------|--------------------------|
| A mobile phone-based health coaching intervention for weight loss and blood pressure reduction in a national payer population: A retrospective study<br>(Mao et al., 2017)                                                                                                                    | SBP:1.64                                                      | 3.92                                 | 2                        |
| Diabetes self-management education and medical nutrition therapy: A multisite study documenting the efficacy of registered dietitian nutritionist interventions in the management of glycemic control and diabetic dyslipidemia through retrospective chart review<br>(Marincic et al., 2018) | HbA1c: 2.80<br>TC: 1.03<br>TG: 0.45<br>LDL: 0.83<br>HDL: 0.21 | 0.86<br>0.92<br>1.72<br>0.93<br>0.18 | 84<br>10<br>1<br>7<br>11 |

The largest sample size from the calculation was 84 subjects. However, this study was a retrospective study, whereby missing data was anticipated. Therefore, 84 subjects was the minimum sample size.

### 3.5 Sampling design

Sampling design for this study was convenient sampling in which elderly patients of dietetic clinic HPUPM from January 2019 to May 2022 became the sample of this study. Then, inclusion criteria was applied to the sample, so that only cases that satisfy the needed criteria could be studied.

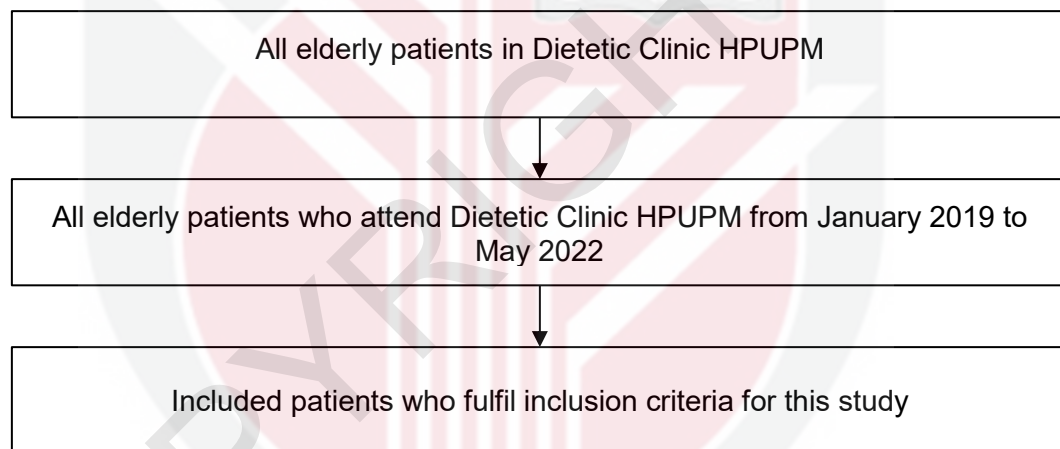


Figure 3.1 Sampling process

### 3.6 Study instrument

Instrument that was used for this study was an Information Recording Form (Refer to Appendix). This instrument was divided into two parts; Part A that gathers information on the participants' background and Part B, records the parameters of blood pressure, HbA1c, fasting serum lipid and body weight of the participants on each visit. These parameters were of those that has been documented by dietitians in the Dietetic

Care Notes or retrieved from their computerized medical records. The said parameters were representing the dietetic outcomes.

### **3.7 Procedure**

Ethical approval was obtained from the Ethics Committee for Research Involving Human Subjects of Universiti Putra Malaysia (JKEUPM). Afterwards, the permission to conduct data collection in HPUPM was applied with the endorsement from the head of Department of Dietetic. Subsequently, data collection began after receiving the permission. It was done within a month's duration, from May to June 2022. With the inclusion criteria set, the data was chosen and recorded in the Information Recording Form. Dietetic Care Notes documentation by dietitians and the electronic medical records system of HPUPM were the two sources of this study. The subjects' personal information such as name and National Registration Identity Card Number (NRIC) were remained private. Only their Medical Record Number (MRN) were recorded in order to identify the patients. Their MRN were also utilised in referring the computerized medical records system. To maintain the integrity, only information relevant to this study were being recorded. Data analysis was done after completing the data collection process.

### **3.8 Data analysis**

Statistical Package for Social Science (SPSS) version-26 was utilised for data analysis in this study. Descriptive statistics was used to obtain the numerical and categorical data of variables such as sociodemographic, anthropometric and clinical status of the study population. It was also used to assess the parameters of blood pressure, fasting serum lipid, HbA1c and body weight of the elderly patient. On the other hand, paired t-test was used to assess the mean changes in mentioned parameters between interventions.

## CHAPTER 4

### RESULTS

#### 4.1 Sociodemographic characteristics

The total number of sample obtained from the systems were 165 and each patient were included in this study. This is because missing data was anticipated.

The sociodemographic characteristics of the elderly patients in dietetic clinic HPUPM are summarised in Table 4.1. The range age of the patients was 60 to 83 years old, whereas the mean age was  $66 \pm 5$  years. Most of them were male which made up 52.7% of the patients. Ethnicity-wise, Malay was the majority among the patients (88.5%) while Chinese and Indian made up 6.7% and 4.8% respectively.

**Table 4.1 Sociodemographic characteristics of elderly patients in dietetic clinic HPUPM (n=165)**

| Characteristics     | n (%)      | Mean $\pm$ SD    | Min-max |
|---------------------|------------|------------------|---------|
| Age                 |            | 65.98 $\pm$ 5.35 | 60-83   |
| 60-74 years old     | 147 (89.1) |                  |         |
| $\geq 75$ years old | 18 (10.9)  |                  |         |
| Gender              |            |                  |         |
| Male                | 87 (52.7)  |                  |         |
| Female              | 78 (47.3)  |                  |         |
| Ethnicity           |            |                  |         |
| Malay               | 146 (88.5) |                  |         |
| Chinese             | 11 (6.7)   |                  |         |
| Indian              | 8 (4.8)    |                  |         |

## 4.2 Anthropometric measurements

Table 4.2 shows the anthropometric measurements of the subjects in this study. The average body weight was  $70.48 \pm 12.63$  kg and mean height was  $158.63 \pm 7.96$  cm. As for Body Mass Index (BMI), the mean was  $28 \pm 4.28$  kg/m<sup>2</sup>. More than half of the subjects were found to have a healthy body weight (52.1%), whereas almost one third were overweight (28.5%) and those among them who were underweight consisted of 9.7%.

**Table 4.2 Anthropometric measurements of elderly patients in dietetic clinic HPUPM (n=160)**

| Measurements                         | n (%)     | Mean $\pm$ SD     |
|--------------------------------------|-----------|-------------------|
| Body weight (kg)                     |           | $70.48 \pm 12.63$ |
| Height (cm)                          |           | $158.63 \pm 7.96$ |
| Body Mass Index (kg/m <sup>2</sup> ) |           | $28.00 \pm 4.28$  |
| Underweight (<23)                    | 16 (9.7)  |                   |
| Healthy Weight (24-30)               | 86 (52.1) |                   |
| Overweight (>30.0)                   | 47 (28.5) |                   |

## 4.3 Clinical status of patients

Table 4.3 shows the medical diagnosis of the patients who received treatments from dietitians. Majority of the patients (39.4%) had diagnosed with all three diseases, diabetes, hypertension and hyperlipidemia.

**Table 4.3 Clinical status of elderly patients in dietetic clinic HPUPM (n=165)**

| Characteristics | n (%)     |
|-----------------|-----------|
| DM              | 5 (3.0)   |
| HTN             | 8 (4.8)   |
| HPL             | 20 (12.1) |
| DM + HTN        | 20 (12.1) |
| DM + HPL        | 15 (9.1)  |
| HTN + HPL       | 32 (19.4) |
| DM + HTN + HPL  | 65 (39.4) |

*DM = diabetes mellitus, HTN = hypertension, HPL = hyperlipidemia*

#### **4.4 Parameters of blood pressure, fasting serum lipid, HbA1c and body weight of the patients**

Table 4.4 presents the average measurement of blood pressure, HbA1c, lipid profile and body weight at baseline, second visit and third visit to a dietitian. Meanwhile, Table 4.5 summarizes the overall mean of the parameters with those at an uncontrolled level.

