PREVALENCE OF SARCOPENIA, EMPTY NEST, DEPRESSIVE SYMPTOMS AND ITS ASSOCIATION WITH DIET QUALITY AMONG OLDER ADULTS WITH LOW SOCIOECONOMIC STATUS IN KELANTAN

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by

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LIST OF ABBREVIATIONS

AWGS	Asian Working Group for Sarcopenia
BHEI	Brazilian Healthy Eating Index
BMI	Body Mass Index
CDC	Centers for Disease Control and Prevention
DHQ	Dietary History Questionnaire
DOSM	Department of Statistics Malaysia
EAR	Estimated Average Requirement
FFQ	Food Frequency Questionnaire
GDS	Geriatric Depression Scale
HEI	Healthy Eating Index
Hh	Household
IADL	Instrumental Activities of Daily Living
KNHANES	Korea National Health and Nutrition Examination Survey
MDG	Malaysian Dietary Guidelines
MUAC	Mid-upper arm circumference
MUFA	Monounsaturated Fatty Acids
NHMS	National Health and Morbidity Survey
NIH	National Institutes of Health
NSI	North South Initiative
OECD	Organization for Economic Co-operation and Development
OP	Older Person
RDA	Recommended Dietary Allowance

RNI	Recommended Nutrient Intake
SES	Socioeconomic Status
SFA	Saturated Fatty Acid
SMI	Skeletal Muscle Index
SPPB	Short Physical Performance Battery
SPSS	Statistical Package for Social Sciences
SQFFQ	Semi-quantitative Food Frequency Questionnaire
TFR	Total Fertility Rate
UN	United Nations
UNDESA	United Nations Department of Economic and Social Affairs
UNFPA	United Nations Population Fund
WHO	World Health Organization

PREVALENS SARKOPENIA, SARANG KOSONG, GEJALA KEMURUNGAN DAN KAITANNYA DENGAN KUALITI DIET DALAM KALANGAN WARGA EMAS DENGAN STATUS SOSIOEKONOMI RENDAH DI KELANTAN

ABSTRAK

Penuaan meningkatkan risiko kualiti diet yang tidak baik dalam kalangan warga emas disebabkan oleh penyakit kronik, masalah psikososial, keterbatasan fizikal dan kesunyian. Warga emas dengan status sosioekonomi rendah berisiko tinggi mengalami masalah kesihatan. Oleh sebab itu, objektif penyelidikan ini dilaksanakan adalah bagi mengkaji perkaitan antara sarkopenia, sarang kosong dan kemurungan dengan kualiti diet dalam kalangan warga emas dengan status sosioekonomi rendah. Seramai 293 warga emas dari lima daerah di Kelantan termasuk Pasir Mas, Bachok, Tumpat, Kota Bharu dan Machang terlibat dalam penyelidikan ini. Subjek yang menepati kriteria kemasukan (berumur 60 tahun ke atas, tahap pendidikan yang rendah, kumpulan B40, tidak mempunyai masalah kesihatan yang mengehadkan keupayaan untuk melaksanakan ujian kecergasan fizikal) telah dipilih melalui kaedah persampelan mudah. Data sosiodemografi, antropometri, komposisi badan, sejarah kesihatan, tekanan darah, gejala kemurungan, sarang kosong, sejarah pemakanan dan sarkopenia telah diperolehi melalui kaedah temuduga yang dibantu. Kebanyakan peserta telah berkahwin (69.6%), berbangsa Melayu (100%) dan mempunyai pendapatan kurang dari RM900 (91.5%). Prevalens sarang kosong adalah 30.7%. Hampir separuh subjek mempunyai masalah kekurangan berat badan (48.8%). Prevalens sarkopenia dan sarkopenia yang teruk adalah 22.2% dan 18.8%. Prevalens tinggi risiko untuk gejala kemurungan adalah 28.3%. Lelaki dan wanita kedua-duannya tidak memenuhi saranan bagi pengambilan tenaga seharian. Skor *Healthy*

Eating Index (HEI) menunjukkan 42% subjek mempunyai kualiti diet yang tidak baik, 57% memerlukan penambahbaikan dalam kualiti diet dan hanya 1% mempunyai kualiti diet yang baik. Skor HEI tinggi adalah signifikan dalam kalangan subjek yang tidak mempunyai sarkopenia berbanding subjek yang mempunyai sarkopenia dan sarkopenia yang teruk. Regresi logistik binari menunjukkan subjek yang mempunyai kolesterol yang tinggi adalah 2.4 kali lebih cenderung untuk mempunyai kualiti diet yang tidak baik berbanding subjek yang mempunyai tahap kolesterol yang normal (95% Interval Keyakinan: 1.107,5.209; nilai p: 0.027). Peningkatan skor *Short Physical Performance Battery* (SPPB) berkait dengan penurunan kecenderungan untuk mempunyai kualiti diet yang tidak baik (OR:0.780; 95% Interval Keyakinan: 0.624-0.974; nilai p:0.028). Kesimpulannya, pengambilan makanan dalam kalangan warga emas adalah merunsingkan terutamanya berkaitan pengambilan sayur-sayuran dan buah-buahan. Intervensi pemakanan terutamanya dalam meningkatkan pengetahuan dan kemahiran warga emas dalam memastikan pemakanan yang sihat adalah penting untuk membantu warga emas yang berpendapatan rendah supaya dapat meningkatkan kualiti diet dan status pemakanan bagi mengurangkan risiko sarkopenia dan penyakit kronik

PREVALENCE OF SARCOPENIA, EMPTY NEST, DEPRESSIVE SYMPTOMS AND ITS ASSOCIATION WITH DIET QUALITY AMONG OLDER ADULTS WITH LOW SOCIOECONOMIC STATUS IN KELANTAN

