PATTERN AND RISK FACTORS OF FUNCTIONAL LIMITATION AND PHYSICAL DISABILITY AMONG COMMUNITY-DWELLING ELDERLY IN KUALA PILAH, MALAYSIA: A 12-MONTH FOLLOW-UP STUDY

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ORIGINAL LITERARY WORK DECLARATION

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Field of Study: Public Health, Ageing, Epidemiology

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ABSTRACT

Functional limitation and physical disability are among the common geriatric conditions that can result in poor health, dependency and institutionalisation. Age-related disability and restriction in the elderly function has become one of the priorities in public health. However, the data on incidence and risk factors associated with functional limitation and physical disability in Malaysia and other developing regions are sparse. Most studies utilized a cross-sectional design which restricts the causal interpretation and inhibits a clear understanding of the relationship between risk factors and occurrence of both conditions. The objectives of this study were; 1) to determine the pattern; in terms of prevalence, incidence and incidence of recovery of functional limitation and physical disability, 2) to identify its associated risk factors, 3) to describe the subtypes of physical disability among community dwelling elderly in Kuala Pilah, Malaysia. This was an observational population-based cohort study with a twelve months follow-up. The study was conducted in Kuala Pilah district, Negeri Sembilan and elderly aged 60 years and above were selected and invited to participate in this study. The data on participants' risk factors and physical function status were collected during comprehensive, home-based assessments, which were completed at baseline and twelve months of follow-up. Disability was assessed during three monthly telephone interviews. Beside their socio-demographic characteristics, other risk factors assessed included depressive symptomology, cognitive impairment, social support level, self-reported visual impairment, history of fall and anthropometry measures. Outcome measures were assessed at twelfth months using validated tools for physical disability (Katz Activity of Daily Living and Instrumental Activity of Daily Living) and functional limitation (4-metre walking speed test). The overall prevalence of functional limitation was 62.8%, Instrumental Activity of Daily Living disability was 32.7% and Activity of Daily Living disability was 7.1%. The incidence of functional limitation at

twelve months of follow-up was 38.4%, IADL disability was 24.8% and ADL disability was 4.8%. The common risk factors for incidence of functional limitation and physical disability were elderly women, advancing age and low educational level. The incidence of recovery from functional limitation at twelve months of follow-up was 31.5%, IADL disability was 34.2% and ADL disability was 43.9%. The most common disability subtype was short term disability, followed by transient disability, long-term disability and recurrent disability. The prevalence and incidence of functional limitation and IADL disability were common among elderly in Kuala Pilah, Malaysia. The prevalence and incidence of ADL disability were lower compared to elderly populations in developed countries. The findings from this study had provided clearer understanding on the relationship between specific impairments and risk factors to the development of functional limitation and physical disability. Specific prevention and early therapeutic interventions can now be outlined in order to optimise function and reduce the disability among elderly.

ABSTRAK

Fungsi badan terhad dan ketidakupayaan fizikal adalah di antara masalah yang sering dihidapi oleh golongan warga emas. Keadaan ini boleh menyumbang kepada masalah kesihatan yang teruk, kebergantungan dan penempatan warga emas di institusi jagaan warga emas. Ketidakupayaan fizikal dan fungsi badan terhad adalah salah satu keutamaan di dalam bidang kesihatan awam. Walaubagaimanapun, data berkaitan insidens dan faktor penyebab kepada keadaan tersebut di Malaysia dan negara membangun yang lain adalah terhad. Kebanyakan kajian yang telah dijalankan sebelum ini adalah kajian prevalens dan ini membatasi pemahaman yang lebih jelas mengenai hubungan di antara faktor risiko dengan kedua-dua keadaan tersebut. Objektif kajian ini adalah; 1) Mengenalpasti corak (prevalens, insidens dan insidens sembuh) fungsi badan terhad dan ketidakupayaan fizikal, 2) Mengenalpasti faktor risiko yang menyebabkan fungsi badan terhad dan ketidakupayaan fizikal, 3) Mengenalpasti jenis ketidakupayaan fizikal di kalangan warga emas yang tinggal di Kuala Pilah, Malaysia. Kajian ini adalah kajian pemerhatian kohort di kalangan masyarakat selama 12 bulan. Kajian ini dijalankan di Kuala Pilah, Negeri Sembilan dan warga emas terpilih adalah yang berusia 60 tahun dan ke atas. Data berkaitan maklumat faktor risiko dan status fungsi fizikal diambil semasa temubual dijalankan dari rumah ke rumah pada awal permulaan kajian dan 12 bulan berikutnya. Ketidakupayaan fizikal juga dinilai dengan temubual melalui telefon kepada warga emas terpilih setiap tiga bulan. Selain sosio-demografik responden, faktor risiko yang lain juga dinilai seperti skala kemurungan, skala fungsi kognitif, skala tahap sokongan sosial, masalah penglihatan dan sejarah jatuh. Hasil kajian dinilai pada 12 bulan kemudiannya menggunakan skala ketidakupayaan fizikal (Katz Activity Daily Living dan Instrumental Activity Daily Living) dan fungsi badan terhad (ujian berjalan sejauh 4 meter). Prevalens keseluruhan untuk fungsi badan terhad adalah 62.8%, ketidakupayaan instrumental aktiviti kehidupan harian (IADL) 32.7%

dan ketidakupayaan aktiviti kehidupan harian (ADL) adalah 7.1%. Insidens fungsi badan terhad dalam tempoh 12 bulan berikutnya adalah 38.4%, ketidakupayaan instrumental aktiviti kehidupan harian (IADL) 24.8% dan ketidakupayaan aktiviti kehidupan harian (ADL) adalah 4.8%. Faktor risiko kepada insidens fungsi badan terhad dan ketidakupayaan fizikal adalah peningkatan umur, warga emas wanita dan tahap pendidikan yang rendah. Insidens sembuh daripada fungsi badan terhad dalam tempoh 12 bulan adalah 31.5%, ketidakupayaan instrumental aktiviti kehidupan harian 34.2% dan ketidakupayaan aktiviti kehidupan harian 43.9%. Jenis ketidakupayaan fizikal yang paling kerap adalah ketidakupayaan fizikal jangka pendek, diikuti oleh ketidakupayan fizikal sementara, ketidakupayaan fizikal jangka panjang dan ketidakupayaan fizikal berulang. Prevalens dan insidens untuk fungsi badan terhad dan ketidakupayaan instrumental aktiviti kehidupan harian adalah masalah yang biasa dialami oleh warga emas di Kuala Pilah, Malaysia. Prevalens dan insidens untuk ketidakupayaan aktiviti kehidupan harian adalah rendah berbanding dengan warga emas di negara maju**.** Hasil pemerhatian yang diperolehi daripada kajian ini juga telah dapat menerangkan dengan lebih jelas hubungan di antara faktor risiko dengan kejadian fungsi badan terhad dan ketidakupayaan fizikal. Langkah pencegahan spesifik dan intervensi perawatan yang awal dapat dirancang dalam mengoptimakan fungsi dan mengurangkan ketidakupayaan fizikal di kalangan warga emas.

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LIST OF ABBREVIATIONS

ADL	Activity of Daily Living
AGS	American Geriatric Society
ANOVA	Analysis of Variance
APTA	American Physical Therapy Association
BADL	Basic Activity of Daily Living
BIA	Bio Impedance Analysis
BMI	Body Mass Index
CHD	Congestive Heart Failure
CI	Confidence Interval
DG	Director General
DM	Diabetes Mellitus
DSSI	Duke Social Support Index
DOS	Department of Statistics
EB	Enumeration Block
EFA	Explanatory Factor Analysis
EPESE	Established Population for Epidemiology Studies of the Elderly
FFM	Fat Free Mass
FOF	Fear Of Falling
GDS	Geriatric Depression Scale
IADL	Instrumental Activity of Daily Living
ICC	Intraclass Correlation Coefficient
ICF	International Classification of Functioning, Disability and Health
JKNNS	Jabatan Kesihatan Negeri, Negeri Sembilan
LQ	Living Quarter
MCAR	Missing Completely At Random
MHAS	Mexican Health and Ageing Study
MMSE	Mini Mental Status Examination
MOH	Ministry of Health
MRC CFAS	Medical Research Council Cognitive Function and Ageing Study
NERI	New England Research Institute
NHANES	National Health and Nutrition Examination Survey
NHMS	National Health and Morbidity Survey
NHS	National Health Surveys
NMRR	National Medical Research Registry
OECD	Organisation for Economic Co-Operation and Development
OR	Odd Ratio
PASE	Physical Activity Scale of the Elderly
POMA	Performance Oriented Mobility Assessment
PR	Prevalence Ratio

PSU	Primary Sampling Unit
SD	Standard Deviation
SPPB	Short Physical Performance Battery
TBW	Total Body Water
TMIG	Tokyo Metropolitan Institute of Gerantology
TUG	Timed Up and Go
UN	United Nations
USA	United States of America
WHO	World Health Organization

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CHAPTER 1: INTRODUCTION

About The Chapter

The first chapter of my thesis introduces the general aspects of the thesis. The demography, population growth of the elderly and problems related to elderly health are discussed in this chapter. The conceptual definition of functional limitation and physical disability are stated here, as well as the two theories of disablement; Nagi disablement model and the WHO International Classification of Functioning, Disability and Health. The last part of this chapter discusses the rationale of conducting the present study as well as the general and specific objectives of the study.

1.1 General Introduction

1.1.1 The Global Scenario of Ageing Population

The world's population today is heading towards an ageing society. Annualy there is tremendous growth in the number of people aged 60-years and above. Population ageing is defined as the increasing proportion of elderly in the total population (Wan Ahmad et al., 2011) and also refers to the alterations in the age structure of a population, which results in increasing proportions of the population at older ages, and consequently decreasing proportions at younger ages (Hermalin et al., 2002). Population ageing is becoming one of the most important demographic phenomena (Mohamed Zaki et al., 2014) and the outcome of declining fertility and improving survival rates resulting from increased access to improved health care facilities, better sanitation and nutritional status of the population. Countries begin to age when fertility rates decline and mortality rates improve, especially at the adult ages (Kinsella, 1996). Declining fertility rates result in smaller additions to the population of younger cohorts, while improvements in survival rates contribute to large numbers

reaching to age 60 years and above, thereby leading to population ageing (Wan Ahmad et al., 2011).

In developed regions, the population aged 60 or over is increasing at 1.0 per cent annually before 2050 and 0.11 per cent annually from 2050 to 2100. It is expected to increase by 45 per cent by the middle of the century, rising from 287 million in 2013 to 417 million in 2050 and reaching 440 million in 2100 (United Nations, 2013). In less developed regions, the populations aged 60 or over are currently increasing at the fastest pace ever, 3.7 per cent annually in the period 2010-2015 and are projected to increase at 2.9 per cent annually before 2050 and 0.9 per cent annually from 2050 to 2100. Its numbers are expected to increase from 554 million in 2013 to 1.6 billion in 2050 and to 2.5 billion in 2100 (United Nations, 2013). The number of persons aged 60 or over is expected to increase more than triple by 2100 and those aged 80 or over is projected to increase almost seven-fold by 2100, increasing from 120 million in 2013 to 392 million in 2050, and 830 million in 2100. Currently, just over half of all persons aged 80 and over live in developing countries, but that share is expected to reach 68 per cent in 2050 (United Nations, 2013).

Developed regions, especially western countries have recognised and used the chronological age of 65 years to define 'elderly' or ‘older person’ (WHO, 2012), but like most of the concepts from the western region which are usually not well adapted in the situation of many developing countries, this cut-off age is not suitable for use in developing nations where the population’s life expectancy is shorter than developed nations. The definition of elderly in many countries is set at an age when someone can obtain their pension benefits. Currently, there is no standard definition of the elderly but the cut-off age of 60 years is to be referred as older population (WHO, 2012).