**Table 4.4 Parameters of blood pressure, fasting serum lipid, HbA1c and body weight of the patients at baseline, second visit and third visit to a dietitian**

| Parameters                   | Baseline |                    | 2nd visit |                    | 3rd visit |                   |
|------------------------------|----------|--------------------|-----------|--------------------|-----------|-------------------|
|                              | n        | Mean $\pm$ SD      | n         | Mean $\pm$ SD      | n         | Mean $\pm$ SD     |
| HbA1c (%)                    | 104      | 7.35 $\pm$ 1.76    | 43        | 7.34 $\pm$ 1.42    | 9         | 7.42 $\pm$ 0.75   |
| Blood pressure (mmHg)        | 113      |                    | 26        |                    | 3         |                   |
| Systolic                     |          | 134.80 $\pm$ 17.62 |           | 142.19 $\pm$ 15.55 |           | 136.00 $\pm$ 9.54 |
| Diastolic                    |          | 71.42 $\pm$ 12.10  |           | 72.73 $\pm$ 11.07  |           | 71.00 $\pm$ 9.64  |
| Fasting serum lipid (mmol/L) | 124      |                    | 53        |                    | 19        |                   |
| Total cholesterol            |          | 4.93 $\pm$ 1.34    |           | 4.68 $\pm$ 1.38    |           | 4.68 $\pm$ 1.27   |
| Triglycerides                |          | 1.78 $\pm$ 1.36    |           | 1.63 $\pm$ 0.75    |           | 1.75 $\pm$ 0.77   |
| LDL-C                        |          | 2.84 $\pm$ 1.22    |           | 2.74 $\pm$ 1.23    |           | 2.63 $\pm$ 1.14   |
| HDL-C                        |          | 1.31 $\pm$ 0.34    |           | 1.31 $\pm$ 0.30    |           | 1.32 $\pm$ 0.37   |
| Body weight (kg)             | 161      | 70.66 $\pm$ 13.01  | 50        | 70.35 $\pm$ 12.74  | 5         | 61.28 $\pm$ 9.14  |

**Table 4.5 Overall mean of the parameters of blood pressure, fasting serum lipid, HbA1c of the patients with the percentage of those with uncontrolled level (n=165)**

| Parameters                      | n (%)     | Mean $\pm$ SD      |
|---------------------------------|-----------|--------------------|
| HbA1c (>6.5%)                   | 64 (38.8) | 7.23 $\pm$ 1.52    |
| Blood pressure                  |           |                    |
| Systolic (>140 mmHg)            | 36 (21.8) | 134.96 $\pm$ 16.08 |
| Diastolic (>90 mmHg)            | 3 (1.8)   | 71.49 $\pm$ 11.13  |
| Fasting serum lipid             |           |                    |
| Total cholesterol (>5.2 mmol/L) | 39 (23.6) | 4.75 $\pm$ 1.20    |
| Triglycerides (>1.7 mmol/L)     | 41 (24.8) | 1.70 $\pm$ 1.20    |
| LDL-C (>2.6 mmol/L)             | 58 (35.2) | 2.73 $\pm$ 1.07    |
| HDL-C (<1.0 mmol/L)             | 13 (7.9)  | 1.31 $\pm$ 0.32    |

## 4.5 Hypothesis testing

### 4.5.1 Changes in blood pressure

Table 4.6 shows the changes in blood pressure at follow up 1 and 2 to dietitians among patients with hypertension. There were no significant changes found in both systolic and diastolic at the two follow ups. The sample size (n) at the second follow up was only 3, which may not satisfy the sampling distribution for the paired t-test.

**Table 4.6 Changes in blood pressure at follow up 1 and follow up 2 among the subjects**

| Parameters              | n  | Mean $\pm$ SD      | t-value | p-value |
|-------------------------|----|--------------------|---------|---------|
| <b>Systolic (mmHg)</b>  |    |                    |         |         |
| Follow up 1             | 26 |                    | -0.299  | 0.767   |
| 1st visit               |    | 140.92 $\pm$ 21.88 |         |         |
| 2nd visit               |    | 142.19 $\pm$ 15.55 |         |         |
| Follow up 2             | 3  |                    | -       | -       |
| 2nd visit               |    | 136.00 $\pm$ 9.54  |         |         |
| 3rd visit               |    | 136.00 $\pm$ 9.54  |         |         |
| <b>Diastolic (mmHg)</b> |    |                    |         |         |
| Follow up 1             | 26 |                    | -0.136  | 0.893   |
| 1st visit               |    | 72.35 $\pm$ 14.91  |         |         |
| 2nd visit               |    | 72.73 $\pm$ 11.07  |         |         |
| Follow up 2             | 3  |                    | -1.000  | 0.423   |
| 2nd visit               |    | 70.33 $\pm$ 8.51   |         |         |
| 3rd visit               |    | 71.00 $\pm$ 9.64   |         |         |

### 4.5.2 Changes in fasting serum lipid

Table 4.7 shows the changes in fasting serum lipid at follow up 1 and 2 to dietitians among patients with hyperlipidemia. There were significant changes found in total cholesterol (t=3.754, p<0.001), triglycerides (t=2.242, p=0.029) and LDL-C (t=2.951, p=0.005) at the first follow up. The sample size (n) at the second follow up was less than

30 for each lipid component, which may not satisfy the sampling distribution for the paired t-test.

**Table 4.7 Changes in fasting serum lipid at follow up 1 and follow up 2 among the subjects**

| Parameters                        | n  | Mean $\pm$ SD   | t-value | p-value |
|-----------------------------------|----|-----------------|---------|---------|
| <b>Total cholesterol (mmol/L)</b> |    |                 |         |         |
| Follow up 1                       | 53 |                 | 3.754   | <0.001* |
| 1st visit                         |    | 5.39 $\pm$ 1.48 |         |         |
| 2nd visit                         |    | 4.68 $\pm$ 1.38 |         |         |
| Follow up 2                       | 18 |                 | 0.312   | 0.759   |
| 2nd visit                         |    | 4.81 $\pm$ 1.45 |         |         |
| 3rd visit                         |    | 4.73 $\pm$ 1.29 |         |         |
| <b>Triglycerides (mmol/L)</b>     |    |                 |         |         |
| Follow up 1                       | 53 |                 | 2.242   | 0.029*  |
| 1st visit                         |    | 1.92 $\pm$ 1.26 |         |         |
| 2nd visit                         |    | 1.63 $\pm$ 0.75 |         |         |
| Follow up 2                       | 27 |                 | 1.597   | 0.122   |
| 2nd visit**                       |    | 0.19 $\pm$ 0.21 |         |         |
| 3rd visit**                       |    | 0.15 $\pm$ 0.19 |         |         |
| <b>LDL-C (mmol/L)</b>             |    |                 |         |         |
| Follow up 1                       | 51 |                 | 2.951   | 0.005*  |
| 1st visit                         |    | 3.21 $\pm$ 1.39 |         |         |
| 2nd visit                         |    | 2.70 $\pm$ 1.23 |         |         |
| Follow up 2                       | 18 |                 | 0.150   | 0.883   |
| 2nd visit                         |    | 2.67 $\pm$ 1.34 |         |         |
| 3rd visit                         |    | 2.63 $\pm$ 1.14 |         |         |
| <b>HDL-C (mmol/L)</b>             |    |                 |         |         |
| Follow up 1                       | 53 |                 | -0.103  | 0.918   |
| 1st visit                         |    | 1.31 $\pm$ 0.35 |         |         |
| 2nd visit                         |    | 1.31 $\pm$ 0.30 |         |         |
| Follow up 2                       | 17 |                 | -0.421  | 0.680   |
| 2nd visit                         |    | 1.29 $\pm$ 0.28 |         |         |
| 3rd visit                         |    | 1.32 $\pm$ 0.37 |         |         |

\*Statistically significant at  $p < 0.05$

\*\*Data treated with log10

#### 4.5.3 Changes in HbA1c

Table 4.8 shows the changes in HbA1c at follow up 1 and 2 to dietitians among patients with hypertension. There were no significant changes found in both follow ups. The sample size (n) at the second follow up was only 8, which may not satisfy the sampling distribution for the paired t-test.