ABSTRACT

Aging itself increases the risk of poor diet quality among older adults due to chronic disease, psychosocial problems, physical limitations and loneliness. Older adults with low socioeconomic status are at higher risk of health problems. Therefore, the current study aimed to assess the association between sarcopenia, empty nest and depressive symptoms with diet quality among older adults with low socioeconomic status. A total of 293 older adults in five districts in Kelantan namely Pasir Mas, Bachok, Tumpat, Kota Bharu and Machang were recruited in the study. Study subjects who fulfilled the inclusion criteria (aged 60 years and above, low education level, B40 group, have no health problems that will limit ability to perform physical fitness tests) were selected through convenience sampling method. Data on socio-demography, anthropometry, body composition, medical history, blood pressure, depressive symptoms, empty nest, diet history and sarcopenia were obtained through interview administered method. Most of the subjects were married (69.6%), are of Malay ethnicity (100%) and has income less than RM900 (91.5%). The prevalence of empty nest was 30.7%. Almost half of the subjects were underweight (48.8%). The prevalence of sarcopenia and severe sarcopenia were 22.2% and 18.8% respectively. The prevalence of high risk of depressive symptoms is 28.3%. Both men and women did not meet the recommendation for daily energy intake. Healthy Eating Index (HEI) score revealed that 42% of the subjects had poor diet quality, 57% need improvement in their diet and only 1% had good diet quality. HEI score was significantly higher in subject with no sarcopenia as compared to those who were

sarcopenic and severe sarcopenic. Binary logistic regression revealed that subjects with high cholesterol were 2.4 times more likely to exhibit poor diet quality than those with normal cholesterol level (95% CI: 1.107, 5.209; p-value: 0.027). Increasing Short Physical Performance Battery (SPPB) score was associated with a reduction in the likelihood of exhibiting poor diet quality (OR:0.780; 95%CI: 0.624-0.974; p-value:0.028). In conclusion, the prevalence of sarcopenia, empty nest, and subjects with high risk of depressive symptoms among the study subjects were considerably high. The dietary intake among older adults is also worrying especially regarding fruits and vegetables intake. Thus, nutrition interventions especially in increasing knowledge and skills of older adults to ensure healthy eating are essential to help older adults with low socioeconomic status to improve their nutritional status for reducing risk of sarcopenia and chronic diseases.

CHAPTER 1

INTRODUCTION

1.1 Background of Study

Population aging is becoming a public health concern with rapid rise in the prevalence of senior citizens. Longer life expectancy especially in the developed countries with advanced health care treatment and accessibility are among the factors contributing to the growth of older adult population aged 60 years old and above. The number of older adults is expected to outnumber the younger population. People aged 55 years and above are expected to outnumber all children aged 0 to 14 years by 2035 and the whole children and youth population aged 0 to 24 years by 2080 (Harasty & Ostermeier, 2020). This significant growth in older adults' population will require additional demand in healthcare and support services. For older adults, nutrition becomes very important to ensure good health, functional independence, and quality of life. Aging is accompanied by physiological changes, chronic illness, reduced energy expenditure and psychological issues which may affect nutritional needs of older adults (Leslie & Hankey, 2015). Besides that, low socio-economic status (SES) is another important factor that affected diet quality of older adults (Nazri et al., 2020). Review by Nazri et al (2020) demonstrated that the prevalence of undernutrition or at risk of undernutrition among older adults with low SES in non-Asian countries was within the range of 28.9% to 48% between year 2010 to 2019 while in Asia, the prevalence ranged from 3% to 64.9%. In addition, another cross-sectional study exploring the SES in both the urban and rural areas by Shahar et al. (2019) reported that the prevalence of low SES is higher among older adults in the rural area (50.6%) as compared to the urban area (49.4%). The study also found that poverty in rural

area is associated with several factors such as lack of dietary fibre intake, lower calf circumference which indicated muscle wasting, limited fresh fruits intake, increased disability and having poor functional status based on lower score in the instrumental activities of daily living (IADL) questionnaire.

Empty nest is defined as older adults who lived alone or only with their spouse. They may not have children or have children who are residing far away from them such as living in another district, state or country (Su et al., 2020). Empty nest syndrome is a psychological condition that cause feeling of grief (feeling of loss, unworthiness, redundancy and uncertainty about the future) among both parents due to their children's departure (Al Ubaidi, 2017). Feeling of loneliness when children moved out of the house or even death of loved ones might affect the health of older adults. A study by Gao et al. (2017) reported that empty nest had significant adverse effect on older adults' physical health, cognitive ability and psychological health. Moreover, depression is one of the psychological problem that may affect the well-being of older adults. World Health Organization (2017) has defined depression as a common mental disorder characterized by persistent sadness and a loss of interest in activities that the individual normally enjoys, together with an inability to carry out daily activities, for at least two weeks. People with depression usually have loss of energy, change in appetite, more or less sleeping hours, anxiety, lack of concentration, indecisiveness, restlessness, feelings of worthlessness, guilt or hopelessness and thoughts of self-harm or suicide (Mina, 2017). Depression is the most common mood disorder among older adults with approximately 15% of older adults suffer from depression and risk factors of depressive symptoms among community dwelling older adults are lower education level, hypertension, osteoarthritis, lower score

in instrumental activities of daily living, limited physical fitness and suffering from neurotic disorders (Mina, 2017; Vanoh et al 2016). Loneliness, depression and lack of physical fitness contributed to loss of muscle mass which finally led to a muscle wasting condition known as sarcopenia (Yuenyongchaiwat & Boonsinsukh, 2020).

Sarcopenia is regarded as a form of disability in the International Classification of Diseases-10 code in 2016 (Cruz-Jentoft & Sayer, 2019). Sarcopenia has been described as decreased in skeletal muscle mass as well as muscle function due to aging which is defined by muscle strength or physical performance (Chen et al., 2020). Sarcopenia may result in loss of physical capability, poor quality of life, impaired cardiopulmonary performance, negative metabolic effects, falls, disability and mortality in older adults (Okayama et al., 2022). Since Asia is the most populated and fastest aging region in the world, it is expected that sarcopenia will give great impact to the Asian population in the future. A review by Woo et al. (2019) among Asian countries including China, Hong Kong, Taiwan, Singapore, Malaysia, Indonesia and Vietnam, revealed that the highest prevalence of sarcopenia among older adults are in Hong Kong (16.6%), Taiwan (19.9%) and Singapore (13.7%)

Poverty is a condition when an individual cannot obtain adequate primary needs to sustain their life (Deonandan, 2019). Aging is associated with poor appetite and malnutrition due to poverty, chewing or swallowing difficulties, lack of accessibility to healthy food, unable to prepare food themselves, polypharmacy (regular use of at least five medications which increased risk of adverse medical outcome) and social isolation (Rusu et al., 2020). Poor diet quality and quantity leads to altered body composition especially declining lean muscle mass. Another study conducted among community

dwelling older adults demonstrated that elderly with lack of appetite had lower intake of energy, fiber, protein, fruits, and vegetables, while having excessive intake of fats, sweets, sodas, and dairy food than those with good appetite (van der Meij et al., 2017). Thus, it is essential to explore the dietary intake of older adults burdened with poverty and further investigate its association with various health parameters.