1.1.2 Demographic of the elderly population in Malaysia

The growth of the elderly people are currently more rapid in developing countries compared to the developed nations which are undergoing relatively little change in the growth of their older population (Kinsella, 2009). Malaysia which is categorized as upper middle income country is an example of one of the developing countries that is currently experiencing tremendous growth of its elderly population.

The 2010 Population and Housing Census of Malaysia (Department of Statistics Malaysia, 2010) revealed that the total population of Malaysia was 28.3 million, as compared to 23.3 million in 2000, with an average annual population growth rate of 2.0 per cent for the period 2000-2010. The total population was 28.3 million of which 91.8 per cent were Malaysian citizens and 8.2 per cent were non-citizens. Malaysian citizens consist of the ethnic groups Bumiputera (67.4%), Chinese (24.6%), Indians (7.3%) and Others (0.7%). Bumiputera is a Malay term to describe the Malay race and other indigenous people of Malaysia such as Iban and Kadazan.

The main groups that constitute the Bumiputera ethnic group are Malay which is the predominant ethnic group in Peninsular Malaysia (63.1%), Ibans which constituted 30.3 per cent of the total citizens in Sarawak and Kadazan/Dusun which made up 24.5 per cent in Sabah. The proportion of the population of Malaysia below the age of 15 years decreased to 27.6 per cent as compared to 33.3 per cent in 2000. In contrast, the proportion of working age population (15 to 64 years) increased to 67.3 per cent from 62.8 per cent (Department of Statistics Malaysia, 2010). The composition of the population in Malaysia according to age group and sex in 2000 and 2010 is shown in Figure 1.1.

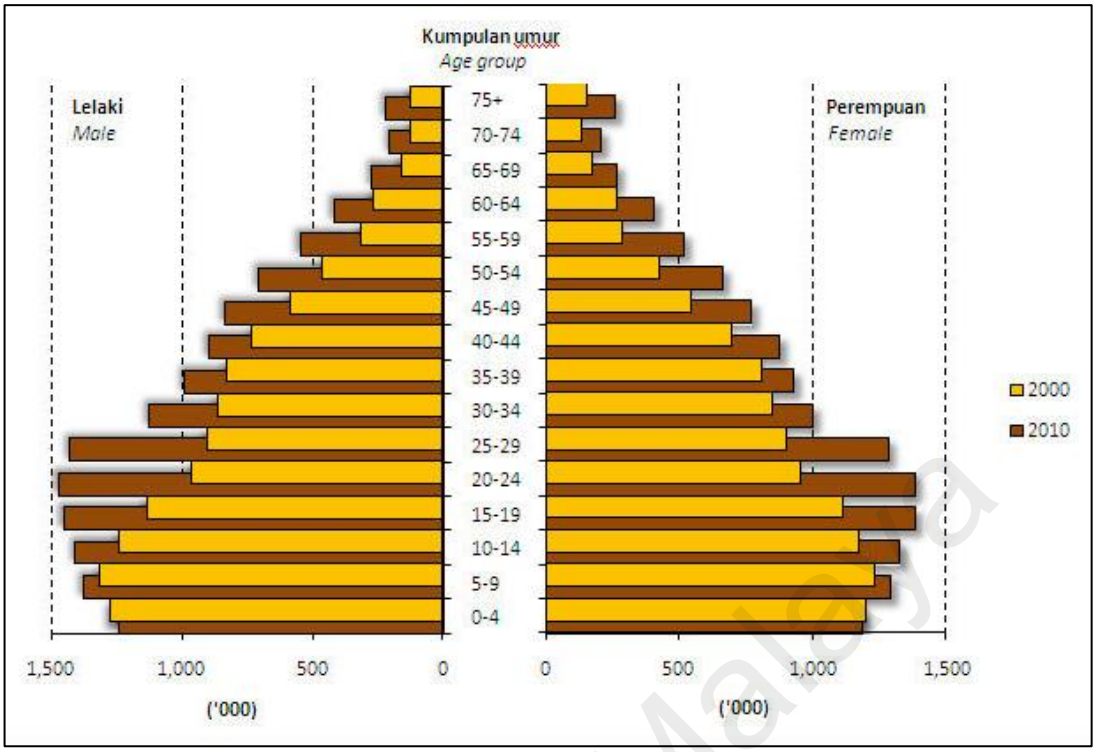


Figure 1.1: Number of population by sex and age group in Malaysia year 2000 and 2010 (Source: Department of Statistic, Malaysia (2010). Census 2010: Population Distribution and Basic Demographic Characteristic Report 2010).

In Malaysia, the percentage of population aged 65 years and over increased to 5.1 per cent in 2010 as compared with 3.9 per cent in 2000 (Department of Statistics Malaysia, 2010) and the proportion of those age 60 years and above is expected to grow from 6.3% (1.4 million) in 2000 to 12% (4.9 million) by 2030 (Department of Statistics Malaysia, 2005). Consequently, the median age had increased from 23.6 years in 2000 to 26.2 years in 2010, while the dependency ratio dropped from 59.2 per cent to 48.5 per cent. The trend of these indicators is in line with the transition of age structure towards ageing population of Malaysia (Mohamed Zaki et al., 2014). By year 2020, 9.5% of the Malaysian population will be 60 years and above (Mohamed Zaki et al., 2014).

In Malaysia, the definition of elderly people as stated in the National Policy for Elderly are those people who are over 60 years old, in line with the definition from the World Assembly on Ageing in Vienna in 1982 (United Nation, 1983).

1.2 Problems related to ageing population

Change in the demographic profile in the population results in epidemiologic shift where increasing life expectancy and number of elderly people as a result of better immunity against acute diseases eventually result in increased cases of chronic diseases and disability (WHO, 2004). Majority of the elderly population (55%) suffered from chronic diseases that lead to limitation in their functional status and disablement (Putignano et al., 2012).

In United States, the most prevalent chronic diseases among the elderly aged over 65 years were hypertension (60%), cholesterol disorders (41%), arthritis (28%), heart disease (25%), and eye disorders (23%) (Anderson, 2010). In Malaysia, the prevalence of heart disease among elderly aged 60-69 years and 70 years and older was 10.4% and 12.6% as reported by our National Health and Morbidity Survey in 2011. The same survey found the prevalence of stroke and arthritis among elderly aged 70 years and older were 5.8% and 19.2% respectively (NHMS, 2011). An earlier study conducted among elderly patients admitted to tertiary hospitals in Malaysia noted that the most common prevalent chronic diseases were cardiovascular diseases (21.2%), followed by neoplasms (16.8%), genitourinary diseases (13.9%), respiratory diseases (7.7%), endocrinology, nutrition and metabolic diseases (7.1%) (Latiffah et al., 2006).

Besides chronic diseases, there are also other prevalent diseases that affect a large number of the elderly people with uncommon symptoms such as immobility, cognitive function impairment and incontinence, which is referred to as geriatric syndromes (Olde Rikkert et al., 2003).

1.2.1 Geriatric syndromes

Geriatric syndromes can be defined as health conditions that arise when the collective impairments involving multiple organs and body systems make an elderly

susceptible to any situational challenges due to multiple contributing factors (Inouye et al., 2007). Geriatric syndromes usually include various abnormalities that typically co-exist and correlate with each other to cause a single apparent outcome. For example, in the case of delirium, the collective effects of many risk factors such as cognitive impairment, severe sickness and advancing age lead to the development of delirium phenomenology (Flacker, 2003).

The term "syndrome" that is being used in geriatric highlights the multiple causation of a combined manifestation (Inouye et al., 2007). Parallel with this usage, the concept of geriatric syndromes can be applied with the concept of "phenotype" where the recognizable features of an individual whether physically or biochemically is determined by their genetic and surrounding environment (Inouye et al., 2007). Figure 1.2 highlights the conceptual differences for the terminology "disease", "syndrome" and "geriatric syndrome".

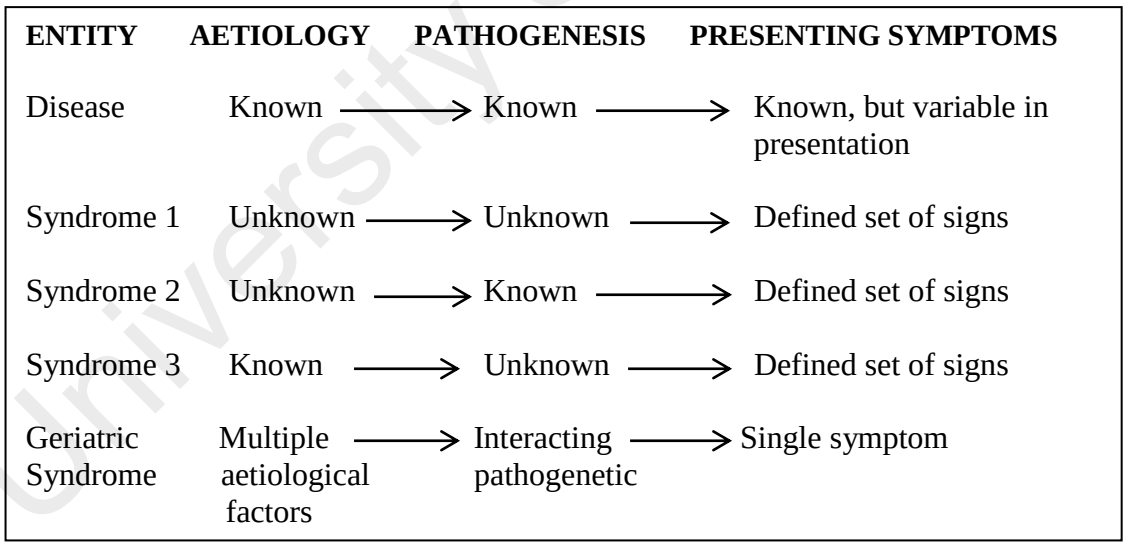


Figure 1.2: Schematic conceptual differences between disease, syndrome and geriatric syndrome term. (Source: Olde Rikkert et al (2003). Geriatric syndromes: medical misnomer or progress in geriatrics? *The Nederlands Journal of Medicine*, 61(3), 83-87).

Geriatric syndromes are commonly due to multifactorial health conditions targeting multiple organs leading to impairment and often inflicting the vulnerable elderly (Wald, 2012). Pressure ulcers, falls, delirium and functional limitations are

examples of geriatric syndromes which occur frequently among hospitalized elderly resulting in significant morbidity, premature mortality, and increased resource utilization (Wald, 2012). Other common geriatric syndromes are physical disability, visual and hearing impairments, urinary incontinence, falls, depression, osteoporosis, and poor nutrition (Mohile et al., 2011).

1.2.2 Functional limitation and physical disability

Functional limitation and physical disability are among the most common geriatric conditions (Guralnik et al., 2003), that can lead to adverse consequences in the elderly such as dependency and institutionalisation. In the United States, report from governmental agency showed that 28% of community-dwelling elderly aged over 65 years and were Medicare recipients had difficulty to perform at least one activity of daily living with 12% of them reporting having difficulty in finishing instrumental activities of daily living (Department of Health and Human Services Administration on Ageing, 2012). Functional limitation and decline lead to serious and severe complications that create problems in the elderly's capability to live independently in the community and negatively affect their social function and quality of life (Puthoff, 2006).