**Table 4.8 Changes in HbA1c (%) at follow up 1 and follow up 2 among the subjects**

| Variables   | n  | Mean $\pm$ SD   | t-value | p-value |
|-------------|----|-----------------|---------|---------|
| Follow up 1 | 43 |                 | 1.757   | 0.086   |
| 1st visit   |    | 7.78 $\pm$ 1.84 |         |         |
| 2nd visit   |    | 7.34 $\pm$ 1.42 |         |         |
| Follow up 2 | 8  |                 | 0.745   | 0.480   |
| 2nd visit   |    | 8.09 $\pm$ 1.95 |         |         |
| 3rd visit   |    | 7.48 $\pm$ 0.78 |         |         |

#### 4.5.4 Changes in body weight

Table 4.9 presents the changes in body weight at follow up 1 and 2 to dietitians among the patients. There were no significant changes found in both follow ups. The sample size (n) at the second follow up was only 5, which may not satisfy the sampling distribution for the paired t-test.

**Table 4.9 Changes in body weight (kg) at follow up 1 and follow up 2 among the subjects**

| Variables   | n  | Mean $\pm$ SD     | t-value | p-value |
|-------------|----|-------------------|---------|---------|
| Follow up 1 | 50 |                   | 1.623   | 0.111   |
| 1st visit   |    | 71.51 $\pm$ 14.62 |         |         |
| 2nd visit   |    | 70.35 $\pm$ 12.74 |         |         |
| Follow up 2 | 5  |                   | 0.513   | 0.635   |
| 2nd visit   |    | 61.78 $\pm$ 7.50  |         |         |
| 3rd visit   |    | 61.28 $\pm$ 9.14  |         |         |

#### 4.5.5 Percentage of changes in the parameters

Table 4.10 presents the percentage of changes in the parameters at follow up 1 and 2. The percentage of changes is calculated by subtracting the measurement of the parameters at their latest visit with the measurement at the previous visit. The value was then divided by the previous measurement, and finally multiplied with 100%  $[(X_2 - X_1)/X_1 \times 100\%]$ . The negative value of the percentages show reduction in the parameters. Table 4.11 shows the difference between the significant changes in total cholesterol, triglycerides and LDL-C between the two follow ups. These differences were analysed using paired t-test analysis to determine the significant changes between follow ups. It can be seen that none of the changes in said parameters had significant differences. Whereas Figure 4.1 illustrates the changes in total cholesterol, triglycerides and LDL-C between the two follow ups.

**Table 4.10 Percentage of changes in the parameters at each follow up**

| Variables                    | Follow up 1<br>(% of change) | Follow up 2<br>(% of change) |
|------------------------------|------------------------------|------------------------------|
| Blood pressure (mmHg)        |                              |                              |
| Systolic                     | 2.36                         | -                            |
| Diastolic                    | 2.46                         | 0.83                         |
| Fasting serum lipid (mmol/L) |                              |                              |
| Total cholesterol            | -10.51                       | 0.40                         |
| Triglycerides                | -4.76                        | -7.96                        |
| LDL-C                        | -10.14                       | 6.25                         |
| HDL-C                        | 7.14                         | 2.06                         |
| HbA1c (%)                    | -3.06                        | -3.57                        |
| Body weight (kg)             | -1.17                        | -1.07                        |

**Table 4.11 Comparison of the significant changes in total cholesterol, triglycerides and LDL-C between follow up 1 and 2**

| Variables                  | Follow up 1  | Follow up 2 | t-value | p-value |
|----------------------------|--------------|-------------|---------|---------|
| Total cholesterol (mmol/L) | -8.4 ± 24.2  | 0.4 ± 18.1  | -0.990  | 0.336   |
| Triglycerides (mmol/L)     | 4.9 ± 36.6   | -8.0 ± 32.3 | 1.118   | 0.279   |
| LDL-C (mmol/L)             | -15.5 ± 36.4 | 6.6 ± 38.1  | -1.410  | 0.178   |

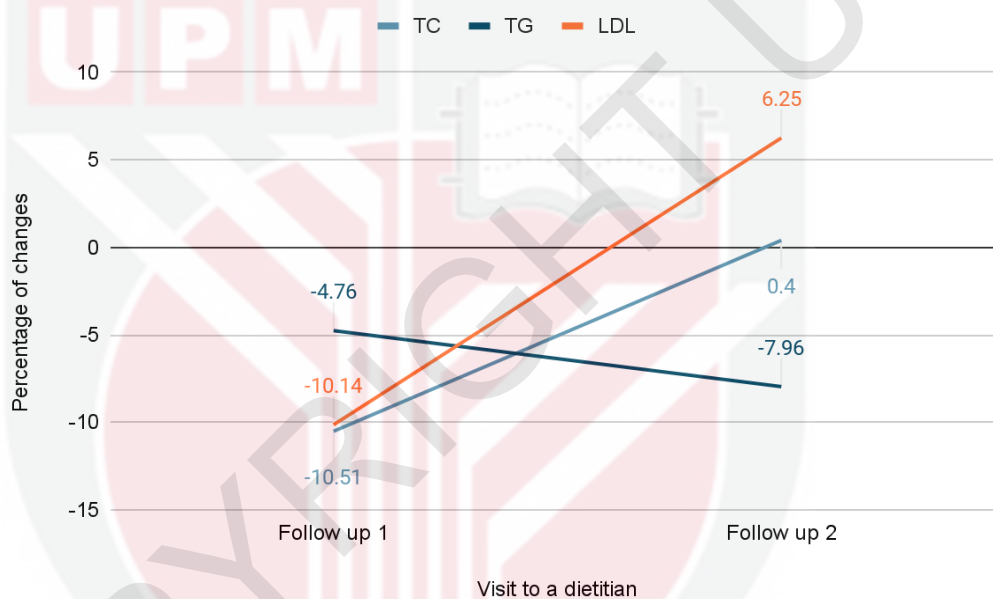


**Figure 4.1 Percentage of changes at follow up 1 and 2**

## CHAPTER 5

### DISCUSSION

#### 5.1 Sociodemographic characteristics

The mean age among the elderlies in this study was 66 years old, almost similar to the mean age from NHMS ( $68.30 \pm 6.95$  years) (NHMS, 2018). In terms of ethnicity, Malay was the majority among the patients, 88.5%. Since Malay is the largest ethnic group in the country, it is plausible that many of them receive treatment at a public hospital. According to NHMS 2019, approximately 70% of patients who seek an outpatient treatment from the public hospital are Malay. Another local study conducted by Chin et al. (2020), found that Malay is the majority among those who receive treatment in public sector hospitals, with 62.9%. However, both studies did not isolate the proportion of elderly patients in the study.

#### 5.2 Anthropometric measurements

The subjects in this study had a mean Body Mass Index (BMI) of  $28.00 \pm 4.28$  kg/m<sup>2</sup> with the majority of them in the healthy weight category or within 24 to 30 kg/m<sup>2</sup> (52.1%). Similar to a local study that was conducted among the senior citizen, as a part of a study called the Malaysian Health and Well-Being Assessment (My-HEBAT), there are 55.5% who have BMI within 23 to 29.9 kg/m<sup>2</sup> (Kyaw et al., 2022). According to the WHO BMI classification, the range indicates overweight and pre-obese. Nonetheless, the categorization in this study was according to the NEMO Queensland (2017), where it differs from the WHO BMI cut-off as elderlies were found to be at risk of mortality with a

BMI lower than 23 and higher than 33 (Winter et al., 2014). Although, many studies refer to the WHO classification or CPG 2004 guidelines to categorize the BMI. It shall be noted that standardization of BMI cut-off for research among elderly is still lacking.

### **5.3 Clinical status**

Many of the elderly patients at the dietetic clinic were found to have multimorbidities (39.4%) that include all three diseases. It was less common to only have diagnosed with one disease, whereby 19.9% had singular disease; be it diabetes, hypertension or hyperlipidemia. However, there were also a large proportion of those with two diseases (40.7%). In contrast to a local study, majority of the sample had only one of the diseases (59%), whereas the proportion of those who had been diagnosed with all three diseases were only 8.1% (Jamal et al., 2015). Their study however, recruited adult of 35 to 70 years old. As their study did not put the focus on elderly, the differences in the findings may be explained by the age of the samples. Apart from the physiological changes that occur with aging, older adults may also have been diagnosed with multidiseases as they tend to have a routine medical check-up (Adams, 2017). Meanwhile among the younger adults, specifically in Malaysia, they are inclined to have different priorities other than their health, such as life stresses (Norris et al., 2014).