1.2 Problem Statement & Study Rationale

The present study had been done during SARS-CoV-2 or coronavirus 2019 diseases (COVID-19) pandemic. COVID-19 had caused tremendous social and economic disruptions around the globe which had affected over 218 million people with more than 4.5 million deaths globally (Ahmad et al., 2021). Among older adults, the direct impacts of COVID-19 on their health and well-being including their morbidity, social exclusion and mortality had received attention from academic research, news media coverage and policy action but limited recognition had been given on the indirect impact on the health of older adults due to COVID-19 through food access, diet quality and nutrition (Nicklett et al., 2021). In Malaysia, there was no study that had been done regarding diet quality among older adults especially those with low socioeconomic status (SES) during this COVID-19 pandemic. A scoping review by Nicklett et al. (2021) reported that COVID-19 caused higher risk of food insecurity, challenges to food access and poorer diet quality among older adults who experienced financial insecurity, job loss or disruptions and also among older adults who experienced functional limitations, frailty or were underweight.

SES may be viewed from the economic and social context which is usually characterized by three dimensions namely education, employment and money (Glymour

et al., 2014). Low SES which is correlated with low educational level, poverty and poor health may ultimately affect the society as a whole. In Malaysia, the SES has been improving throughout the years. According to the Department of Statistics Malaysia (2017), the median monthly household income for Malaysian increased from RM4,585 in 2014 to RM5,228 in 2016 with a growth rate of 6.6 per cent per annum at nominal value. However, the SES in Malaysia is still low in several states. In Peninsular Malaysia, high SES index is located in Kuala Lumpur, Pulau Pinang, Selangor and some regions in Kedah, Perak, Melaka, Negeri Sembilan and Johor whereas the low SES index is located in areas in Kelantan, Terengganu and some rural areas in Kedah and Pahang (Abdul Rahman & Abd Naeeim, 2018). Abdullah et al. (2016) reported that Kelantan is considered as one of the poorest states in Malaysia due to slower growth rates of industries. In 2012, a total of 58,000 people in Kelantan are classified as poor and their income are between RM1,800 to RM2,500 which classify them as hard-core poor (household income less than half the poverty line). A study by Siwar et al. (2016) among 47, 625 household in Kelantan showed that the highest incidence of poverty was reported in Kota Bharu followed by Tumpat. Even there were several studies that had been done regarding diet quality among older adults in Malaysia, but none of them were done in Kelantan. Therefore, there is a need to examine the diet quality among older adults with low SES in Kelantan.

Low SES has been identified as one of the most important determinant of health status and has strong association with poor health outcomes, especially in older adults. Read et al. (2016) has portrayed that poor socioeconomic position is associated with declining subjective health and well-being. Similarly, several other studies found

significant association between low SES with skeletal muscle loss which may contribute to sarcopenia (Dorosty et al., 2016; Jeng et al., 2018). Declining muscle strength and physical capability among older adults might affect the ability to access and prepare food (Robinson et al., 2012). In a vicious cycle, poor diet quality especially lack of protein intake may increase the risk of skeletal muscle loss. Many studies have been done to investigate the association between sarcopenia and intake of specific nutrients such as protein, vitamins (Takahashi et al., 2021), minerals (van Dronkelaar et al., 2018) and antioxidants (Brioche & Lemoine-Morel, 2016). However, limited study had been done regarding the association between sarcopenia and diet quality especially among low SES older adults in Malaysia.

Malaysia together with many other countries had implemented a nationwide lockdown during the peak of this COVID-19 pandemic. This had caused many impacts on the physical, mental, social interactions and psychological among all population around the world. (Ahmad et al., 2021). Many studies reported an increase in anxiety and depression in the general population due to extended lockdowns but these effects are magnified among older adults' population due to stricter lockdowns, higher threat of illness and loss of social support (Martins Van Jaarsveld, 2020). Diet quality of older adults might be worsened by the effect of psychological problems such as depression and dementia as well as the social effects of living and eating alone (Robinson et al., 2012). However, there are limited research that had been done regarding the association between depression and empty nest with diet quality among older adults' population. Therefore, there is a need to conduct a study to determine the prevalence of sarcopenia, empty nest

syndrome, depressive symptoms and its association with diet quality especially among older adults with low SES.

1.3 Research Questions

1) What is the prevalence of sarcopenia, depressive symptoms and empty nest among older adults with low SES in Kelantan?
2) What is the adherence of the energy and nutrient intake of older adults with low SES in Kelantan to the Recommended Nutrient Intake (RNI) of Malaysia and their diet quality?
3) Is there any association between diet quality and sarcopenia among older adults with low SES in Kelantan?
4) Is there any association between diet quality and depression among older adults with low SES in Kelantan?
5) Is there any association between diet quality and empty nest among older adults with low SES in Kelantan?
6) Is there any association between sarcopenia and empty nest among older adults with low SES in Kelantan?
7) What are the risk factors of poor diet quality among older adults with low SES in Kelantan?