Restriction or limitation in the ability to perform normal and usual activities in day to day life can be regarded as disability (Verbrugge et al., 1994), and the word 'disability' itself assist us in measuring the effect of certain diseases or injuries (Abdulraheem et al., 2011). The recent definition of disability according to the International Classification of Functioning, Disability and Health (ICF) developed by the World Health Organization (WHO) is limitation in functioning due to combination and interactions between the individual's health condition such as diseases, injuries, and disorders with factors in the environment (WHO, 2006).

Functional limitation is defined as the incapability of an individual to perform specific tasks either physically or mentally in everyday life. According to the WHO, limitation in functional status comprise any health problems that inhibits a person from finishing either simple or complex tasks and eventually restrict the individual's performance (Verbrugge et al., 1994). Functional status is usually assessed with reference to specific tasks, for example whether the person can walk independently for four metres, lifts certain objects, or grasps a pencil.

1.2.3 The difference between functional limitation and physical disability

The words "action" and "activity" are simple terms to distinguish the concepts of functional limitation and disability. These words help convey the generic (situation-free) features of one and the social (situational) features of the other. This distinction has been recognized and described by Haber (1990) and Pope (1991): "Functional limitation refers to individual capability without reference to situational requirements" (Haber, 1990). Disability is a social process—the pattern of behaviour arising from the loss or reduction of ability to perform expected or specified social role activities of extended duration because of a chronic disease or impairment (Haber, 1990). Disability refers to the expression of a functional limitation in a social context (Pope, 1991) while physical disability refers specifically disability in performing physical activities. Functional limitation and disability refer to different behaviours, not to different aspects or ways of measuring the same behaviour. Kelly-Hayes and colleagues (1992) suggested that functional limitation and physical disability in the elderly are two distinct concepts and that the measure of choice for both conditions should be in accordance to the objectives and type of study population (Kelly-Hayes et al., 1992).

1.3 Theoretical model of disablement

There were numerous theoretical models that have been proposed from previous researchers for better understanding of association between age and decline in physiological systems that can result in functional deficits among elderly people (Puthoff, 2006). The two most common theoretical models were Nagi disablement model and the model of WHO International Classification of Functioning, Disability and Health.

Nagi disablement model is one of the theoretical models that is widely used in research and also well accepted by healthcare practitioners (Verbrugge et al, 1994). This model was conceived and developed by sociologist Saad Nagi (Nagi, 1965; Nagi, 1979; Nagi, 1991). The model was used to elucidate the reason why some elderly lose the ability to perform daily activities. The International Classification of Functioning, Disability and Health, known more commonly as ICF, is WHO's framework for health and disability. It is the conceptual basis for the definition, measurement and policy formulation for health and disability. It is a universal classification of disability and health for use in health and health related sectors.

The ICF model has two parts, each with two components. Part 1 is entitled Functioning and Disability, which includes body functions and structures as well as activities and participation. Part 2 is entitled Contextual Factors, which includes environmental factors and personal factors. Unlike the Nagi model, each component of the ICF can be expressed in both positive (e.g positive aspect is functional and structural integrity) and negative terminology (e.g negative aspect for the same component was impairment). However, both models have in common the view that overall disablement represents a series of related concepts that describe the consequences or impact of a health condition like arthritis and diabetes on a person’s body, on a person’s activities, and on the wider participation of that person in society (Jette et al., 2003). Table 1.1

shows the general comparion between Nagi's disablement model and International Classification of Functioning, Disability and Health (ICF).

Table 1.1: Comparison between Nagi's disablement model and ICF

Models	Anatomical Body Parts	Physiological Functions of the Body	Task Performance	Involvement in Life Roles
Disablement Model	Pathology	Impairment	Functional Limitations	Disability
	Disease, injury, congenital conditions	Dysfunctions and structural abnormalities in specific body systems	Restriction in basic physical and mental actions	The expression of a physical or mental limitation in a social context
ICF	Body Function and Structures		Activity and Participation	
	Physiological functions of body systems and anatomical parts of body		Activity: Execution of a task or action Participation: Involvement in a life situation	

Source: Jette AM, Keysor J. Disability Models: Implications for Arthritis Exercise and Physical Activity Interventions. Arthritis and Rheumatism (Arthritis Care and Research), 2003: 49: 114-120.

1.4 Rationale and purpose of the study

The present "ageing population" result in substantial increase in the numbers and proportion of elderly. Ageing is characterized by loss of function and elderly are among the most sedentary segment of society (Paterson et al., 2010). In many respects the increased life expectancy now appears to be exceeding our ability to maintain function and functional independence. A large proportion of elderly may live perilously close to important thresholds of physical ability that may render them dependent. The reduced quality of life and the social and economic (health-care) consequences are staggering and alarming (Paterson et al., 2010).

Numerous studies on functional limitation and physical disability had been conducted mostly in developed countries as these two conditions had become their main focus and concern (Kelly-Hayes et al., 1992; Gill et al., 2003; Lafortune et al., 2007;

Alexandre et al., 2012). In Malaysia, there was a prevalence study on functional limitation and physical disability conducted by Hairi and colleagues in 2010 among community-dwelling elderly in Melaka. In that study, about one-fifth of the elderly population reported had functional limitation and the prevalence of ADL disability ranged from 10% to 30% (Hairi et al., 2010). However, there is no data available on incidence of functional limitation and physical disability as well as subtypes of physical disability among elderly in Malaysia. Such data were also scanty for other developing countries. Many previous studies utilize a cross-sectional design, probably due to the time intensive nature and high cost associated with repeated, one-on-one contact with participants. However, this restricts causal interpretation and inhibits a clear understanding of how the relationship between risk factors and incidence of functional limitation and physical disability.

During the past decade, evidence supporting the dynamic nature of disability has emerged with the availability of multiple waves of data from longitudinal studies (Gill et al., 2008). Evidence from these longitudinal studies showed that disability is reversible and often recurrent based from monthly assessments of functional status (Gill et al., 2003; Hardy et al., 2004; Gill et al., 2008). Moreover, it was found that multiple transitions between different disability states were common in elderly (Hardy et al., 2005). These findings supported an emerging paradigm of disability as a complex and highly dynamic process with considerable heterogeneity, which highlighted the need for additional research to further enhance understanding of the disabling process in elderly. Currently, there are still no published studies focusing on different subtypes of disability among elderly in Malaysia.

The purpose of this study is to determine the pattern (prevalence, incidence and incidence recovery) of functional limitation and physical disability and its' associated risk factors. The other purpose of the current study is to characterize the subtypes of

disability. This is important because it will be beneficial for effective prevention and early recognition and also for the management of collective comorbid diseases and syndromes. This will eventually result in prevention of disability and increase the quality of life among elderly population. In terms of public health, the benefits derived from a more physically independent elderly population are essential for maintenance of a cost effective health-care delivery system. By identifying distinct subtypes of disability, it is hoped that the knowledge about the disabling process will further enhance and spur additional research that embrace the inherent complexity of disability. The goal is to reduce the overall burden of disability in elderly persons.

1.5 Research questions

The research questions of the present study are:

1. What is the prevalence of functional limitation and physical disability among the community-dwelling elderly in Malaysia?

2. What is the incidence and risk factors associated with functional limitation and physical disability at twelve months follow-up among the community-dwelling elderly in Malaysia?

3. What are the incidence of recovery from functional limitation and physical disability and risk factors associated with the recovery from both conditions at twelve months follow-up?

4. What are the subtypes of physical disability among community dwelling elderly in Malaysia?

1.6 Study objectives

1.6.1 General Objective

To determine the pattern and risk factors of functional limitation and physical disability among the community dwelling elderly in Kuala Pilah district, Negeri Sembilan.

1.6.2 Specific Objectives

a) To describe the prevalence of functional limitation and physical disability among community dwelling elderly in Kuala Pilah district, Negeri Sembilan.

b) To determine the incidence and risk factors associated with functional limitation and physical disability at twelve months follow-up.

c) To determine the incidence of recovery and risk factors associated with recovery from functional limitation and physical disability at twelve months follow-up.

d) To describe the subtypes of physical disability (transient, short term, long term, recurrent and unstable disability) among community dwelling elderly in Kuala Pilah, Negeri Sembilan.

CHAPTER 2: LITERATURE REVIEW

About the chapter

The second chapter of this thesis discuss the literature review that was conducted during the early phase of the research. This chapter start with the description of theories of disablement and disablement process model. Both the prevalence and incidence of functional limitation and physical disability based from previous literature are stated here as well as the information on subtypes of physical disability. Risk factors associated with functional limitation and physical disability that were identified from other studies are also described in this chapter. The final part of this chapter explains the conceptual framework for this research based upon literature review.

2.1 Theoretical model of disablement

2.1.1 Nagi disablement model

The Nagi disablement model explained how acute and chronic conditions can lead to specific deficits of body systems functions which were declines in basic physical and mental tasks. These deficits caused limitation in daily living activities. Generally, this model has been used to describe how age-associated alterations in the body system can cause reduction in the elderly's capacity to fulfill their social duties (Puthoff, 2006). The disablement model based on the Nagi Scheme described the disablement process into four main stages or levels: pathology, impairments, functional limitation and disability as shown in the Figure 2.1.

PATHOLOGY ↔	IMPAIRMENTS ↔	FUNCTIONAL LIMITATION ↔	DISABILITY
Interruption or interference normal processes	Anatomical, physiological, mental or emotional abnormality or loss	Limitation in performance at the level of the person	Limitation in performance of socially defined roles and tasks within the environment
Stroke-denervated arm muscle	*Muscle atrophy*	*Inability to move arm*	*No longer dine out with friends*

Figure 2.1: The disablement model based on Nagi model of disability (Source: Verbrugge LM, Jette AM. The disablement process. Social Science and Medicine 1994:38 (1):1-14).

2.1.1.1 First stage: Pathology

Pathology is defined as the existence of abnormalities in the body whether changes in the biochemical or physiological components due to an acute or chronic disease state (Verbrugge et al., 1994). These changes start at the fundamental stage which is at the cellular level and usually the progression is slow and takes years before it can manifest. The stimulus for the start of this pathological process is the age-associated changes in the physiological systems. Chronic pathology encompasses progressive diseases, injuries with long term sequelae, and enduring structural or sensory abnormalities. Acute pathology includes the short-term diseases and injuries, usually less than three months in duration. Examples of pathology (stated as diagnoses) are osteoarthritis, lung cancer, cataracts, tinnitus and Alzheimer's disease.

2.1.1.2 Second stage: Impairment

Impairment is defined as pathological changes that have progressed to another level and can cause malfunctions to certain body systems that deviate from normal functions (Verbrugge et al., 1994). Impairment also refers to dysfunctions and

significant structural abnormalities in specific body systems. “Significant” means that the abnormality can have consequences for physical, mental or social functioning.

Impairments occur in the pathology’s primary locale, but they may also occur in secondary locales, either immediately or delayed. For example, diabetes has primary impact on the metabolic system, but it can also affect the cardiovascular, renal and other systems. Medical procedures to evaluate impairments include clinical examination, laboratory tests, imageing procedures and patients’ medical history and symptom reports. The results are used directly to score the severity of the pathology.

2.1.1.3 Third stage: Functional limitation

Functional limitations are restrictions in performing fundamental physical and mental actions used in daily life by one’s age-sex group (Verbrugge et al., 1994). At this stage, the impairment has already caused significant effect which is restrictions in doing the activities that are essential for day to day living. Fundamental physical (body) actions include overall communication, mobility, discrete motions and strengths, visual and auditory functions. Examples are difficulty in walking, lifting objects, climbing stairs, reading standard-size print and hearing other people speak in a room. Basic mental (mind) actions include central cognitive and emotional functions; examples are short-term memory, intelligible speech, alertness in daytime activities, orientation in time and space and positive affect.