### **5.4 Parameters of blood pressure, HbA1c and fasting serum lipid**

More than one-third of the patients have uncontrolled HbA1c (38.8%) and LDL-C (35.2%). Consistent with findings from a local study by Sazlina et al. (2015) and a study from China conducted by Zhu and colleagues (2019), there were more than 30% rate of uncontrolled HbA1c level among the elderly in their studies population. Poor glycemic control with respect to a high level of HbA1c, may be explained by the advanced age itself. As found by a previous study, there is a correlation between age and the level of

HbA1c (Dubowitz et al., 2014). HbA1c measurement is highly related with the life span of red blood cell (RBC). However, RBC life expectancy has shown to be influenced by a certain aging-related changes such as hematopoietic system, thus affecting the measurement of HbA1c among older adults (Masuch et al., 2019). Aside from that, having multi-morbidities such as hypertension and/or dyslipidemia is common among the patients in this study. On that matter, the presence of the two diseases were linked with poor glycemic control as well as disturbed insulin metabolism (Haghighatpanah et al., 2018). As a further explanation, a simultaneous development of these chronic diseases increase the chances of exacerbation and degeneration of vital organs (Espinosa et al., 2021). As for the findings related to the LDL cholesterol in this study, it is known that LDL-C level escalation is common among elderly. This is due to the rate of LDL-C clearance from the circulation gradually decreases as age increases (Morgan et al., 2016). Although, more information has emerged and revealed that a raised level of LDL cholesterol do not necessarily linked with death among older adults. In fact, the findings call for further research on the appropriate level of plasma lipid for the elderly as it is ought to be distinctive from the general adult population (Ravnskov et al., 2016; Wang et al., 2019).

In regards to blood pressure measurement and other components of lipid profile, there were relatively low number of uncontrolled cases. This may be because many of the patients were taking antihypertensive and lipid lowering drugs which have shown to be effective in managing the blood pressure level as well as lipid profile. As compared to diabetes, even with prescribed medications, there may have been much more challenges and complexity in its treatment due to the physiology of the disease itself. For example, it disrupts the energy pathway that is highly influenced by dietary intake like inconsistent

carbohydrate diets. Furthermore, these detrimental diets can cause fluctuations in blood sugar level, which would indicate poor glycemic control.

### **5.5 Changes in parameters of blood pressure, HbA1c and fasting serum lipid**

There are no significant changes in systolic and diastolic blood pressure between follow ups. These findings are similar to a cluster-randomized trial that shows insignificant reduction in blood pressure measurements after the subjects received lifestyle interventions that include dietary and eating behaviour modifications (Höchsmann et al., 2021). In elderly population, arterial stiffening is one of the common ageing effects which challenges blood pressure lowering (Benetos et al., 2019). This may explain the findings of this study as well as the randomized trial. Many of the patients in this study also did not show changes in their measurement of blood pressure, due to latest of that, not being measured and recorded at each visit. These in turn produce a statistical result that may not be representative of their actual progress. The missing data in this parameter should have been taken into consideration during data analysis. In order to obtain a more accurate result, only those subjects with a complete measurement of their blood pressure should be included in this study.

As for the fasting serum lipid, there are significant changes found in total cholesterol, triglycerides and LDL-C at the first follow up while there are no significant changes in HDL-C in both follow ups. The changes of the lipid profile parameters upon receiving nutrition care in this study were inconsistent with a previous study conducted in Brazil, whereby, only the changes in triglycerides and total cholesterol from baseline were significant (Del Razo-Olvera et al., 2021). However, of noteworthy, the barriers in adhering to a nutrition plan were addressed, and a structured dietary intervention was provided in the study. On the other hand, a meta-analysis has also revealed a similar

finding to this study whereby dietary counseling by dietitians are able to reduce the total cholesterol, triglycerides and LDL-C ( $p < 0.05$ ) whereas HDL-C has no significant changes (Mohr et al., 2022). Although, this study is highly predisposed to such changes due to the use of lipid-lowering medications such as statins. Many of the patients in this study were prescribed with and consumed such drugs, which can contribute significantly to the changes in their lipid profile parameters, statistically. Therefore, the findings in this study may only partly reflect the outcome of the nutrition intervention provided by the dietitians. The variation in the results may also be due to the comorbidities of this study population may have. As previously discussed, the development of these chronic diseases affects each other physiologically. Consequently, it challenges the progress of improving the parameters of lipid profile.

Aside from that, there are no significant changes in body weight among the patients after the first visit. This can be explained as weight management was often not the main goal when providing nutrition intervention for the elderly patients in this study. This is because advanced age comes with a high risk of mortality (ESPEN, 2019). Older adults are also susceptible to sarcopenia and malnutrition with unnecessary weight loss (Coker & Wolfe, 2017).

There are also no significant changes found in HbA1c among the patients after the first visit. In contrast to a local study, HbA1c significantly improved after receiving individualized nutrition intervention that accompanied with structured meal plans and weekly phone support by dietitians ( $p < 0.001$ ) (Mottalib et al., 2018). However, the study was inclusive of individuals aged less than 60 years, indicating that they did not focus on elderly patients. The findings may differ because the physiological changes of the older adults can influence the outcome of HbA1c. This finding may also be explained by the

short duration of this study. The duration of data collection was only one month, which may have eliminated the potential changes in the subjects' HbA1c at their future follow-ups to the dietitian. It may suggest that the duration was not sufficient in order to observe significant changes, especially because different patients may have different interval between follow-ups. In reality, there are limited number of dietitians in the clinic and they may only see a limited number of patients in a day. Often times, the appointment slots were fully booked and patients may need to wait longer for their follow-up visits. In addition, HbA1c is only able to reflect the cumulative glycemic history of the previous two to three months (Sherwani et al., 2016) and this makes the measurement of HbA1c scarce compared to the other blood tests in this study.

Some of the parameters had shown an improvement where there were 4 to 10% reduction from their baseline measurements. The reduction can be seen in total cholesterol (-10.51%), LDL-C (-10.14%) and triglycerides (-4.76%). Evidently, lipid-lowering medications are able to aid hyperlipidemic patients to improve their lipid profile, specifically LDL-C by 25 to 61% (Feingold, 2021; Nawrocki et al., 1995) and thus reducing the cardiovascular incident by 16 to 22% among the elderly group (Feingold, 2021). However, in this study, these parameters were not constantly reduced which can be seen at the second follow up. In fact, the three parameters increased. Although, the changes were not statistically significant ( $p > 0.05$ ) in which total cholesterol at  $p = 0.336$ , triglycerides at  $p = 0.279$  and LDL-C at  $p = 0.178$ . Some of the factors that may contribute to the fluctuations in the findings were dietary alterations. As this study included the duration of festivities like Ramadan fasting and eid, the patients may have not been able to maintain their dietary pattern. Instead, it may become highly challenging for them to adhere to dietary advice as well as comply with their medications. There was also a local study that found higher intake of fat among Malaysian Muslim during the fasting month

(Osman et al., 2020). Behavioural factors may also disrupt the sustenance of lipid profile (de Souza et al., 2015). As an example, patients who refused to stop smoking often have difficulties in improving their lipid profile.

Overall, the changes in the parameters may be affected by the presence of comorbidities as well as the use of medications. Many confounding factors may have altered the outcome of the parameters which have been intervened by dietitians. This would explain that other types of treatments are also as important in order to prevent the progression of the non-communicable diseases. However, nutrition care must not be disregarded since it is able to help patients modify their lifestyle and allow patients to get the best quality of life.

## CHAPTER 6

### CONCLUSION

#### 6.1 Conclusion

This study has found some positive dietetic outcomes, as defined by the outcome of anthropometric measurements and biochemical data as well as blood pressure readings, as per previously stated. Although, the outcomes were influenced by many factors such as the presence of comorbidities and the use of medications, aside from the nutrition intervention provided by dietitians. As for the research hypothesis, this study fails to accept the alternative hypothesis, as there are no significant changes found in the blood pressure, fasting serum lipid, HbA1c and body weight among elderly patients in the second and third visit to a dietitian. Despite the hypothesis, there are also statistically significant findings in the total cholesterol, triglycerides and LDL cholesterol after receiving dietary counseling from a dietitian at their first follow-up visit.