1.4 Objective

1.4.1 General:

To determine the association between sarcopenia, depressive symptoms and empty nest with diet quality among older adults with low socioeconomic status (SES) in Kelantan

1.4.2 Specific:

1) To determine the prevalence of sarcopenia, depressive symptoms and empty nest among older adults with low SES in Kelantan
2) To determine the adherence of the energy and nutrient intake of older adults with low SES in Kelantan to the Recommended Nutrient Intake (RNI) of Malaysia and their diet quality
3) To determine the association between diet quality and sarcopenia among older adults with low SES in Kelantan
4) To determine the association between diet quality and depression among older adults with low SES in Kelantan
5) To determine the association between diet quality and empty nest among older adults with low SES in Kelantan
6) To determine the association between sarcopenia and empty nest among older adults with low SES in Kelantan
7) To determine the risk factors of poor diet quality among older adults with low SES in Kelantan

1.5 Conceptual Framework

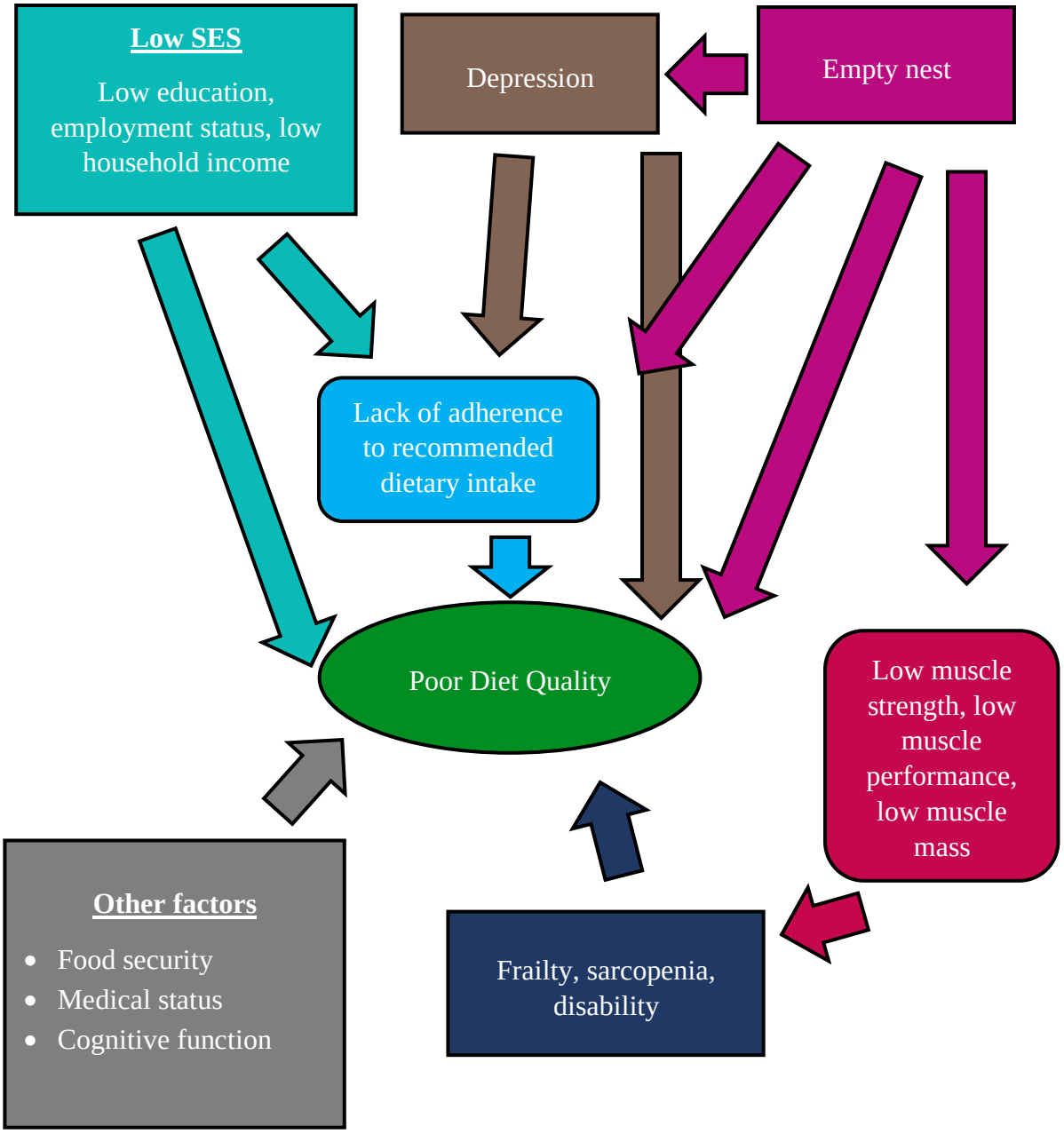

Figure 1. 1: Conceptual framework

Figure 1.1 shows the relationship between factors such as low SES, empty nest, depression and sarcopenia on the quality of diet among older adults. Older adults with low SES which consist of low education, employment status and low household income are more prone to have poor diet quality due to lack of adherence to recommended dietary intake. Food intake is further affected by loneliness from empty nest syndrome and depression together with reduced ability to assess and prepare food due to sarcopenia. Apart from diet quality, empty nest is a contributor to depression, low muscle strength, low muscle performance and low muscle mass as older adults tend to be physically inactive and have lack of healthy food consumption.

There are several other factors that may contribute to poor diet quality including food security, medical status and cognitive function. Food insecurity was found to be associated with lower diet quality especially among older adults with low SES (Leung & Wolfson, 2021). The study by Fanelli et al. (2020) found that those with a greater number of chronic conditions presented with poorer diet quality. Poor cognitive function among older adults might cause loss of cognitive control of eating. For example, poor episodic memory ability is related to reduced sensitivity to internal states of hunger and satiety causing a tendency towards uncontrolled eating (Higgs & Spetter, 2018).

1.6 Operational Definition

Older adults were individuals aged 60 years and above (Abdi et al., 2019).

Low socioeconomic status was defined as individuals who has low education level and were categorized in the B40 group with mean household income of RM4360 and below per month (Chamsuri et al., 2019)

Empty nest was defined as older adults who lived alone or with their spouse. They may not have children or have children who were staying in different districts, states or country (Chen et al., 2012)

Depressive symptoms were defined as having score of 5 and above in the Geriatric Depression Scale-15 (Vanoh et al., 2016).

Sarcopenia was defined using the Asian Working Group on Sarcopenia (AWGS) guidelines. Sarcopenia was defined as having low muscle strength and low muscle mass or muscle performance or having scored low in all the three categories (Chen et al., 2020).

Diet quality was defined as a dietary pattern or an indicator of variety across key food groups relative to those recommended in dietary guidelines. It is possible via the Healthy Eating Index (HEI) (Karupaiah et al., 2013).