2.1.1.4 Fourth stage: Disability

This is the level where the functional limitations have progressed to a stage where the person has to rely on assistance from others and can no longer perform independently their essential daily activities (Verbrugge et al., 1994). Disability is experiencing difficulty doing activities in any domain of life (the domains typical for

one's age-sex group) due to a health or physical problem. Current studies (Tang et al., 1999; Fujita et al., 2006 and Feng et al., 2013) often focus on three domains: personal care (basic activities of daily living; BADL or ADL), household management (instrumental activities of daily living; IADL), and job (paid employment). ADLs are necessary for survival; IADLs are necessary for maintaining a dwelling in a given sociocultural setting.

2.1.2 The Disablement Process

The Disablement Process model is an extension and elaboration of the Nagi disablement model that is especially useful for research design (Verbrugge et al., 1994). The Disablement Process restates that pathway in the language that suits medical and survey research. This is because in real life, the main pathway does not occur in a pure untampered way. There is always integration between social, psychological and environmental factors that can affect and alter it as shown in Figure 2.2.

"Disablement" refers to impacts that chronic and acute conditions have on the functioning of specific body systems. It does reflect the impact on people's abilities to act in usual, expected and necessarily desired ways in their society. The term "disablement" is general, covering all consequences of pathology for functioning. The term "process" reflects interest in the dynamics of disablement; that is, the trajectory of functional consequences over time and the factors that affect their direction, pace, and patterns of change.

Verbrugge and colleagues (1994) proposed the disablement process model and Lawton and colleagues (1973) proposed the competence-environmental press model. Both models examine the relationship between the physical environment and disability. Verbrugge and colleagues (1994) distinguished between intrinsic ability (i.e., an

individual's ability to perform an activity regardless of context) and actual ability (i.e., an individual's ability to perform an activity when supported by the physical or social environment). According to the model, the physical environment has the potential to help an individual overcome his or her intrinsic disability through either the removal of environmental barriers or the provision of environmental modifications. Whether individuals with age-related disabilities reside in community or institutional dwellings, the physical environment serves as a valuable resource by which their remaining cognitive and physical abilities can be supported (Iwarsson, 2005; Oswald et al., 2007).

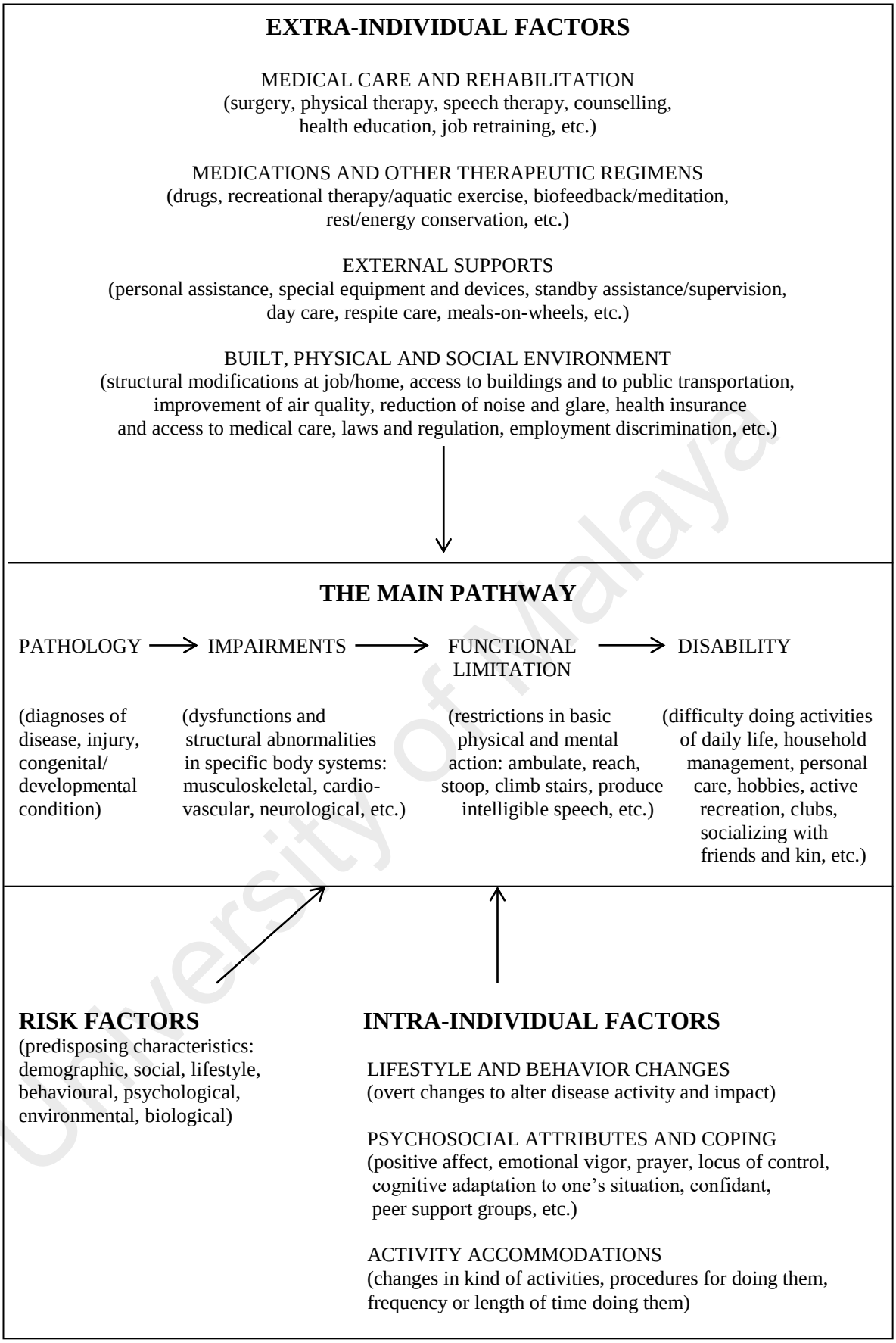


Figure 2.2: A model of disablement process (Source: Verbrugge LM, Jette AM. The disablement process. Social Science and Medicine 1994:38 (1):1-14).

2.1.3 The Model of WHO International Classification of Functioning, Disability and Health (ICF)

The International Classification of Functioning, Disability and Health (ICF) are viewed as outcomes of interactions between health conditions (diseases, disorders and injuries) and contextual factors. Figure 2.3 identifies the three levels of human functioning classified by ICF: functioning at the level of body or body part, the whole person, and the whole person in a social context.

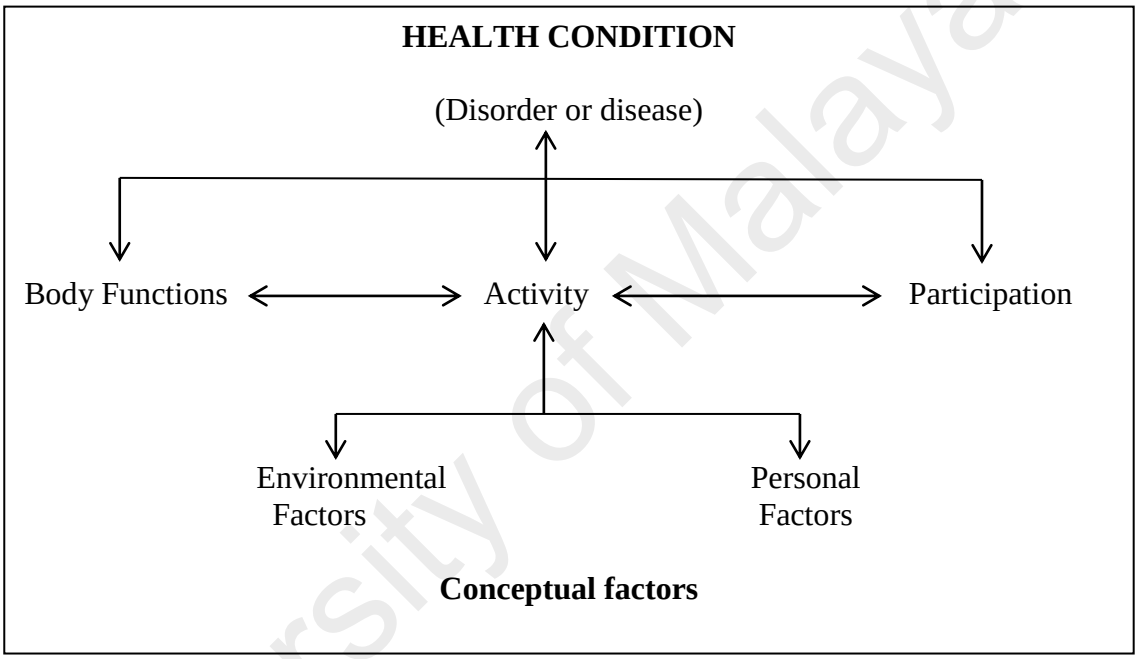


Figure 2.3: The basis for ICF model of disability (Source: World Health Organization. International Classification of Functioning, Disability and Health (ICF). Geneva, WHO 2001).

Table 2.1 summarise the ICF model of disablement. The first component of the ICF comprises Body Functions and Structures. Body functions are the physiological functions of body systems (including psychological functions) while body structures are anatomical parts of the body such as organs, limbs, and their components. Impairments are problems in body function or structure such as a significant deviation or loss. The second component of the ICF model is Activity and Participation. Activity is the execution of a task by a person while limitation in activities is defined as difficulties that

a person may have in executing activities. Participation is involvement in a life situation and participation restrictions are problems that a person may experience during the involvement in life situations.

The second part of the ICF framework consists of environmental factors and personal factors. Environmental factors are defined as the physical, social, and attitudinal environment in which people live and conduct their lives. Personal factors are the particular background of an individual's life and living, such as gender, race, age, fitness, social background and coping styles that are not part of a health condition or health states.

Table 2.1: An overview of International Classification of Functioning, Disability and Health

Component	**Part 1: Functioning and Disability**		**Part 2: Contextual Factors**	
	Body functions and structures	**Activities and participation**	**Environmental factors**	**Personal factors**
Domains	Body functions Body structures	Life areas (tasks, actions)	External influences on functioning and disability	Internal influences on functioning and disability
Constructs	Change in body functions (physiological) Change in body structures (anatomical)	-Capacity: executing tasks in a standard environment -Performance: executing tasks in the current environment	Facilitating or hindering impact of features of the physical, social, and attitudinal world	Impact of attributes of a person
Positive aspect	Functional and structural integrity	Activities Participation	Facilitators	Not applicable
Negative aspect	Impairment	Activity limitation Participation restriction	Barriers/hindraces	Not applicable

Source: World Health Organization. International Classification of Functioning, Disability and Health (ICF). Geneva, WHO 2001.

ICF classifies functioning and disability associated with health conditions and describes three models of disability which are medical, social and biopsychosocial model of disability.

2.1.3.1 The medical model of disability

The medical model views disability as a feature of the person, directly caused by disease, trauma or other health conditions, which requires medical care provided in the form of individual treatment by professionals. Disability, in this model, calls for medical or other treatment or intervention, to 'correct' the individual's problem.

2.1.3.2 The social model of disability

The social model of disability views disability as a socially created problem and not as an attribute of an individual. In the social model, disability demands a political response, since the problem is created by an unaccommodating physical environment brought about by attitudes and other features of the social environment.

2.1.3.3 The biopsychosocial model of disability

Disability is a complex phenomenon that is both a problem at the level of a person's body, and it is primarily a complex social phenomena. Disability is always due to the interaction between attributes of the person and characteristics of the overall context in which the person lives, but some aspects of disability are almost entirely internal to the person, while another aspect is almost entirely external. In other words, both medical and social interventions are appropriate responses to the problems associated with disability. The biopsychosocial model is a better model of disability. It is an integration of medical and social factors that provides a coherent view of different perspectives of health: encompassing the biological, individual and social components.