Although the changes did not persist at the consequent follow-up, it is worth noting that nutritional care can be beneficial in managing non communicable diseases. Moreover, it does play a part in improving the clinical status of the patients and slowing down the disease progression. Nevertheless, this study was not able to produce a conclusive finding related to the effects of nutrition intervention on the biomarkers of the diseases. In addition, many of the available research guidelines as well as clinical recommendations do not specify for older adults. Most of the guidelines were designed to encompass the general adult population.

## 6.2 Limitations

This study has some limitations. To observe dietetic outcomes, it might be more notable to discuss and relate the outcomes with the type of nutrition intervention provided. It would be useful because it would provide a more in-depth information or explanation related to the findings. Apart from that, this study was conducted within a short period of time which may not be sufficient to represent the outcome of dietary counseling by the dietitians. A longer period of data collection may be able to include further changes in the measurements of the parameters. On the other hand, this study is also a retrospective study where it is subjected to biases. Confounding factors were also not being adjusted, thus affecting the findings and causing volatility in the outcomes. The most apparent example was the disease itself. As non-communicable diseases are known to be related to one another, the findings of this may not produce the most valid conclusion. In terms of the data collection, there may also be misinterpretation as the information recording system at the study location is dependent on handwritten notes. The duration or gaps between visits were also not being recorded or taken into consideration which can also influence the changes in the parameters.

## 6.3 Recommendations

This study calls for more research on dietetic outcomes upon receiving dietary intervention, especially among elderly. As there are limited studies done locally, it is recommended that future studies observe the outcomes using longitudinal cohort methods which would provide a higher level of evidence and more reliable inferences. It would also be more significant with a large scale of study that includes patients of dietetic clinics in private and public institutions. For future research recommendations, this study could be improved by adjusting the data as it was collected secondarily. To achieve a

more homogenous sample and increase the generalizability, only subjects with similar gaps between visit, without co-morbidities and without medications shall be included.



## REFERENCES

- Ab Majid, N. L., Rodzlan Hasani, W. S., Mat Rifin, H., Robert Lourdes, T. G., Jane Ling, M. Y., Saminanthan, T. A., Ismail, H., Ahmad, A., & Mohd Yusoff, M. F. (2020). Self-reported diabetes, hypertension and hypercholesterolemia among older persons in Malaysia. *Geriatrics & Gerontology International*, 20(S2), 79–84. <https://doi.org/10.1111/ggi.13968>
- Abdul-Razak, S., Daher, A. M., Ramli, A. S., Ariffin, F., Mazapuspavina, M. Y., Ambigga, K. S., Miskan, M., Abdul-Hamid, H., Mat-Nasir, N., Nor-Ashikin, M. N., Ng, K. K., Nawawi, H., & Yusoff, K. (2016). Prevalence, awareness, treatment, control and socio demographic determinants of hypertension in Malaysian adults. *BMC Public Health*, 16(1). <https://doi.org/10.1186/s12889-016-3008-y>
- Academy of Nutrition and Dietetics: Scope of practice for the registered dietitian. (2013). *Journal of the Academy of Nutrition and Dietetics*, 113(6). <https://doi.org/10.1016/j.jand.2012.12.008>
- Acelajado, M.C. (2010). Optimal management of hypertension in elderly patients. *Integrated Blood Pressure Control*, 145. <https://doi.org/10.2147/ibpc.s6778>
- Adams, M. L. (2017). Differences between younger and older US adults with multiple chronic conditions. *Preventing Chronic Disease*, 14. <https://doi.org/10.5888/pcd14.160613>
- Al-Goblan, A. S., Al-Alfi, M. A., & Khan, M. Z. (2014). Mechanism linking diabetes mellitus and obesity. *Diabetes, metabolic syndrome and obesity: Targets and therapy*, 7, 587–591. <https://doi.org/10.2147/DMSO.S67400>
- Alhawari, H. H., Al-Shelleh, S., Alhawari, H. H., Al-Saudi, A., Aljbouir Al-Majali, D., Al-Faris, L., & AlRyalat, S. A. (2018). Blood pressure and its association with gender, body mass index, smoking, and family history among university students. *International Journal of Hypertension*, 2018, 1–5. <https://doi.org/10.1155/2018/4186496>
- Anagnostis, P., Stevenson, J. C., Crook, D., Johnston, D. G., & Godsland, I. F. (2015). Effects of menopause, gender and age on lipids and high-density lipoprotein cholesterol subfractions. *Maturitas*, 81(1), 62–68. <https://doi.org/10.1016/j.maturitas.2015.02.262>
- Appel, L. J., Moore, T. J., Obarzanek, E., Vollmer, W. M., Svetkey, L. P., Sacks, F. M., Bray, G. A., Vogt, T. M., Cutler, J. A., Windhauser, M. M., Lin, P.-H., Karanja, N., Simons-Morton, D., McCullough, M., Swain, J., Steele, P., Evans, M. A., Miller, E. R., & Harsha, D. W. (1997). A clinical trial of the effects of dietary patterns on blood pressure. *New England Journal of Medicine*, 336(16), 1117–1124. <https://doi.org/10.1056/nejm199704173361601>
- Ariaratnam, S., Rodzlan Hasani, W. S., Krishnapillai, A. D., Abd Hamid, H. A., Jane Ling, M. Y., Ho, B. K., Shariff Ghazali, S., Tohit, N. M., & Mohd Yusoff, M. F. (2020). Prevalence of obesity and its associated risk factors among the elderly in Malaysia:

- Findings from the National Health and Morbidity Survey (NHMS) 2015. *PLOS ONE*, 15(9). <https://doi.org/10.1371/journal.pone.0238566>
- Bales, C. W., & Porter Starr, K. N. (2018). Obesity interventions for older adults: Diet as a determinant of physical function. *Advances in Nutrition*, 9(2), 151–159. <https://doi.org/10.1093/advances/nmx016>
- Bellary, S., Kyrou, I., Brown, J. E., & Bailey, C. J. (2021). Type 2 diabetes mellitus in older adults: Clinical considerations and management. *Nature Reviews Endocrinology*, 17(9), 534–548. <https://doi.org/10.1038/s41574-021-00512-2>
- Benetos, A., Petrovic, M., & Strandberg, T. (2019). Hypertension management in older and frail older patients. *Circulation Research*, 124(7), 1045–1060. <https://doi.org/10.1161/circresaha.118.313236>
- Briggs Early, K., & Stanley, K. (2018). Position of the Academy of Nutrition and Dietetics: The role of medical nutrition therapy and registered dietitian nutritionists in the prevention and treatment of Prediabetes and type 2 diabetes. *Journal of the Academy of Nutrition and Dietetics*, 118(2), 343–353. <https://doi.org/10.1016/j.jand.2017.11.021>
- British Dietetic Association. (2019). *BDA outcomes guidance document*.
- Buford, T. W. (2016). Hypertension and aging. *Ageing Research Reviews*, 26, 96–111. <https://doi.org/10.1016/j.arr.2016.01.007>
- Buonacera, A., Stancanelli, B., & Malatino, L. (2018). Management of hypertension in the elderly: Looking for a trade-off between cardiovascular prevention and serious adverse events. *Monaldi Archives for Chest Disease*, 88(2). <https://doi.org/10.4081/monaldi.2018.960>
- Cavagnoli, G., Pimentel, A. L., Freitas, P. A., Gross, J. L., & Camargo, J. L. (2017). Effect of ethnicity on hba1c levels in individuals without diabetes: Systematic review and meta-analysis. *PLOS ONE*, 12(2). <https://doi.org/10.1371/journal.pone.0171315>
- Chan, Y. Y., Sahril, N., Rezali, M. S., Kuang Kuay, L., Baharudin, A., Abd Razak, M. A., Azlan Kassim, M. S., Mohd Yusoff, M. F., Omar, M. A., & Ahmad, N. A. (2021). Self-reported modifiable risk factors of cardiovascular disease among older adults in Malaysia: A cross-sectional study of prevalence and clustering. *International Journal of Environmental Research and Public Health*, 18(15), 7941. <https://doi.org/10.3390/ijerph18157941>
- Chin, M. C., Sivasampu, S., Wijemunige, N., Rannan-Eliya, R. P., & Atun, R. (2019). The quality of care in outpatient primary care in public and private sectors in Malaysia. *Health Policy and Planning*. <https://doi.org/10.1093/heapol/czz117>
- Coker, R. H., & Wolfe, R. R. (2017). Weight loss strategies in the elderly: A clinical conundrum. *Obesity*, 26(1), 22–28. <https://doi.org/10.1002/oby.21961>