CHAPTER 2

LITERATURE REVIEW

2.1 Definition of Aging

Aging as a multidimensional concept which may be defined in many perspectives. Aging is defined by most evolutionary biologist as an age-dependent or age-progressive reduction in intrinsic physiological function which lead to increase in age-specific mortality rate and decrease of age-specific reproductive rate (Libertini, 2019). Aging is defined as a reduction or loss (a 'de-tuning') of adaptation when age increase due to a time-progressive reduction of Hamilton's forces of natural selection (Chung et al., 2021). The concept of de-tuning of adaptation is applied as adaptation by natural selection depend on heritable variation in fitness. From a human development perspective, aging can be defined as a lifelong process from conception, birth, and maturity to death. From a societal perspective, aging is viewed as an aggregated statistics of the population's births and deaths in a society that show a successful health outcome of the country's socioeconomic development (Hamid, 2015).

Individual aging as the process of individuals growing older which is multidimensional and involves physical, social and psychological changes (Chalise, 2019). However, these changes are non-linear and inconsistent where they are not rigidly associated with age in years. For example, some older adults aged 70 years old might enjoyed good physical and mental function whereas others might have health problems or require support from others to meet the basic needs. This is because the mechanisms of aging are mostly random and the changes are significantly associated with environmental and behavioral factors (Medici, 2021). When discussing about aging, it is important to

distinguish between individual aging and population aging. Demographic or population aging is the process where the older individuals become a proportionately larger share of the total population (Balachandran et al., 2019). Increased in population aging in low- and middle-income countries might be due to large reduction of mortality at younger age during childhood and childbirth, also from infectious diseases (Bollyky et al., 2017). Whereas in high-income countries, ongoing incline in life expectancy nowadays mainly because of reduction in mortality among older adults (Bonnet et al., 2021).

There is no exact definition of 'old' as different societies has different concept of what they called it. The United Nations refer older people as those aged 60 years and above (Abdi et al., 2019). However, the age of 65 is commonly used in many developed countries to refer to older people because this age is usually when the person become entitled for old-age benefits (Ralston et al., 2015). In Malaysia, the older adult is defined as those who are 60 years old and above where the cut-off age adopted from the United Nations (Yunus et al., 2017). Chronological age is not important in defining old age compared to physical and mental capacity. Old age is usually related to change in social roles or activities such as being a grandfather or pensioner. It can also be defined as a stage at which physical and mental capacity is reduced (Amarya et al., 2018).

2.2 Population Aging

Population aging is a phenomenon that should not be ignored. There were 703 million older adults aged 65 years and above in the world in 2019 and projected to double to 1.5 billion in 2050 with the share of the older adults population increased from 6% in 1990 to 9% in 2019 and projected to increase further to 16% by 2050, so that one in six

people in the world will be aged 65 years and above (UN, 2019). In the earlier recorded history till now, young children have outnumbered the older adults. By 2035, older adults aged 55 years and above are expected to outnumber all children aged 0 to 14 years and the whole children and youth population aged 0 to 24 years by 2080 (Harasty & Ostermeier, 2020). Figure 2.1 shows the evolution of the number of four age groups including children (under 14 years old), youth (15 to 24 years old), adults (25 to 64 years old) and older adults (65 years or over). The figure shows that the adult population at working ages represent the largest age segment of the worldwide population in 1990 (42%), followed by children (33%). Although older adults only represent 6% of the total population in 1990, it is estimated to increase to 16% in 2050 while youth and children are estimated to decrease from 19% to 14% and 33% to 21% respectively over the same period (UNDESA, 2020).

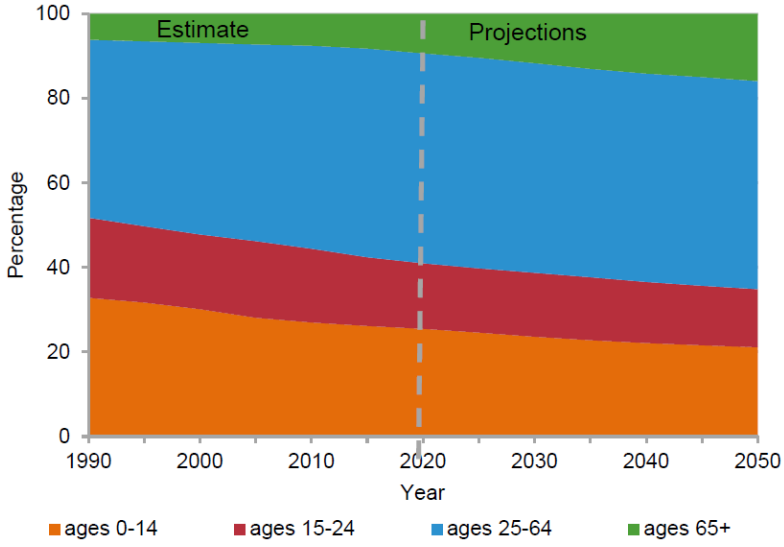

Figure 2.1: Population by broad age group, 1950-2100

Source: UNDESA (2020)

Aging occurs within the older adult's population itself. The number and proportion of people at very old age has been increasing. Globally, the number of 'oldest old' (older adults aged 80 and above) population increase nearly triple from 54 million to 143 million between 1990 and 2019 (UNDESA, 2019). The number is estimated to triple again between 2019 and 2050 reaching 426 million. Figure 2.2 shows that the proportion of older adults aged 80 years and above increased from 7% in 1950 to 14% in 2013 within the older adult's population. The proportion of oldest old is also projected to reach 19% in 2050 and 28% in 2100.