2.2 Application of Nagi Disablement Model in the studies

As mentioned earlier, there were four stages in Nagi's Disablement Model from pathology as a first stage until disability as a final stage. In this model, the progression from first to the final stage is a bidirectional relationship and the individual's progression can change at different stages (Puthoff, 2006). This is because, it relies on changes in the individual's health status or whether there was any effective interventions that can improve the impairments. The disablement model offered a valid conceptualization on the process of disability in the elderly as shown in many earlier studies (Puthoff, 2006).

In a longitudinal study involving over 6800 healthy elderly aged 70 years and above, the presence of risk factor which was chronic health conditions was found to predict the occurrence of functional limitations at follow-up four years later (Boult et al., 1994). Numerous studies either cross sectional, longitudinal, or interventional studies involving elderly used this disablement model as the foundation for their study (Puthoff, 2006).

Since the nature of this research was a prospective longitudinal study, application of Nagi's Disablement model and disablement process was more appropriate as Nagi's model not only explained the direction from certain pathology to disability but also the reverse direction from having some disability to having normal physical function again.

2.3 Methods of literature review

The strategy applied for the literature review was a computer-assisted literature search. The literature search was carried out to identify the prevalence, incidence, incidence recovery and risk factors of functional limitation and physical disability

among elderly population. Articles included were identified through a broad electronic search of the following databases: PubMed, Embase, Science Direct, JSTOR and Digital Dissertations. Each database was searched to find studies related to the stated objectives of this study by using the following keywords: elderly, older people, older adults, aged, functional (status), impairment, decline, deficit, functional (physical fitness), limitation (function), limitation (mobility), activities of daily living, basic activities of daily living and instrumental activities of daily living. Other terms used were prevalence, incidence, incidence (recovery), cross sectional studies, cohort studies, longitudinal studies and risk factors. Further internet search was also conducted with the Google scholar using the same search terms. Hand searching was also undertaken and a total of 152 papers (17 papers of prevalence studies, 19 papers of incidence studies, 74 papers of risk factors, 24 papers of instruments used, 6 papers of disablement model, 5 papers of elderly demographic, 4 papers of disability subtypes and 3 papers of incidence of recovery) were reviewed during the process of literature review. Non-English published studies were excluded.

2.4 Prevalence of functional limitation and physical disability

Comparison of prevalence across studies was difficult due to differences in the concept and types of measurement used to assess functional limitation and physical disability (Hairi et al., 2010). For example, walking speed test that was used to measure functional limitation were varied in terms of the walking distance used and lack of standardisation in the administration of most of the tests. The most frequently used tests covered distances of 2.44 meters, 4 meters, and 6 meters, carried out at usual gait speed (Munoz-Mendoza et al., 2010).

The prevalence of functional limitation and physical disability among elderly in Malaysia were 19.5% and 24.7% respectively (Hairi et al, 2010). An earlier study conducted in Singapore noted lower prevalence of ADL disability which was 6.6% among noninstitutionalized elderly aged 65 years and above (Ng et al., 2006). Tang and colleagues (1999) reported 6.5% of community dwelling elderly in China had ADL disability and 7.9% had IADL disability. However, more recent study conducted among 9890 elderly aged 65 years and above in China found higher prevalence rate of ADL disability (14.9%) and IADL disability (30.1%) (Feng et al., 2013).

Studies from other developing countries showed a wide range of prevalence rates. The prevalence of ADL and IADL disability found by Millan-Calenti and colleagues (2010) in their cross sectional study was 34.6% and 53.5%. In Nigeria, the prevalence of functional limitation was 22.5% and 6-items ADL disability was 15.7% among 1824 rural elderly population (Abdulraheem et al., 2011). Alexandre and colleagues (2012) found 23.8% of elderly aged 60 years and above in Brazil had ADL dependence. Recent cross sectional study conducted in the same country found comparable prevalence of ADL disability (24.7%) (Busch et al., 2015). Busch and colleagues (2015) also reported prevalence of functional limitation and IADL disability which was 54.9% and 33% respectively. In summary, the prevalence for functional limitation from all these studies ranged from 19.5% to 54.9%. The prevalence of IADL disability ranged from 7.9% to 53.5% and ADL disability ranged from 6.5% to 34.6%.

2.5 Incidence of functional limitation and physical disability

The differences in the definition, measuring tools and duration of the study made the comparison for incidence of functional limitation and physical disability also difficult. Different studies used different definitions of disability, different data

collection strategies, and different research designs, as well as different thresholds for defining disability. As Mont (2007) noted, some measures focused on body and function (sometimes referred to as impairment), some on activity limitation, and some on participation restriction. Different studies measured disability as: self-identification as disabled, diagnosable conditions, activities of daily living, instrumental activities of daily living, and participation.

In a study conducted among the 2895 participants in United States of America, the incidence of functional limitation was 41.3% (1195 participants) during 3.5 years of follow-up (Figaro et al., 2006). In that study, functional limitation was assessed by several physical performance tests including repeated chair stands, standing balance (semitandem, fulltandem, and single-leg stands), a 6-metre walk at the usual pace, and a narrow 6-metre walk (Figaro et al., 2006)

In another longitudinal study involving 2984 elderly participants over 6.5 years of follow-up, the overall incidence of mobility limitation was 55.1% (Stelholm et al., 2010). All the participants were free of mobility limitation at baseline. Incident of mobility limitation was defined as a self-report of any difficulty walking one quarter of a mile or climbing 10 steps.

In the Women's Health and Ageing Study, the cumulative incidence of severe walking disability, defined as customary walking speed of < 0.4 meters/second and inability to walk one quarter of a mile, or being unable to walk from the first to the sixth follow-up was: 7.8%, 12.0%, 15.1% 19.5% 21.2%, and 22.8% in a 3-year prospective study with 6 semi-annual follow-up (Rantanen et al., 2001).

Gobben and colleagues (2014) had examined the incidence of both ADL and IADL disability at 1 year of follow up and found the prevalence was 15.3% for ADL disability and 12.5% for IADL disability. The incidence of IADL disability ranged

from 22.1% at 2 years to 52.1% at 7 years follow-up (Carriare et al., 2005). The study examined disability in IADL among 545 high-functioning women aged 75 years and older. Another study documented 149 cases of new disability in instrumental or basic activities of daily living over two years among the 1680 adults aged 49-83 years and free of baseline disability (Dunlop et al., 2014).

In the study conducted in Taiwan, 145 (11.0%) participants out of 1321 community dwelling elderly aged 65 years and above developed ADL disability during the 3-year study period (Wu et al., 1999). In another study examining gender differences in incidence and determinants of disability in ADL involving 1634 elderly totally independent in ADL at baseline, 15.3% (69 male and 181 female) developed incident of ADL disability at 6 years of follow up (Alexandre et al., 2012).

In an eleven-year longitudinal study of 5644 elderly participants in the Mexican Health and Ageing Study (MHAS), the incident of functional limitation and physical disability was investigated based on the elderly frailty status. Frailty was defined by meeting at least three of the following criteria: weight loss, weakness, exhaustion, slow walking speed and low physical activity. After 11-years of follow-up, 51.9% nonfrail, 67.5% prefrail, and 82% frail participants developed mobility disability. Incident IADL disability was 24.2%, 27.1%, and 40.8% among nonfrail, prefrail, and frail subgroups respectively; whereas the incidence of ADL disability was 19.9%, 30%, and 44.6% in nonfrail, prefrail, and frail participants, respectively (Aguilar-Navarro et al., 2015).

In summary, the incidence of functional limitation was between 41.3% at 3.5 years to 55.1% at 6.5 years of follow up. The incidence rates of ADL disability ranged from 15.3% at 1 year to 44.6% at 11 years of follow up while the incidence of IADL disability ranged from 12.5% to 52.1% (from 1 year to 7 years of follow up).

2.6 Incidence of recovery from functional limitation and physical disability

It has been documented that even if the elderly become disabled, a substantial proportion of them recovered and became independent (Manton et al., 1988; Hardy et al., 2004). The Medical Research Council Cognitive Function and Ageing Study (MRC CFAS) demonstrated that less than 10% of disabled community-living elderly recovered and became independent in their function within 2 years of follow-up (Seidel et al., 2009), which was lower than other studies that reported on basic ADL recovery (27–34%) (Gill et al., 1997; Al Snih et al., 2003). For ADL disability recovery rate, previous longitudinal studies of community-dwelling elderly that included assessment intervals of 12 to 24 months found the recovery rates were as high as 28% (Manton et al., 1988; Gill et al., 1997; Katz et al., 1983). In another longitudinal study that followed up their participants for seven years, the incidence of recovery from disability was 28.4% (Carriere et al., 2005). More recent evidence demonstrated that assessment intervals longer than 3 to 6 months led to incomplete ascertainment of disability and that this incomplete ascertainment was largely due to recovery from disability (Gill et al., 2002). These results suggested that recovery might be considerably more common than previous studies (Hardy et al., 2004).

In Japan, the prevalence of recovery from disability was 26.3% using self-reported questionnaire on mobility difficulty (Fujita et al., 2006). Fujita and colleagues (2006) examined the incidence of recovery from mobility disability, IADL and ADL disability based on frequency of going outdoors. The incidence of recovery for mobility disability ranged from 15% (elderly with frequency of going outdoors once a week or less) to 46% (elderly with frequency of going outdoors once a day or more) (Fujita et al., 2006). The incidence of recovery for IADL disability ranged from 4% (elderly with frequency of going outdoors once a week or less) to 33.6% (elderly with frequency of

going outdoors once a day or more) (Fujita et al., 2006). The incidence of recovery for ADL disability ranged from 22% (elderly with frequency of going outdoors once a week or less) to 61% (elderly with frequency of going outdoors once a day or more) (Fujita et al., 2006).

2.7 Subtypes of disability among the elderly

Emerging evidence during the past decade showed that disability was actually a dynamic process. It arose due to the accessibility to multiple data derived from prospective studies where they had found that there were transition periods in the disability process that followed a certain pattern (Gill et al., 2008). In his study, Gill and colleagues (2008) had also stated that there were five distinct disability subtypes which were transient, short-term, long-term, recurrent, and unstable based on the number and duration of disability episodes.

Table 2.2: Operational definitions of the five distinct disability subtypes

Disability Subtype	Operational Definition
Transient	One episode of disability lasting only 1 month
Short-term	One episode of disability lasting 2 to 5 months
Long-term	One or more episodes of disability, with at least one lasting 6 or more months
Recurrent	Two episodes of disability, with none lasting 6 or more months
Unstable	Three or more episodes of disability, with none lasting 6 or more months

Source: Gill, T.M., Guo, Z., & Allore, H.G. (2008). Subtypes of Disability in Older Persons over the Course of Nearly 8 Years. *J Am Geriatr Soc,* 56, 436-443.

Transient disability was the most common subtypes which was about 9.7% and followed by long-term disability (6.9%). About 24.7% of the study participants had more than two intervals with an incident disability subtype (Gill et al., 2008). The time frame commonly used by clinicians when discussing their elderly patients' prognosis was between 12 to 24 months (Gill et al., 2008) and this time frame had also been used for disability assessment intervals in many longitudinal studies.

Prior research and clinical judgement had determined the duration of disability subtypes, although it was not intended to be definitive. For example, 6 months was chosen as the minimum duration to define episodes of long-term disability, because this period was often used to predict recovery after a disabling event (Hardy et al., 2004; Dubin et al., 2007; Hoenig et al., 1997; Campbell et al., 1997). The operational definition of unstable disability, as three or more episodes of disability with none lasting 6 or more months (i.e., not long-term), was based on the theoretical construct proposed previously, as substantial fluctuations in function with minor external events (Campbell et al., 1997).