- Colin, C. R. (2021). *The Nutrition Care Process in Diabetes Medical Nutrition therapy* (dissertation). UNF Graduate Theses and Dissertations, Jacksonville, Florida.
- Dahl, W. J., & Stewart, M. L. (2015). Position of the Academy of Nutrition and Dietetics: Health implications of dietary fiber. *Journal of the Academy of Nutrition and Dietetics*, 115(11), 1861–1870. <https://doi.org/10.1016/j.jand.2015.09.003>
- Dai, X., Hummel, S. L., Salazar, J. B., Taffet, G. E., Zieman, S., & Schwartz, J. B. (2015). Cardiovascular physiology in the older adults. *Journal of geriatric cardiology : JGC*, 12(3), 196–201. <https://doi.org/10.11909/j.issn.1671-5411.2015.03.015>
- de Souza, J. D., Ribeiro, A. Q., Martinho, K. O., Franco, F. S., Martins, M. V., Rodrigues, M. G., Wick, J. Y., & Tinôco, A. L. A. (2015). Lipid profile and associated factors among elderly people, attended at the Family Health Strategy, Viçosa/MG. *Nutrición Hospitalaria*, 32(2), 771–778. <https://doi.org/10.3305/nh.2015.32.2.8875>
- Del Razo-Olvera, F. M., Martin-Vences, A. J., Brito-Córdova, G. X., Elías-López, D., Landa-Anell, M. V., Melgarejo-Hernández, M. A., Cruz-Bautista, I., Manjarrez-Martínez, I., Gómez-Velasco, D. V., & Aguilar-Salinas, C. A. (2021). Primary barriers of adherence to a structured nutritional intervention in patients with dyslipidemia. *Nutrients*, 13(6), 1744. <https://doi.org/10.3390/nu13061744>
- Dubowitz, N., Xue, W., Long, Q., Ownby, J. G., Olson, D. E., Barb, D., Rhee, M. K., Mohan, A. V., Watson-Williams, P. I., Jackson, S. L., Tomolo, A. M., Johnson, T. M., & Phillips, L. S. (2014). Aging is associated with increased HbA1c levels, independently of glucose levels and insulin resistance, and also with decreased HbA1c diagnostic specificity. *Diabetic Medicine*, 31(8), 927–935. <https://doi.org/10.1111/dme.12459>
- Espinosa, M. M., Almeida, V., & Nascimento, V. (2021). Poor glycemic control and associated factors in diabetic people attending a reference outpatient clinic in Mato Grosso, Brazil. *Investigacion y educacion en enfermeria*, 39(3), e10. <https://doi.org/10.17533/udea.iee.v39n3e10>
- European Federation of the Associations of Dietitians. (2016). The Voice of European Dietitians Dietitians in Europe Definition, Profession and Education Statement by the European Federation of the Associations of Dietitians (EFAD).
- Evert, A. B., Dennison, M., Gardner, C. D., Garvey, W. T., Lau, K. H., MacLeod, J., Mitri, J., Pereira, R. F., Rawlings, K., Robinson, S., Saslow, L., Uelman, S., Urbanski, P. B., & Yancy, W. S. (2019). Nutrition therapy for adults with diabetes or prediabetes: A consensus report. *Diabetes Care*, 42(5), 731–754. <https://doi.org/10.2337/dci19-0014>
- Feingold, K. R. (2021). Cholesterol lowering drugs. *Endotext [Internet]*.
- Félix-Redondo, F. J., Grau, M., & Fernández-Bergés, D. (2013). Cholesterol and cardiovascular disease in the elderly: Facts and gaps. *Aging and Disease*, 4(3), 154–169.

- Freijer, K., Lenoir-Wijnkoop, I., Russell, C. A., Koopmanschap, M. A., Kruijsenga, H. M., Lhachimi, S. K., Norman, K., Nuijten, M. J., & Schols, J. M. (2015). The view of European experts regarding health economics for medical nutrition in disease-related malnutrition. *European Journal of Clinical Nutrition*, 69(5), 539–545. <https://doi.org/10.1038/ejcn.2014.280>
- Goisser, S., Kiesswetter, E., Schoene, D., Torbahn, G., & Bauer, J. M. (2020). Dietary weight-loss interventions for the management of obesity in older adults. *Reviews in Endocrine and Metabolic Disorders*, 21(3), 355–368. <https://doi.org/10.1007/s11154-020-09577-2>
- Gupta, S., & Bansal, S. (2020). Does a rise in BMI cause an increased risk of diabetes?: Evidence from India. *PLOS ONE*, 15(4). <https://doi.org/10.1371/journal.pone.0229716>
- Haghighatpanah, M., Nejad, A., Haghighatpanah, M., Thunga, G., & Mallayasamy, S. (2018). Factors that Correlate with Poor Glycemic Control in Type 2 Diabetes Mellitus Patients with Complications. *Osong public health and research perspectives*, 9(4), 167–174. <https://doi.org/10.24171/j.phrp.2018.9.4.05>
- Hickman, I. J., Cotugno, J., Lassemillante, A. C. M., & Ferguson, M. (2015). Am I making a difference? measuring dietetic outcomes in clinical practice. *European Journal of Clinical Nutrition*, 69(11), 1181–1183. <https://doi.org/10.1038/ejcn.2015.148>
- Höchsmann, C., Dorling, J. L., Martin, C. K., Newton, R. L., Apolzan, J. W., Myers, C. A., Denstel, K. D., Mire, E. F., Johnson, W. D., Zhang, D., Arnold, C. L., Davis, T. C., Fonseca, V., Lavie, C. J., Price-Haywood, E. G., & Katzmarzyk, P. T. (2021). Effects of a 2-year primary care lifestyle intervention on cardiometabolic risk factors. *Circulation*, 143(12), 1202–1214. <https://doi.org/10.1161/circulationaha.120.051328>
- Howatson, A., Wall, C., & Turner-Benny, P. (2015). The contribution of Dietitians to the primary health care workforce. *Journal of Primary Health Care*, 7(4), 324. <https://doi.org/10.1071/hc15324>
- Jamal, R., Syed Zakaria, S. Z., Kamaruddin, M. A., Abd Jalal, N., Ismail, N., Mohd Kamil, N., Abdullah, N., Baharudin, N., Hussin, N. H., Othman, H., & Mahadi, N. M. (2014). Cohort profile: The Malaysian cohort (TMC) project: A prospective study of non-communicable diseases in a multi-ethnic population. *International Journal of Epidemiology*, 44(2), 423–431. <https://doi.org/10.1093/ije/dyu089>
- Kelly R. B. (2010). Diet and exercise in the management of hyperlipidemia. *American family physician*, 81(9), 1097–1102.
- Khan, M. A., Hashim, M. J., King, J. K., Govender, R. D., Mustafa, H., & Al Kaabi, J. (2019). Epidemiology of type 2 diabetes – global burden of disease and forecasted trends. *Journal of Epidemiology and Global Health*, 10(1), 107. <https://doi.org/10.2991/jegh.k.191028.001>