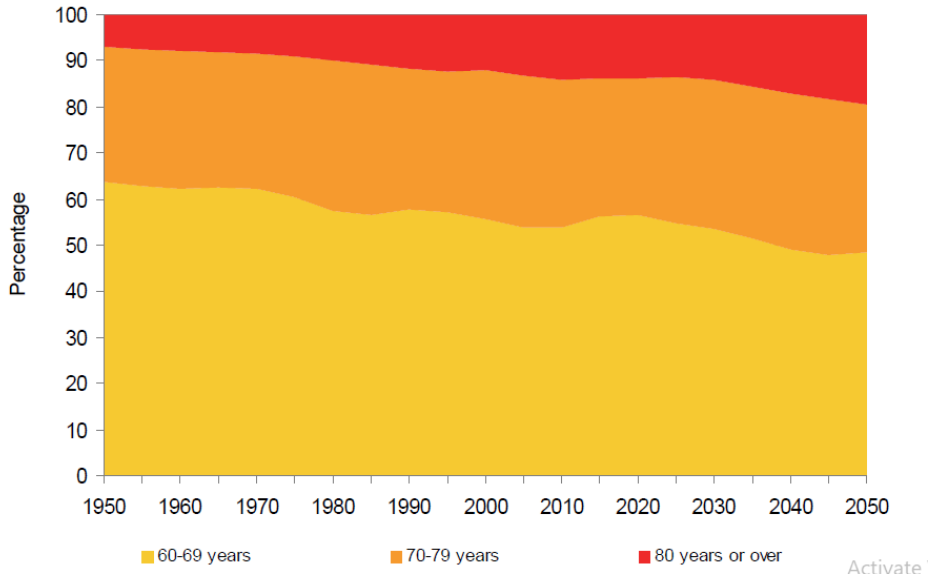

Figure 2.2: World distribution of population (60 years and above) by broad age, 1950-2050

Source: UNDESA (2013)

2.2.1 Causes of Population Aging

The changes in the age structure of the population are natural consequences of demographic transition. The demographic transition is a term used to describe population changes over time which is influenced by birth and death rates (Hamid, 2015). Bloom and

Luca (2016) explained demographic transition into three stages which started in a Malthusian world where both mortality and fertility rates are high and population growth is near zero. In the first stage, mortality begins to decrease while fertility remains high and the proportion of children increasing in the population as most of the mortality cases decrease among young ages. In the second stage, fertility begins to decrease and the population growth rate also decrease but remains positive. This phase may last for 40 or 50 years. In the third stage, mortality and fertility both reach equilibrium causing the overall population to stop growing and sometimes decreasing. At this stage, increased in longevity cause rapid increase in older adults' population while low fertility cause slowing in the growth of working-age population. As all the three stages of the transitions are completed, population growth returns to near zero as fertility and mortality stabilize at low levels. This process typically takes more than a century to complete (Bloom & Luca, 2016).

In demographic terms, the causes of population aging are divided into three concepts including decreasing in fertility and mortality which lead to the last concept which is increasing in life expectancy or longevity (Beard et al., 2016). According to the data from World Population Prospects: the 2012 Revision, fertility has been decreasing in most regions over the last several decades (UNDESA, 2013). Figure 2.3 shows the world's total fertility rate (TFR) has declined by about a half from 5.0 children per women in 1950-1955 to 2.5 children per women in 2010-2050. This is expected to continue decreasing in the coming decades where the world's TFR will decrease to 2.2 in 2045-2050 (UN, 2013). As fertility decreases, the numbers of young children decline, thus producing smaller

cohort of working age population. On the other hand, when life expectancy increased, number of older adults will also increase (Bloom & Luca, 2016).

Figure 2.4 shows that increased in life expectancy at birth have been occurring in all regions worldwide. At the global level, life expectancy at birth has reached 72.3 years and people who reached age 65 years in 2015-2020 can expect to live an additional of 17 years, in average (UN, 2019). Life expectancy at age 65 is estimated to increase in all regions between 2015-2020 and 2045-2050. However, increased in life expectancy did not result in population aging immediately. As improvement in live expectancy is most probably due to the decline in child mortality, this might cause increased number of children and reduced in the proportion of older adults. However, continuous improvement in life expectancy then cause increase in the proportion of older adults as more people survive their older ages. Eventually, low mortality and high life expectancy cause reinforcement of the impact of lower birth rates on population aging (UN, 2013).

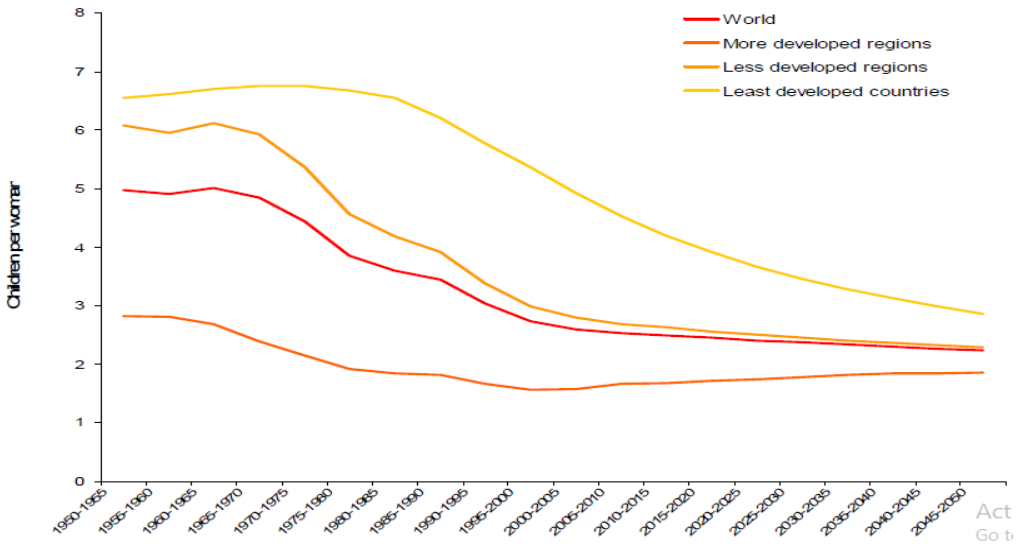

Figure 2.3: Total fertility rate: world and development regions, 1950-2050

Source: UNDESA (2013)