Recurrent disability was modelled after other clinically relevant outcomes, such as falls and urinary tract infections, which commonly recur over discrete periods of time. Finally, episodes of disability lasting only 1 month (transient) were distinguished from those lasting 2 to 5 months (short term), because it was likely that this difference in duration was meaningful to the elderly and their caregivers.

2.8 Measurement tools used in assessing functional limitation and physical disability

2.8.1 Functional limitation

Functional limitations can be measured through self-report or performance based assessment (Guralnik et al., 2003). Performance based measurements offers more information as they identify important physical parameters involved in performing daily tasks (Guralnik et al., 2003).

2.8.1.1 Walking speed test

Walking speed test was the most frequently used objective physical performance test to evaluate functional limitation of the lower limbs (Guralnik et al., 2003; Buchner et al., 1995; Imms et al., 1981). Speed is calculated over a relatively short distance and its measurement does not influence the resistance factor (Steffen et al., 2002). In longitudinal epidemiological studies, speed tests have demonstrated their capacity to predict important adverse results such as: hospitalization, dependence, and mortality (Cesari et al., 2005; Cesari et al., 2009; Onder et al., 2005; Ostir et al., 2007). Furthermore, numerous advantages of walking speed test have been reported in terms of test-retest reliability, sensitivity to change and applicability to different population groups (Bohannon, 2009; Guralnik et al., 1989; Guralnik et al.,1994).

In a study carried out on a sample of primary care patients, Studenski and colleagues (2003) found that walking speed, calculated over a distance of 4 meters, was a predictor of hospitalization, health deterioration, and physical function decline. Cavazzini et al. (2004) performed a study to see whether a simple test based on physical performance could be incorporated into routine clinical practice. The results supported its viability and efficacy.

The walking speed test is very simple and highly evidenced based. The only equipment needed is a tape measure and a stopwatch or mobile phone as an accurate timer. Taking more than 5 seconds to cover the 4-metre distance is highly indicative of frailty if there is no obvious alternative reason for slow walking such as a previous stroke or arthritis of the knee/hip (Abellan et al, 2009). The slower a person walks, the greater the degree of frailty.

Among community-dwelling elderly, mean value for gait speed vary substantially depending not only on the population studied, but also on the method used (Busch et al., 2015). Mean speed was most frequently reported in tests over 4, 5, and 6 meters, performed at usual gait speed; the values (comparing two studies with similar characteristics) vary between 0.88 m/s for the 4 meters test (Studenski et al., 2003) and 1.17 m/s for the 6 meters test (Cesari et al., 2005). Walking speed decreased with advanced ages. Bohannon and colleagues (2011) found that for healthy women and men aged 70–79, the usual gait speed was 1.13 m/s and 1.26 m/s, respectively, and for those aged 80–89, the values were 0.94 and 0.97 m/s respectively.

Walking speed is a particularly good predictor of functional disability (Guralnik et al., 2000). Deficits in gait speed may be due to the age-related development of sarcopenia, which predominantly affects the lower extremities, causing changes in muscle activity patterns and reducing muscle strength and power (Gomes et al., 2014).

2.8.1.2 Tinetti Performance Oriented Mobility Assessment Tool

The Tinetti Performance Oriented Mobility Assessment Tool was also one of the measures used to detect functional limitation (Tinetti., 1986; Ferruci., 2007). The Tinetti-test was published by Mary Tinetti (Yale University) to assess the gait and balance in elderly. This test has been recommended and widely used in elderly to assess mobility, balance and gait, and predict falls. It is therefore also called: performance-

oriented mobility assessment or POMA (Shumway-Cook et al., 2012). Besides giving information on maneuverability it is also a very good indicator for risk of fall of the person tested. It was reported to have better test-retest, discriminative and predictive validities concerning risk of fall compared to other tests such as Timed Up and Go test (TUG), one-leg stand and functional reach test (Lin et al., 2004).

2.8.2 Physical Disability

2.8.2.1 Katz ADL scale

Self-reported limitations in activities of daily living (ADL) were often used to assess functional performance, both in research and in daily care (Katz et al., 1970). The Katz Index of Independence in Activities of Daily Living, commonly referred to as the Katz ADL, was the most commonly used instrument to assess functional status and a person's ability to perform activities of daily living independently. The scale measured the adequacy of performance of six functions; i.e of bathing, dressing, toileting, transferring, continence, and feeding.

This index was first tested among patients in hospitals, where clinicians rated patients' ability to perform six tasks. Nowadays, the index is used to measure the functional status of community dwelling, non-institutionalized elderly individuals, either in its original set-up or with adaptations, and also as a self-report measure instead of an assessment tool for clinicians (Reijneveld et al., 2007). The instrument can also be used for baseline measurements when the elderly are well and compared to periodic or subsequent measures. From the time this instrument was developed, it had been modified and simplified and different approaches of scoring had been used. This tool had consistently demonstrated its utility in evaluating functional status in the elderly population and had been used extensively as a flag signalling functional capabilities of

elderly in the clinical and home environment. Most of the previous studies among community dwelling elderly used Katz ADL scale to measure disability in their studies (Nybo et al., 2001; Serraino et al., 2001; Graciani et al., 2004; Hairi et al., 2010; Busch et al., 2015).

2.8.2.2 Barthel Index ADL

The Barthel Index measured functional independence in personal care and mobility. This is an assessment of patients' level of independence in activities of daily living (Wade et al., 1988). This questionnaire takes two to five minutes to be completed whether through self-reporting or via face to face interview. The ten ADL items assessed are feeding, bathing, dressing, grooming, toileting, bladder control, bowel control, transfering from bed to chair, walking and stair climbing. Each item is rated in terms of whether the patient can perform the task independently, with some assistance or is totally dependent on others. The Barthel Index also has been used in earlier studies as one of the measurement tools for physical disability (Hairi et al., 2010; Abdulraheem et al., 2011).

2.8.2.3 Lawton IADL

Physical disability also can be assessed using the instrumental activities of daily living (IADL) which comprise the following domestic functions: telephone and transportation use, shopping, cooking, house-keeping, medication intake and budgeting. The IADL method is the extension of ADL for a more comprehensive measurement of disability and integrating some elements of handicap concept.

It had been inferred that IADL might be more sensitive than basic ADL in screening individuals with functional disability (Walter-Ginzburg et al., 2001) as IADL is influenced by societal, environmental, educational, and cultural factors, which are

more complex while ADL represent the basic physiological functions of human beings. The incapability to complete one or more IADL can also be referred to as having physical disability and increasing inability to perform IADL may result in the need for institutional care.

The Lawton Instrumental Activities of Daily Living Scale (IADL) is a valid and reliable tool to assess whether a person can perform domestic activities and living skills independently (Lawton et al., 1969). This instrument was not only useful to measure the current functions of a person but also can recognize either improvement or deterioration with time. This scale has been used in previous studies before (Serraino et al., 2001; Graciani et al., 2004; Busch et al., 2015). In Malaysia, this questionnaire was validated in a previous study conducted among elderly aged above 60 years, its Cronbach's alpha was reported as 0.7346 (Latifah et al., 2003).

2.9 Summary of the prevalence and incidence rates of functional limitation and physical disability

For the review of prevalence and incidence rates of functional limitation and physical disability, various rates were identified from previous literature. There was a large range found between the lowest and highest reported prevalence rates of functional limitation and physical disability. The prevalence of functional limitation reported from the studies conducted in the developing countries ranged from 19.5% to 54.9%. The prevalence of IADL disability ranged from 7.9% to 33% and for ADL disability, the range was from 3.0% to 24.7%. There was only one study from the developing countries that reported the incidence of functional limitation ranging from 51.9% to 82.0%. The range of incidence for IADL disability in developing countries was from 24.2% to 40.8% and ADL disability was from 11.0% to 44.6%. The prevalence of functional limitation and IADL disability reported by studies from developing countries was

comparable with those in developed regions. For ADL disability, the prevalence range reported by studies from developing countries was lower than in developed contries. The range of incidence for functional limitation, IADL and ADL disability were higher in the studies conducted in developing countries than those from the developed regions.

Several issues need to be addressed in comparing the prevalence and incidence of functional limitation and physical disability across studies. First, the term functional limitation and physical disability were used interchangeably in some studies. Secondly, different definitions were utilized to describe functional limitation and physical disability including mobility limitation, functional disability and mobility disability. Thirdly, a variety of assessment tools were used to measure both functional limitation and physical disability adding to the complexity in drawing a conclusion for prevalence and incidence rates of both conditions. The differences in the prevalence and incidence were more prominent among the studies that examined functional limitation. Studies that used objective assessments and consist several tests usually yield much lower prevalence and incidence rates compared to those that used single objective assessment or subjective assessment such as self-reported limitation of their functional status. For physical disability, the differences in the prevalence and incidence rates were mainly due to differences in the number of activity items being measured. Lastly, there were also differences in the characteristics of the elderly population especially among studies that were conducted in the developed countries where their participants were mainly those in more advanced age group (e.g 65 years or 70 years and older) and their studies also focussed on the elderly with specific impairments (e.g elderly with diabetes or metabolic disease).

2.10 Risk factors of functional limitation and physical disability

The progression to functional limitation and physical disability which was already explained in the disablement model will also be accelerated with the presence of certain risk factors. Risk factors can be regarded as behaviours or attributes that affect the chance of developing functional limitation or disability in the presence of pathological changes (Verbrugge et al., 1994). A number of risk factors that have demonstrated to be involved in the progression of both conditions in the disablement model were gender, age, education level, and body composition (Lawrence et al., 1996). The risk factors that can affect the development of disability can be further divided into: a) intra-individual factors: lifestyle and psychosocial attributes; and b) extra-individual factors: medical care, social environment, and external support (Puthoff, 2006).

2.10.1 Age and gender

Age was independently associated with functional limitation and physical disability especially for those aged more than 75 years old where the prevalence ratio (PR) was 7.9 and 3.0 respectively (Hairi et al, 2010). In the same study, being female was also a risk factor for functional limitation (PR 2.7) but not for physical disability. In a detailed study that examined different subtypes of disability, there were also no differences in the incidence rates between males and females elderly (Gill et al., 2008).

In the study conducted by Arroyo and colleagues (2007), age was also found to be a significant risk factor for functional limitation in women. Data from cross-sectional household-based epidemiological study in Brazil also suggested that older individuals and women had more functional limitations (Barbosa et al, 2005). The cumulative effect of pregnancy and childbearing, poor/lack of education, and poor health care may be

responsible for higher functional limitation seen in elderly women (Abdulraheem et al., 2011).

Two recent studies conducted among elderly aged 60 years and above in Brazil noted that older age was a significant risk factor for both functional limitation and physical disability (Alexandre et al., 2012; Busch et al., 2015) and being a women was a risk factor for ADL disability (Alexandre et al., 2012). In a cohort study involving 1745 elderly aged 75 years and above, age was found to be associated with functional dependence defined as need for assistance in one or more activities of daily living at baseline and also at follow-up three years later (Agiiero-Torres et al, 1998). Ageing has been suggested to be a predictive factor of functional disability (Martin et al., 1988; Fulton et al., 1989; Parker et al., 1996).