- Klop, B., Elte, J., & Cabezas, M. (2013). Dyslipidemia in obesity: Mechanisms and potential targets. *Nutrients*, 5(4), 1218–1240. <https://doi.org/10.3390/nu5041218>
- Kohn, M.A., & Senyak, J. (2022). *Sample Size Calculators*. UCSF CTSI. <https://www.sample-size.net/>
- Kyaw, T. M., Ismail, Z., Selamat, M. I., & Nawawi, H. (2022). Obesity and its associated factors among older adults: Myhebat study. *Health Science Reports*, 5(4). <https://doi.org/10.1002/hsr2.668>
- Leggio, M., Lombardi, M., Caldarone, E., Severi, P., D'Emidio, S., Armeni, M., Bravi, V., Bendini, M. G., & Mazza, A. (2017). The relationship between obesity and hypertension: An updated comprehensive overview on Vicious Twins. *Hypertension Research*, 40(12), 947–963. <https://doi.org/10.1038/hr.2017.75>
- Leung, E., Wongrakpanich, S., & Munshi, M. N. (2018). Diabetes management in the elderly. *Diabetes Spectrum*, 31(3), 245–253. <https://doi.org/10.2337/ds18-0033>
- Li, Q., Liu, C., Zhang, S., Li, R., Zhang, Y., He, P., Zhang, Z., Liu, M., Zhou, C., Ye, Z., Wu, Q., Li, H., & Qin, X. (2021). Dietary carbohydrate intake and new-onset hypertension: A nationwide cohort study in China. *Hypertension*, 78(2), 422–430. <https://doi.org/10.1161/hypertensionaha.120.16751>
- Masuch, A., Friedrich, N., Roth, J., Nauck, M., Müller, U. A., & Petersmann, A. (2019). Preventing misdiagnosis of diabetes in the elderly: Age-dependent hba1c reference intervals derived from two population-based study cohorts. *BMC Endocrine Disorders*, 19(1). <https://doi.org/10.1186/s12902-019-0338-7>
- McArdle, P. D., Greenfield, S. M., Rilstone, S. K., Narendran, P., Haque, M. S., & Gill, P. S. (2019). Carbohydrate restriction for glycaemic control in type 2 diabetes: A systematic review and meta-analysis. *Diabetic Medicine*, 36(3), 335–348. <https://doi.org/10.1111/dme.13862>
- McKee, A. M & Morley, J.E. (2021). Obesity in the Elderly. *Endotext [Internet]*. <https://www.ncbi.nlm.nih.gov/books/NBK532533/>
- Mills, K. T., Bundy, J. D., Kelly, T. N., Reed, J. E., Kearney, P. M., Reynolds, K., Chen, J., & He, J. (2016). Global disparities of hypertension prevalence and control. *Circulation*, 134(6), 441–450. <https://doi.org/10.1161/circulationaha.115.018912>
- Ministry of Health. (2017). *Clinical Practice Guidelines: Management of Dyslipidemia* (5th ed.).
- Ministry of Health. (2018). *Clinical Practice Guidelines: Management of Hypertension* (5th ed.).
- Ministry of Health. (2018). *National health and morbidity survey: Elderly health*.
- Ministry of Health. (2019). *National health and morbidity survey: Healthcare demand*.

- Ministry of Health. (2019). *National health and morbidity survey: Non-communicable diseases: Risk factors and other health problems*.
- Ministry of Health. (2020). *Clinical Practice Guidelines: Management of Type 2 Diabetes Mellitus* (6th ed.).
- Ministry of Health. (2020). *Nutrition Research Priorities in Malaysia. For 12<sup>th</sup> Malaysia Plan (2021-2025)*.
- Ministry of Health. (2020). *The impact of noncommunicable diseases and their risk factors on Malaysia's gross domestic product*.
- Mohr, A. E., Hatem, C., Sikand, G., Rozga, M., Moloney, L., Sullivan, J., De Waal, D., & Handu, D. (2022). Effectiveness of medical nutrition therapy in the management of Adult Dyslipidemia: A systematic review and meta-analysis. *Journal of Clinical Lipidology*. <https://doi.org/10.1016/j.jacl.2022.06.008>
- Morgan, A. E., Mooney, K. M., Wilkinson, S. J., Pickles, N. A., & Mc Auley, M. T. (2016). Cholesterol metabolism: A review of how ageing disrupts the biological mechanisms responsible for its regulation. *Ageing Research Reviews*, 27, 108–124. <https://doi.org/10.1016/j.arr.2016.03.008>
- Mottalib, A., Salsberg, V., Mohd-Yusof, B.-N., Mohamed, W., Carolan, P., Pober, D. M., Mitri, J., & Hamdy, O. (2018). Effects of nutrition therapy on hba1c and cardiovascular disease risk factors in overweight and obese patients with type 2 diabetes. *Nutrition Journal*, 17(1). <https://doi.org/10.1186/s12937-018-0351-0>
- Nawrocki, J. W., Weiss, S. R., Davidson, M. H., Sprecher, D. L., Schwartz, S. L., Lupien, P.-J., Jones, P. H., Haber, H. E., & Black, D. M. (1995). Reduction of LDL Cholesterol by 25% to 60% in Patients With Primary Hypercholesterolemia by Atorvastatin, a New HMG-CoA Reductase Inhibitor. *Arteriosclerosis, Thrombosis, and Vascular Biology*, 15(5), 678–682. <https://doi.org/10.1161/01.atv.15.5.678>
- NCDS & Sustainable Human Development. NCD Alliance. (2021). [https://ncdalliance.org/why-ncds/NCDs\\_Sustainable\\_Human\\_Development](https://ncdalliance.org/why-ncds/NCDs_Sustainable_Human_Development)
- Nelson, R. H. (2013). Hyperlipidemia as a risk factor for cardiovascular disease. *Primary Care: Clinics in Office Practice*, 40(1), 195–211. <https://doi.org/10.1016/j.pop.2012.11.003>
- NoorAni, A., Rajini, S., Balkish, M. N., Noraida, M. K., SMaria, A., Fadhli, M. Y., Jabrullah, A. H., & Tahir, A. (2018). Morbidity patterns and healthcare utilisation among older people in Malaysia: 1996–2015. *Public Health*, 163, 105–112. <https://doi.org/10.1016/j.puhe.2018.06.018>
- Norris, S. A., Anuar, H., Matzen, P., Cheah, J. C., Jensen, B. B., & Hanson, M. (2014). The life and health challenges of young Malaysian couples: Results from a stakeholder consensus and engagement study to support non-communicable disease prevention. *BMC public health*, 14 Suppl 2(Suppl 2), S6. <https://doi.org/10.1186/1471-2458-14-S2-S6>

- Nutrition Education Materials Online. (2017). *Estimating energy, protein & fluid requirements for adult clinical conditions*. Queensland Health.
- Oliveros, E., Patel, H., Kyung, S., Fugar, S., Goldberg, A., Madan, N., & Williams, K. A. (2019). Hypertension in older adults: Assessment, management, and challenges. *Clinical Cardiology*, 43(2), 99–107. <https://doi.org/10.1002/clc.23303>
- Osman, F., Haldar, S., & Henry, C. J. (2020). Effects of Time-Restricted Feeding during Ramadan on Dietary Intake, Body Composition and Metabolic Outcomes. *Nutrients*, 12(8), 2478. <https://doi.org/10.3390/nu12082478>
- Porter Starr, K., McDonald, S., Weidner, J., & Bales, C. (2016). Challenges in the management of geriatric obesity in high risk populations. *Nutrients*, 8(5), 262. <https://doi.org/10.3390/nu8050262>
- Prevention and treatment of high cholesterol (hyperlipidemia). (n.d.). [www.heart.org](http://www.heart.org). <https://www.heart.org/en/health-topics/cholesterol/prevention-and-treatment-of-high-cholesterol-hyperlipidemia>
- Rabkin, S. W., Chen, Y., Leiter, L., Liu, L., & Reeder, B. A. (1997). Risk factor correlates of body mass index. *Canadian Medical Association Journal*, 157(1).
- Ramadas, A., Chan, C. K., Oldenburg, B., Hussein, Z., & Quek, K. F. (2018). Randomised-controlled trial of a web-based dietary intervention for patients with type 2 diabetes: Changes in health cognitions and glycemic control. *BMC Public Health*, 18(1). <https://doi.org/10.1186/s12889-018-5640-1>
- Ravnskov, U., Diamond, D. M., Hama, R., Hamazaki, T., Hammarskjöld, B., Hynes, N., Kendrick, M., Langsjoen, P. H., Malhotra, A., Mascitelli, L., McCully, K. S., Ogushi, Y., Okuyama, H., Rosch, P. J., Schersten, T., Sultan, S., & Sundberg, R. (2016). Lack of an association or an inverse association between low-density-lipoprotein cholesterol and mortality in the elderly: A systematic review. *BMJ Open*, 6(6). <https://doi.org/10.1136/bmjopen-2015-010401>
- Sazlina, S. G., Mastura, I., Cheong, A. T., Bujang Mohamad, A., Jamaiyah, H., Lee, P. Y., Syed Alwi, S. A., & Chew, B. H. (2015). Predictors of poor glycaemic control in older patients with type 2 diabetes mellitus. *Singapore medical journal*, 56(5), 284–290. <https://doi.org/10.11622/smedj.2015055>
- Schumacher, T., Burrows, T., Rollo, M., Spratt, N., Callister, R., & Collins, C. (2016). Effectiveness of a brief dietetic intervention for hyperlipidaemic adults using individually-tailored dietary feedback. *Healthcare*, 4(4), 75. <https://doi.org/10.3390/healthcare4040075>
- Shahar, S., Jan Bin Jan Mohamed, H., de Los Reyes, F., & Amarra, M. S. (2018). Adherence of Malaysian Adults' Energy and Macronutrient Intakes to National Recommendations: A Review and Meta-Analysis. *Nutrients*, 10(11), 1584. <https://doi.org/10.3390/nu10111584>