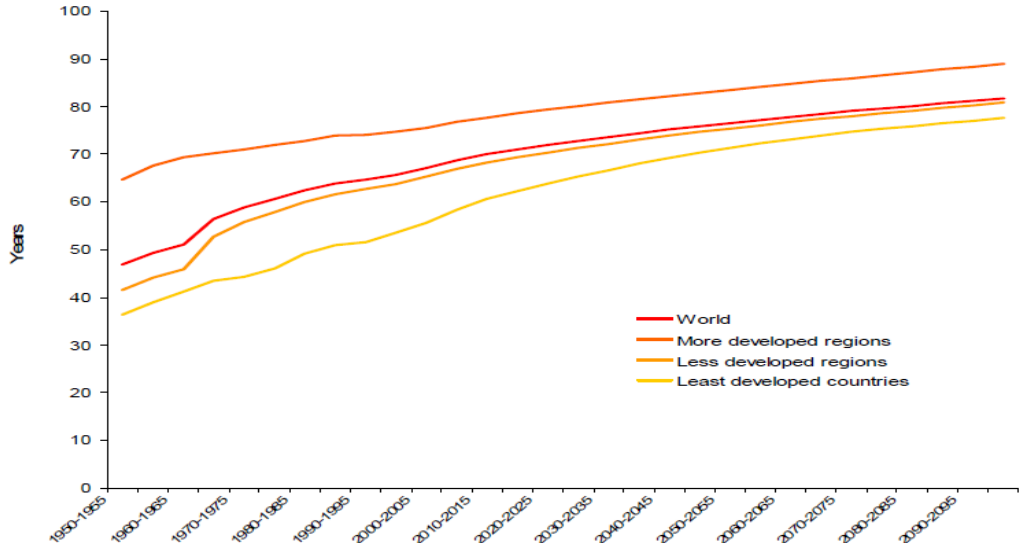

Figure 2.4: Life expectancy at birth: world and development regions, 1950-2050

Source: UNDESA (2013)

2.2.2 Population Aging in Malaysia

Like many other regions around the globe, Malaysia is also undergoing a rapid growth of older adult population. It might be the impact of socio-economic development over the decades and public health policies that cause decreased in fertility and increased in longevity causing rise in new generations (DOSM, 2019). The composition of the older adult's population aged 65 years and above increased from 6.5% in 2018 to 6.7% in 2019. Meanwhile, the population of children aged 0-14 years old decreased from 23.8% in 2018 to 23.3% in 2019 (DOSM, 2019). The increase in older adult's population leads to increase of the median age from 28.6 years in 2018 to 28.9 years in 2019. Figure 2.5 shows the population age structure and median age of Malaysia. The graph shows a steep decline in the population aged 0-14 years starting from 1965 to 1970 which indicated the start of declining fertility rate. In 2010, the graph shows an increase in the older adult's

population. The median age increases from 26.1 years in 2010 into 39.8 years in 2050 (Hamid, 2015).

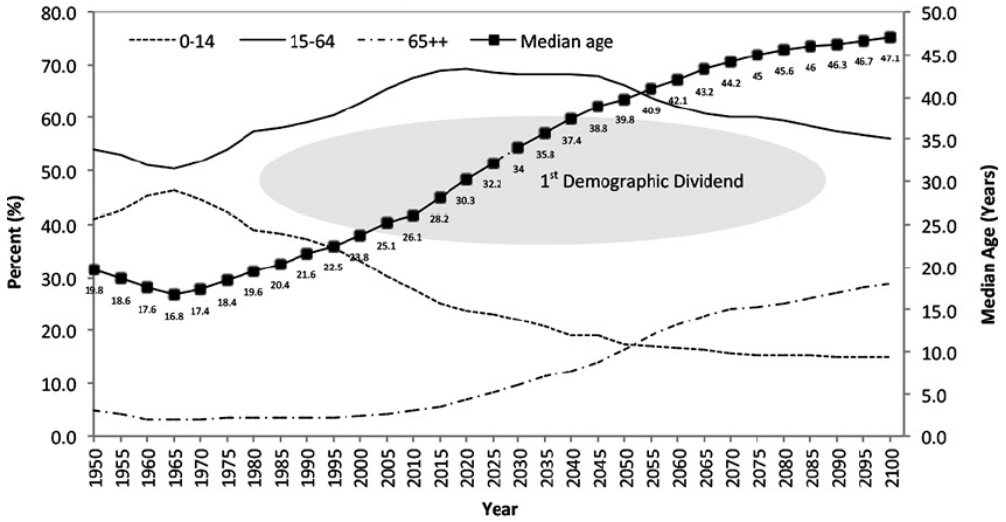

Figure 2.5: Population age structure and median age, Malaysia, 1950-2100

Source: World Population Prospects: The 2012 Revision (UN, 2013)

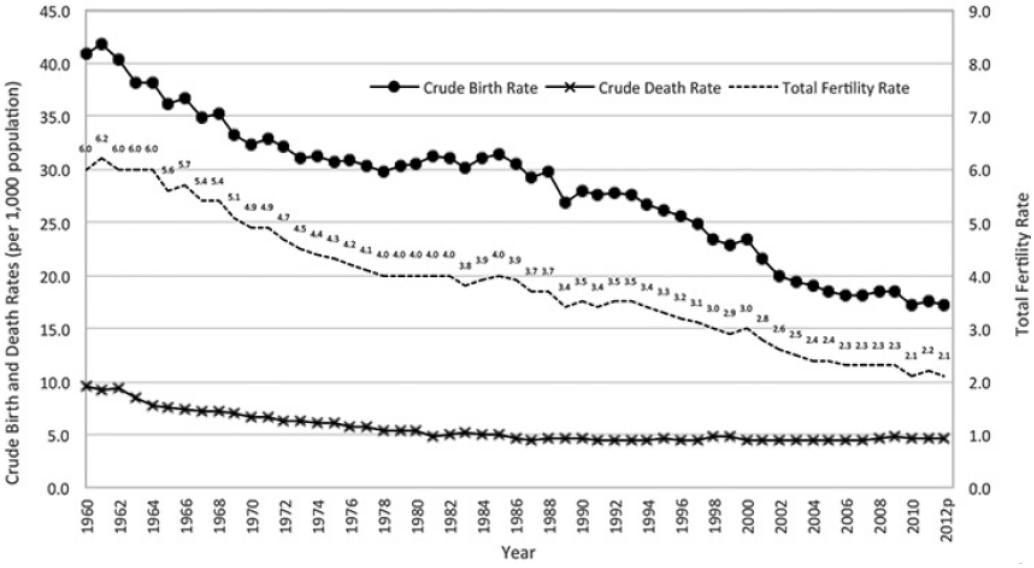

Figure 2.6: Crude birth rate, crude death rate and total fertility rate, Malaysia, 1960-2012

Source: DOSM (2014)

Malaysia is in the third stage of the demographic transition where the fertility rates are decreasing faster than mortality rates (Tey et al., 2016). During 1960s until 1970, birth

rates show a steep decline according to Figure 2.6 as Malaysia was actively promoting family planning aiming for smaller families. Even in the 1980s, Malaysia made an effort of more pro-natalist policies to increase the population, but the birth rates continue to decrease (Ng, 2021). At the same time, the leading cause of death changed from communicable diseases to non-communicable disease which leads to epidemiologic transition. Over the years, life expectancy at birth was increasing significantly as a new-born boy can expect to live on average for 72.2 years while new-born girl can expect to live on average for 77.3 years in 2019 (DOSM, 2019). Life expectancy at 65 years in 2019 for both males and females are 14.8 years and 17.1 years, respectively. This means that on average, older adults of both genders in 2019 might look forward to another fourteen to seventeen years of retirement living.