2.10.2 Ethnicity

Risk factors such as race and ethnicity were found to be contributing factors for functional limitation and resulted in disability (Verbrugge et al., 1994). A study conducted by Leon and colleagues (1995) describing the prevalence among two ethnic groups (Blacks and Whites) living in two different community revealed that Blacks had higher prevalence of functional disability in both regions; however these Black-White differences revealed a geographic variation (Leon et al., 1995). In a recent study conducted in Europe, the researchers found that Indian Asian people had higher risk of contracting all types of disability as compared to Europeans and this significant finding persisted even after controlling for other confounders such as socioeconomic status, behavioural habits, body fat composition and chronic diseases which were measured at baseline (Williams et al., 2012).

In Malaysia, among the three main ethnic groups, Indians had the highest prevalence of physical disability as compared to Malays and Chinese but for functional limitation the prevalence was similar across all ethnic groups (Hairi et al., 2010). They found that 76% of the older Indians worked as manual unskilled labourers mainly in the rubber plantations (Hairi et al., 2010). The low socioeconomic status of Indian elderly contributed to higher prevalence of physical disability.

2.10.3 Socioeconomic status and education level

Low socioeconomic status was found to be correlated with physical disability (Koster et al., 2006). A cross sectional study conducted by Feng and colleagues (2013) in China reported poor economic status as a significant factor for ADL disability but not for IADL disability. Systematic review done by Rodrigues and colleagues (2009) noted that lack of schooling and livings in rented house were among the main risk factors for functional disability regardless of gender. Inadequate education was known to be associated with low income and poverty. In a local study, having low education was associated with functional limitation and physical disability in univariate analysis but it appeared to be not significant in multivariate analysis (Hairi et al, 2010). Low level of education was found to be associated with low walking speed in a cross sectional study involving 1112 elderly aged 60 years and above (Busch et al., 2015) and predictor for ADL dependence in a cohort study involving 2143 community dwelling elderly in Brazil (Alexandre et al., 2012). In another cohort study involving 545 elderly women aged 75 years and above, the investigators also found that lower educational level was predictor of disability measured by IADL items (Carriere et al., 2005).

2.10.4 Living arrangement

Living arrangements were closely related to the health and wellbeing of the elderly (Sereny et al., 2011). The associations between living arrangements and health outcomes, such as mortality, activities of daily living (ADL) disability, self-rated health, and psychological well-being have been reported by others (Cheng, 2006; Russell et al., 2009; Wong et al., 2009). In a study by Wang and colleagues (2013) of Chinese elderly, unmarried persons including widowers, the divorced and the never married, living with children were disadvantaged on all three dimensions of functional disability measured by the BADL, IADL and ADL. Living with others was associated with functional disability in 1079 community elderly in Singapore (Ng et al., 2006) while living alone was associated with slow walking speed among community living elderly in Brazil (Busch et al., 2015).

2.10.5 Tobacco smoking

Smoking was recognized as a major public health problem among the elderly (Marinho et al., 2010). Risk of death among elderly smokers was higher as compared to those who never smoked (Marinho et al., 2010). Morbidity and mortality from cancer, stroke, cardiovascular, and respiratory diseases were also higher among elderly smokers (Bratzler et al., 2002; Husten et al., 1997). Due to this high prevalence of chronic diseases among elderly smokers, they also tend to have more limitations in their functional status and eventually suffered from disability. Tobacco smoking was found to be a primary cause of premature mortality and morbidity in a cross sectional study conducted among Malaysian adult males aged 18 years and above (Lim et al., 2013).

Some data suggested that, as a group, the elderly not only smoke for a longer period of time than younger smokers, but were also less aware of the potential harmful

effects of tobacco use. As a result, they were more resistant to quit smoking, do not report a greater number of quitting attempts or methods, and tend not only to underestimate the risks but also to overestimate the benefits of smoking (Bratzler et al., 2002; Orleans et al., 1994).

2.10.6 Chronic diseases

Presence of diabetes and stroke were associated with physical disability while for functional limitation only arthritis was found to be significant (Hairi et al., 2010). In initially healthy and high-functioning elderly, those with diabetes and had high inflammation were found to have an elevated risk of decline in their functional status (Figaro et al., 2006). Similar findings were also documented in the study conducted by Resnick and colleagues (2003) where they demonstrated that diabetes was an early indicator for functional deficits, and the association was still significant even after controlling for potential confounders and uncontrolled blood glucose level contributed to this relationship. Presence of cardiovascular diseases were found to be associated with low walking speed (Busch et al., 2015) and stroke was a predictor for ADL disability (Alexandre et al., 2012).

Cardiovascular health problems, including hypertension, showed to have a more prominent harmful effect on ADL/IADL limitations than other types of health conditions such as osteoporosis that may affect the elderly (Johnson et al., 1993). Pinsky and colleagues (1985) found that ever having a hypertension diagnosis was predictive of greater disability status for both men and women. Similar findings by Wu and colleagues (2007) indicated that hypertension was among one of the highest risk factors for severe disability (defined as two or more ADL limitations) in a sample of

community-dwelling elderly. The association between high BP and physical functional limitations has been demonstrated in a cohort study on ageing (Rosano et al., 2011).

Hubert and colleagues (1994) also identified hypertension as a risk factor for the development of disability over a period of 6 years. Recent evidence suggested by the Charleston Heart Study (Hajjar et al., 2007) noted that only those with uncontrolled hypertension had an increased risk of incident disability, whereas those with controlled hypertension had a similar incident disability as those without hypertension. The lack of association between controlled hypertension and disability risk suggested that adequate control of hypertension may prevent functional decline.

Elderly with chronic diseases such as diabetes, hypertension and heart diseases had higher chances to have disability and if, coexists with obesity problem, would further worsen their functional and disability status (Figaro et al., 2006). In a study conducted by Hairi and colleagues (2010), obesity was more frequently seen among older women in contrast with underweight that were more common among older men. In addition, besides poor glycemic control, diabetes related complications such as neuropathy and vasculopathy can also mediate the progression of disability (Figaro et al., 2006).

Baseline data analysis from the cross-sectional Women Health Initiative Study noted that in older women, geriatric syndromes were correlated with functional impairment and the association was more significant in geriatric conditions combined with cardiometabolic diseases (Rosso et al., 2011).

2.10.7 Depressive symptoms

Earlier studies found the incidence of depressive disorders was high among elderly population (Barcelos-Ferreira et al., 2009; Costa et al., 2007; Ormel et al., 2002).

Elderly with depressive symptoms were found to be significantly associated with physical disability and functional limitation (Hairi et al., 2010). In Singapore, elderly with diabetes and depression had higher prevalence of common geriatric syndromes such as functional decline and urinary incontinence compared to those non-depressed elderly (Lai et al., 2012). A longitudinal study conducted in Taiwan to examine the relationship between depression and disability among elderly demonstrated that disability was a stronger predictor of depressive symptoms (Chen et al, 2012).

Depressive symptoms in elderly patients have been shown to affect many aspects of health, such as cognitive function (Sikkes et al., 2011), inflammatory biomarkers (Looper et al., 2011), quality of life (Duivis et al., 2011), and physical health (Chen et al., 2011). However, the greatest impact of depression was related to functional disability, as this condition was associated with low levels of physical activity that led to deficits in mobility and physical performance (Everson-Rose et al., 2005; Hassmen et al., 2000; Lindwall et al., 2007). The relationship between depression and physical functioning among elderly was well documented in both cross-sectional and longitudinal studies, either in patients with major depression or among adults with depressive symptoms (Lenze et al., 2001).

Penninx and colleagues (1998) followed a cohort of 6247 community-dwelling elderly aged 65 or older originally free from disability for six years, and found that those elderly who were depressed at baseline had an increased risk of incident self-reported disability in both activities of daily living (ADLs) and mobility. Depressive symptoms also predicted physical decline as measured by objective tests of physical performance (Penninx et al., 1998). In a sample of high-functioning elders free of any disability, high levels of depressive symptoms predicted an increased risk of onset of disability in basic

ADLs over a 2.5-year interval (Bruce et al., 1994). Depression has also been shown to accelerate the disablement process in elderly (van Gool et al., 2005).

The Italian Longitudinal Study on Ageing recently reported baseline depressive symptoms were associated with higher rates of reported disability in men and women and performance based disability in men over 3.5 years (Carbonare et al., 2009). In a systematic review of variables predicting functional decline in community-dwelling elderly, depression was one of the key risk factors identified (Stuck et al., 1999).

2.10.8 Cognitive impairment

Cognitive impairment was among the significant contributor for the progression of long-term functional decline based on the findings of the cohort study conducted among the oldest elderly population in Sweden (Rosso et al, 2011). They found that Mini Mental Status Examination (MMSE) score was among the strongest determinants for functional dependence at baseline and also three years later during follow-up and the population attributable risk proportion for occurrence of functional dependence in the presence of dementia was 49% (Rosso et al, 2011).

Cognitive impairment was found to be associated with disability (Graciani et al., 2004; Ng et al., 2006) and low walking speed (Busch et al., 2015). Low MMSE score was shown to be significant predictors for functional deterioration among hospitalized elderly with geriatric syndrome (Chang et al, 2010). Cognitive impairment together with functional impairment, older age and impaired mobility were shown to be shared risk factors for functional deficits, pressure ulcers, falls, incontinence and delirium (Rodrigues et al., 2009).

2.10.9 Visual impairment

In a study done in Taiwan, subjects with correctable visual problems scored significantly less compared to others in the physical functioning dimension questionnaire (Kuang et al., 2007). Visual impairment was also shown to be associated with physical disability but not functional limitation (Hairi et al., 2010). Visual impairment was listed among the main factors for functional disability regardless whether in men or women (Rodrigues et al., 2009). A cross sectional study conducted in Spain by Martinez-Huedo and colleagues (2011) found that loss of vision was a risk factor for ADL, IADL and mobility disability among diabetic elderly who participated in their National Health Surveys.

2.10.10 Falls and fear of falling

In Malaysia, the prevalence of falls among diabetic elderly was 18.8% (Azidah et al., 2012). Two-thirds of fall events usually occurred outdoors and mainly while walking and were associated with injuries (Lee at al., 2011). Half of the patients reported reduced activities in their daily living because of fear of falling (Lee et al., 2011). Fear of falling was not only correlated with functional limitation and physical disability but also with other multiple geriatric syndromes (Kim et al., 2007). Since the identification of the post-fall syndrome (Murphy et al., 1982) and use of the term "ptophobia" which is defined as the phobic reaction to standing or walking (Bhala et al., 1982) in the early 1980s, fear of falling (FOF) has gained recognition as a health problem of the elderly (Legters, 2002).

Ironically, fear of falling also contributed to the falls. Elderly with fear of falling often changed their gait, decreased their activity, or attempted to use assistive devices to prevent falling. The decrease in activity and walking were perhaps the worst

consequences of fear of falling, leading to de-conditioning and overall decrease in strength (Cumming et al., 2000; Mendes de Leon, 1996). Fear of falling was more prevalent with increasing age and fall history and it was not only limited to individuals with a history of falls (Kumar et al., 2008). Another study also reported that higher fear of falling scores in community-dwelling elderly people was associated with greater declines in self-reported ADL performance over a 12-month period (Mendes de Leon et al., 1996).

2.10.11 Social isolation and social support

Social isolation is a crucial criterion in determining an individual's health status and quality of life. It is broadly understood that when people were socially isolated, they usually suffered poor health condition and were more likely to visit health care services (Hawthorne, 2000). Evidence also showed that there was a link between social isolation and dementia (Fratiglioni et al., 2000). Social isolation had been associated with poorer functioning in elderly adults (Perissinotto et al., 2012).

In a study conducted in rural Taiwan, solitary living was an important risk factor for falls that can later result in functional limitation and physical disability among patients who visited primary care based outpatient geriatric services (Lee et al., 2011). A study conducted among homeless elderly found that they were more likely to have geriatric conditions such as functional impairment, depression, and urinary incontinence compared to the general population (Brown et al., 2011).