- Sherwani, S. I., Khan, H. A., Ekhzaimy, A., Masood, A., & Sakharkar, M. K. (2016). Significance of hba1c test in diagnosis and prognosis of diabetic patients. *Biomarker Insights*, 11. <https://doi.org/10.4137/bmi.s38440>
- Sheth, J., Shah, A., Sheth, F., Trivedi, S., Nabar, N., Shah, N., Thakor, P., & Vaidya, R. (2015). The Association of Dyslipidemia and obesity with glycated hemoglobin. *Clinical Diabetes and Endocrinology*, 1(1). <https://doi.org/10.1186/s40842-015-0004-6>
- Sikand, G., Cole, R. E., Handu, D., deWaal, D., Christaldi, J., Johnson, E. Q., Arpino, L. M., & Ekvall, S. M. (2018). Clinical and cost benefits of medical nutrition therapy by registered dietitian nutritionists for management of dyslipidemia: A systematic review and meta-analysis. *Journal of Clinical Lipidology*, 12(5), 1113–1122. <https://doi.org/10.1016/j.jacl.2018.06.016>
- Suastika, K., Dwipayana, P., Siswadi, M., & Tuty, R. A. (2012). Age is an important risk factor for type 2 diabetes mellitus and cardiovascular diseases. *Glucose Tolerance*. <https://doi.org/10.5772/52397>
- The European Federation of the Associations of Dietitians. (2020). *The importance of Outcomes Management in Dietetics Policy paper – EFAD Professional Practice Committee*.
- Vekic, J., Zeljkovic, A., Stefanovic, A., Jelic-Ivanovic, Z., & Spasojevic-Kalimanovska, V. (2019). Obesity and dyslipidemia. *Metabolism*, 92, 71–81. <https://doi.org/10.1016/j.metabol.2018.11.005>
- Volkert, D., Beck, A. M., Cederholm, T., Cruz-Jentoft, A., Goisser, S., Hooper, L., Kiesswetter, E., Maggio, M., Raynaud-Simon, A., Sieber, C. C., Sobotka, L., van Asselt, D., Wirth, R., & Bischoff, S. C. (2019). Espen guideline on clinical nutrition and hydration in geriatrics. *Clinical Nutrition*, 38(1), 10–47. <https://doi.org/10.1016/j.clnu.2018.05.024>
- Wang, M.C., Hu, H.Y., Lin, I.F., & Chuang, J.T. (2019). Plasma lipid concentrations and survival in geriatric population. *Medicine*, 98(49). <https://doi.org/10.1097/md.00000000000018154>
- Whelton, P. K., Appel, L. J., Espeland, M. A., Applegate, W. B., Ettinger, Jr, W. H., Kostis, J. B., Kumanyika, S., Lacy, C. R., Johnson, K. C., Folmar, S., Cutler, J. A., & for the TONE Collaborative Research Group. (1998). Sodium reduction and weight loss in the treatment of hypertension in older persons. *JAMA*, 279(11), 839. <https://doi.org/10.1001/jama.279.11.839>
- Winter, J. E., MacInnis, R. J., Wattanapenpaiboon, N., & Nowson, C. A. (2014). BMI and all-cause mortality in older adults: a meta-analysis. *The American journal of clinical nutrition*, 99(4), 875-890.
- World Health Organization, Regional Office for Europe. (2015). European Food and Nutrition Action Plan 2015-2020.

World Health Organization. (2021). *Non communicable diseases*. <https://www.who.int/news-room/fact-sheets/detail/noncommunicable-diseases>

World Health Organization. (n.d.). *Obesity*. [https://www.who.int/health-topics/obesity#tab=tab\\_1](https://www.who.int/health-topics/obesity#tab=tab_1)

Wu, L., Lin, H., Gao, J., Li, X., Xia, M., Wang, D., Aleteng, Q., Ma, H., Pan, B., & Gao, X. (2017). Effect of age on the diagnostic efficiency of hba1c for diabetes in a Chinese middle-aged and elderly population: The Shanghai Changfeng Study. *PLOS ONE*, 12(9). <https://doi.org/10.1371/journal.pone.0184607>

Yakaryılmaz, F. D., & Öztürk, Z. A. (2017). Treatment of type 2 diabetes mellitus in the elderly. *World Journal of Diabetes*, 8(6), 278. <https://doi.org/10.4239/wjd.v8.i6.278>

Zhu, H. T., Yu, M., Hu, H., He, Q. F., Pan, J., & Hu, R. Y. (2019). Factors associated with glycemic control in community-dwelling elderly individuals with type 2 diabetes mellitus in Zhejiang, China: A cross-sectional study. *BMC Endocrine Disorders*, 19(1). <https://doi.org/10.1186/s12902-019-0384-1>

## Appendix C: Information Recording Form

### Information Recording Form

#### Part A: Background

| No | Age | Gender (M/F) | Ethnicity | BMI | Diagnosis |
|----|-----|--------------|-----------|-----|-----------|
| 1  |     |              |           |     |           |
| 2  |     |              |           |     |           |
| 3  |     |              |           |     |           |
| 4  |     |              |           |     |           |

#### Part B: Dietetic Outcome

| No   | HbA1c (%) |   |   | BP |   |   | Body weight (kg) |   |   | TC |   |   | TG |   |   | LDL-C |   |   | HDL-C |   |   |
|------|-----------|---|---|----|---|---|------------------|---|---|----|---|---|----|---|---|-------|---|---|-------|---|---|
| Date |           |   |   |    |   |   |                  |   |   |    |   |   |    |   |   |       |   |   |       |   |   |
|      | 1         | 2 | 3 | 1  | 2 | 3 | 1                | 2 | 3 | 1  | 2 | 3 | 1  | 2 | 3 | 1     | 2 | 3 | 1     | 2 | 3 |
| 1    |           |   |   |    |   |   |                  |   |   |    |   |   |    |   |   |       |   |   |       |   |   |
| 2    |           |   |   |    |   |   |                  |   |   |    |   |   |    |   |   |       |   |   |       |   |   |
| 3    |           |   |   |    |   |   |                  |   |   |    |   |   |    |   |   |       |   |   |       |   |   |

## Appendix D: Originality Report

| ORIGINALITY REPORT      |                                                                                                                                                                                                                                                  |              |                |
|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|----------------|
| 2%                      | 1%                                                                                                                                                                                                                                               | 2%           | 1%             |
| SIMILARITY INDEX        | INTERNET SOURCES                                                                                                                                                                                                                                 | PUBLICATIONS | STUDENT PAPERS |
| PRIMARY SOURCES         |                                                                                                                                                                                                                                                  |              |                |
| 1                       | Knut Hestad, Pål Aukrust, Bjørn Ellertsen, Hallgrim Kløve. "Neuropsychological Deficits In HIV-1 seropositive and seronegative intravenous drug users (IVDUs): A follow-up study", Journal of the International Neuropsychological Society, 2009 |              | 1%             |
|                         | Publication                                                                                                                                                                                                                                      |              |                |
| 2                       | Submitted to Universiti Putra Malaysia                                                                                                                                                                                                           |              | 1%             |
|                         | Student Paper                                                                                                                                                                                                                                    |              |                |
| 3                       | www.nutriweb.org.my                                                                                                                                                                                                                              |              | 1%             |
|                         | Internet Source                                                                                                                                                                                                                                  |              |                |
| Exclude quotes On       |                                                                                                                                                                                                                                                  |              |                |
| Exclude bibliography On |                                                                                                                                                                                                                                                  |              |                |
| Exclude matches < 1%    |                                                                                                                                                                                                                                                  |              |                |