Population aging in Malaysia is happening at lower levels of development as compared to other regions. Many countries in Asia are getting old before getting rich including Malaysia, Thailand, Sri Lanka, Vietnam and many other Southeast Asian countries which are aging rapidly (Hamid, 2015). Singapore has a very small percentage of older adult's population with high gross of national income per capita (Maestas et al., 2016). On the other hand, Malaysia is aging at lower levels of development and at a rapid speed. Thus, well planned strategies are needed to avoid the problem of old age in Malaysia but at the same time addressing the needs of other groups in the population. Malaysia as a multi-ethnic country give a unique insight into the diversity of population aging with two of the largest ethnic groups in the world, Chinese and Indians, in addition to Malay which is the largest ethnic group in the country. In terms of life expectancy at birth, Chinese is the longest with 77.3 years followed by Bumiputera with 73.3 years and

Indians with 71.8 years in 2019 (DOSM, 2019). Therefore, due to their longevity in life, it is not a surprise that the Chinese are aging faster than other ethnic groups as shown in table 2.1.

Table 2.1: Percentage of the population in Malaysia by age group and ethnicity, 2005 & 2015

Ethnicity	2005			2015		
	0-14	**15-59**	**60+**	**0-14**	**15-59**	**60+**
Bumiputera	34.8	59.1	6.1	31.8	61.6	7.0
Chinese	25.3	64.5	10.1	22.6	65.3	12.1
Indian	28.8	64.9	6.3	25.8	66.4	7.8
Others	41.7	53.6	4.7	40.6	54.5	4.9
Malaysia	32.0	60.8	7.1	29.2	62.5	8.3
Non-Malaysian	15.7	81.7	2.6	6.7	90.5	2.9
Total	30.9	62.3	6.8	27.4	64.8	7.9

Source: Hamid (2019)

2.2.3 Physiological Changes Associated with Aging among Older Adults

Senescence can be defined as the organic process of growing older and portraying the characteristics of aging (Wellman & Kamp, 2017). The rate of changes varies among individuals and within the organ systems. Aging can be associated with gradual, lifelong stack of molecular and cellular damage that lead to progressive impairment in body functions which increased vulnerability to environmental challenges such as pollution, increased risk of diseases and death (Liguori et al., 2018). Some body functions that are impaired due to aging are movement, sensory system, cognitive function and immune system.

Muscle mass tend to decrease with increasing age which leads to decline in strength and musculoskeletal function (Boutari & Mantzoros, 2017). Moreover, aging is also related to decreasing bone mass or density which increases risk of fracture (known as

osteoporosis) (WHO, 2015). This might cause serious implications for disability, decrease quality of life and even death. Besides that, aging is frequently related with decrease in both vision and hearing ability. Age-related hearing loss is also known as presbycusis. It occurs due to cochlear aging, genetic susceptibility, environmental exposure, and increase in vulnerability from physiological stressor and lifestyle behaviours (Wang & Puel, 2020). The cumulative effect of daily exposure to noises such as traffic, loud music, machines, and noisy office might cause changes to the inner ear complex. The prevalence of presbycusis increased with age from 40% to 60% in person aged 75 years and above to more than 80% in person aged 85 years and above (Wellman & Kamp, 2017). Aging is also associated with vision impairment namely presbyopia which is a decrease in the ability to focus that cause blurring of near vision that often becomes obvious in midlife (Rozanova et al., 2018). These changes might provide great impact to older adults' everyday lives. Untreated hearing loss might affect older adults' communication and leads to social isolation and loss of autonomy together with depression, anxiety and decreasing cognitive (Cosh et al., 2018). On the other hand, visual impairments can cause limitation of mobility, trigger depression and eventually affect interpersonal interactions, increased risk of falls and accidents and make it hazardous to drive (Cosh et al., 2018).

Cognitive function deterioration differs greatly among individual and it is closely related to years of education. Usually, cognitive functions begin to decline at a relatively young age, with different functions declining at different rates. Therefore, this causes cognitive function becomes increasingly heterogeneous with aging (Lövdén et al., 2020). Various factors such as lifestyles, socioeconomic status, the use of medications and the presence of chronic diseases influenced the cognitive function among older adults (WHO,

2015). In addition, immune function also decreases with aging particularly involving T-cell activity (Castelo-Branco & Soveral, 2014). This limits the capacity to respond to new infections and vaccinations in later life which is also known as immunosenescence. Some research also found that chronic stress can cause reduction in immune response, lower the effectiveness of vaccines in older adults and increase inflammatory cytokines (inflammaging) which lead to frailty, sarcopenia and atherosclerosis (Macaulay et al., 2013).

2.3 Aging and Poverty

Poverty is one of the main issues that might affect the well-being of the older adults' population. Poverty is linked with low educational level, low income and malnutrition. A person's socioeconomic background, life situation and lifetime opportunities will determine their economic status in old age (Torres et al., 2018). Older adults who are advantaged during their earlier life stages may have better wealth accumulation than those who were disadvantaged. Therefore, their financial situation during old age depends on their financial and wealth accumulation in their younger age. Most poor older adults have limited access to good nutrition, adequate shelter, healthcare services and other basic services. There are noticeable differences between income and economic status with health. Older adults with higher income have greater health advantages than those with lower income. Older adults with high income may get the advantages of medical service access which enable them to cultivate a relatively healthy lifestyle (Atal & Cheng, 2016).

Moreover, poverty and vulnerability of older adults have significant association with the situation within the countries and the communities where they lived (Abdi et al.,