Many previous studies showed that social support positively influenced health and reduced mortality (Vanderhorst et al., 2005; Taylor et al., 2004; Auslander, 1991; Lennartsson, 1999) but these findings were rather inconsistent. For example, recent studies reported both a positive association between social support and everyday

functioning (Zunzunegui et al., 2005) and no relationship between social support and limitations in either activity of daily living (ADLs) or instrumental activities of daily living (IADLs) (Hybels et al., 2010). In another study conducted in Malaysia, living alone and poor social support were found to be not associated with physical disability and functional limitation (Hairi et al., 2010). However, there were evidence of consistent association between functional disability and lower subjective social support (James et al., 2011; Mendes de Leon et al., 2003).

2.10.12 Physical activity

Maintenance of physical function is important for independent living of elderly. According to the World Health Organization (WHO), physical inactivity leads to disability and is one of the leading causes of chronic conditions such as hypertension, diabetes, and obesity (WHO, 2001). Previous study showed that people with disability had consistently low prevalence of engagements in physical activity (Escobar-Viera et al., 2014).

Prospective studies showed that regular physical activity in middle-aged and elderly conferred reduced risk of functional limitation and disability in older age (Paterson et al., 2010). Lang and colleagues (2007) suggested a number of factors to explain the relationship between physical activity and lower risk of functional limitation and physical disability which were: i) physical activity may relate specifically to physical function; for example muscle strength may have a mediating role between physical activity and disability; ii) physical activity is protective against the metabolic syndrome thus reducing incidence of conditions whose consequences include reduced physical function; iii) exercise and physical activity are associated with lower inflammatory markers in elderly and may reduce the damageing effects of

inflammation, including those associated with excess adipose tissue; iv) physical activity provides psychological benefits; v) physical activity may maintain body weight and strength (and mitigate against age-related loss of lean body mass).

Paterson and colleagues (2010) also suggested a few mechanisms that may underlie the association between physical activity and disability which included the effects of: i) improved aerobic capacity, muscle strength, and flexibility; ii) protection against development and progression of disabling conditions (diseases such as cardiovascular, respiratory, osteoporosis, as well as nerve growth factors relating to cognitive function and protection against ischemic and neurotoxic damage); and, iii) favourable psychological effects.

2.10.13 Self-rated health status

Self-rated health has been one of the most frequently used variables in gerontological and health research. Self-rated health was particularly interesting because of its mediating role between human biology and psychology. Self-rated health has been found to be a strong predictor of mortality (Pijls et al., 1993; Idler et al., 1997) and other biomedical outcomes such as hip fracture (Cummings et al., 1995), ADL disability (Kaplan et al., 1993; Tas et al., 2007a) and IADL disability (Carriere et al., 2005). Elderly reported as having poor self-rated health status had significantly higher risk of having disability (Graciani et al., 2004; Ng et al., 2006) and functional limitation (Busch et al., 2015). In a cohort study conducted by Seidel and colleagues (2009) in the United Kingdom found that elderly with poor self-rated health status were least likely to recover from disability. Self-rated health was a useful health outcome in research because it was simple, short, and easily understood.

2.10.14 Chronic pain

Chronic pain is defined as "unpleasant sensory or emotional experience associated with actual or potential tissue damage, or described in terms of such damage" (International Association for the Study of Pain, 1986). Among Asian countries, prevalence of chronic pain varies from 7.1% in Malaysia to 90.8% in Hong Kong (Mohamed Zaki et al., 2012). Most studies have shown that prevalence of chronic pain increased with age. There was ample literature to support the relationship between persistent pain and functional disability among elderly (Horgas et al., 2008).

In a study of community-dwelling elderly in Canada, Scudds and colleagues (2000) reported that 73% of participants had musculoskeletal pain in the 2 weeks prior to the study, and almost 70% had physical disability. They found that pain-related variables, including more painful body locations, higher pain intensity, greater pain frequency, and more pain medications used, were significantly associated with more physical disability. Lichtenstein et al (1998) also reported that pain intensity was strongly associated with limitations in physical functioning among elderly. In a sample of elderly with osteoarthritis, other investigators reported that pain severity was a stronger determinant of physical disability than structural joint changes (Creamer et al., 2000). In a cohort study that examined the impact of self-reported pain on limitation of ADL, Al Sinh and colleagues (2001) found that pain was a significant independent predictor of subsequent disability.

2.10.15 Anthropometric measures

There was a mixed finding in the studies that examined the relationship between body anthropometric measures with functional limitation and physical disability. In one study, anthropometric measures which was body mass index was demonstrated as not a

risk factor for functional limitation (Arroyo et al., 2007). However, in another study, higher proportion of body fat not only increased the risk for urinary incontinence but also increased the prevalence of IADL and intellectual disability, and later affected elderly walking ability and balance (Kim et al., 2008). Obesity was found to be associated with a number of adverse health outcomes, including physical disability (Jensen et al., 2005; Jensen et al., 2006; Lee et al., 2005; Bhattacharya et al., 2008). In a cohort study where 2984 elderly participated in Health, Ageing and Body Composition Study, it was reported that obesity was a risk factor for mobility limitation (Stenholm et al., 2010). An and colleagues (2015) confirmed that obesity had adverse impacts on functional limitations with odds ratio of 2.31 higher among obese middle-aged and older American adults to have mobility limitations.

2.11 Summary of the risk factors of functional limitation and physical disability

Previous literature identified the risk factors of functional limitation and physical disability and documented the positive association between risk factors such as advanced age, gender (female), chronic disease (diabetes, cardiovascular disease and hypertension), depression, cognitive impairment, chronic pain, visual impairment, low physical activity and poor self-rated health with the prevalence and incidence of functional limitation and physical disability. There were mixed findings in the association between low educational level and risk of having functional limitation and physical disability.

A few variables such as living arrangement, marital status and social support level were still debatable as risk factors for functional limitation and physical disability. There were three studies that reported different living arrangements (living with children, living with others and lived alone) as a risk factor for functional limitation and

physical disability. One study conducted among Chinese elderly noted that single persons (widowed, divorced or never married) were having higher risk of physical disability in contrast with the finding from another study, where having a partner was shown as a predictor for physical disability. The findings also have been inconsistent for the association between social support with functional limitation and physical disability.

There were two variables that were given less attention which were smoking and body fat percentage. Most studies had focussed on the association between smoking and chronic diseases such as cardiovascular disease and stroke which were the precursors for functional limitation and physical disability and not the direct association between smoking with both outcomes. Only one study reported positive association between high body fat proportions with disability. Most studies utilised body mass index (BMI) as the risk factor variable and there were mixed findings of the association between BMI with functional limitation and physical disability. BMI is not an accurate predictor of body fat in the elderly population as it does not distinguish between body fat and lean body mass. BMI tend to underestimate the amount of body fat in people who have lost muscle mass, such as elderly people.

Table 2.3: Summary table of studies on prevalence, incidence and risk factors of functional limitation and physical disability

Author	Study design	Study participants	Study measurement	Main findings		
				Prevalence	Incidence	Risk factors
Hairi et al. (2010) (Malaysia)	Cross sectional study	765 rural elderly aged 60 years and above	1) Test of functional limitation: Tinetti Performance Oriented Mobility Assessment Tool. 2) Physical disability assessment: Self-reported ADL using- -Barthel Index (10 items) -6 basic ADL -5 basic ADL	Prevalence of: 1) 10 basic ADL disability: 24.7% (95% CI 21.6-27.9) 2) 6 basic ADL disability: 14.4% (95% CI 11.9-17.2) 3) 5 basic ADL disability: 10.6% (95% CI 8.5-13.1) 4) Functional limitation: 19.5% (95% CI 16.8-22.5)	-	1) Physical disability: • Advanced age(≥75 years: PR 7.9; 95% CI 4.8-12.9), • Presence of diabetes (PR 1.8; 95% CI 1.4-2.3) • Presence of stroke (PR 1.5; 95% CI 1.1-2.2) • Presence of depressive symptomology (PR 1.3; 95% CI 1.1-1.8) • Visual impairment (blind: PR 2.0; 95% CI 1.1-3.6). 2)Functional limitation: • Advancing age(≥75 years: PR 3.0; 95% CI 1.7-5.2) • Being female (PR 2.7; 95% CI 1.2-6.1) • Presence of arthritis (PR 1.6; 95% CI 1.2-2.1) • Depressive symptomology (PR 2.0; 95% CI 1.5-2.7) *PR=Prevalence Ratio

'Table 2.3, continued'.

Author	Study design	Study participants	Study measurement	Main findings		
				Prevalence	Incidence	Risk factors
Ng et al. (2006) (Singapore)	Cross sectional study	1,079 noninstitutionalized Chinese, Malay, and Indian people aged 60 and older	Functional disability: -10 items Barthel Index. -5 basic ADLs (eating, bathing, dressing, transferring, toileting)	Prevalence of disability in at least one of five ADL items (6.6% in those aged > or = 65)	-	Functional disability was associated • female sex, • Indian ethnicity, • older age, • poor self-rated health, • specific chronic diseases, • cognitive impairment, • sensory impairment, • living with others. 3) The population attributable risks for leading modifiable factors were arthritis (12%) and cognitive impairment (14%).
Wu et al. (1999) (Taiwan)	Cohort study (3 years of follow up)	1321 community-dwelling people aged 65 years or older	6 items ADL (eating, bathing, dressing, toileting, transfers, and walking inside the house)	-	11.0% of the participants developed chronic ADL disability.	Multiple hazard regression analysis showed: a) aged 70 to 79 years or older than age 80 had increased risk of ADL disability (RR: 2.05, 95% CI: 1.35-3.11) and 3.89 (95%CI: 2.33-6.50), respectively compared with those participants younger than age 70. b) risk of chronic ADL disability was inversely associated with routine exercise (RR = 0.52; 95% CI, 0.39-0.68).

'Table 2.3, continued'.

Author	Study design	Study participants	Study measurement	Main findings		
				Prevalence	Incidence	Risk factors
Tang et al. (1999) (China)	Cross sectional study	3440 non-institutionalized elderly population	1) 6 items ADL 2) IADL	Functional disability prevalence was 6.5% on ADL and 7.9% on IADL.	-	Functional disabilities were associated with: • gender • marital status
Feng et al. (2013) (China)	Cross sectional study	9860 elderly aged 65 years and above	1) 8 items ADL 2) 10 items IADL	1) ADL: 14.9% 2) IADL: 30.1%	-	1) ADL disability: • increasing age • urban elderly • poor economic status • depressive symptoms • cognitive symptoms 2) IADL disability: • increasing age • female • depressive symptoms • cognitive symptoms

'Table 2.3, continued'

Author	Study design	Study participants	Study measurement	Main findings		
				Prevalence	Incidence	Risk factors
Fujita et al. (2006) (Japan)	Cohort study (2 years of follow up)	1267 rural elderly aged 65 years	1) Mobility: 2 self reported questions 2) IADL: five-item subscale of Instrumental Self-Maintenance of the TMIG Index of Competence 3) 5 items BADL	1) Mobility disability: a) Elderly with high frequency of going outside: 5% b) Elderly with moderate frequency of going outside: 28% c) Elderly with least frequency of going outside:61.5% 2) IADL disability: a) Elderly with high frequency of going outside: 15.8% b) Elderly with moderate frequency of going outside: 41.5% c) Elderly with least frequency of going outside:78.1% 3) BADL disability: a) Elderly with high	1) Mobility disability: a) Elderly with high frequency of going outside: 5.8% b) Elderly with moderate frequency of going outside: 14.8% c) Elderly with least frequency of going outside:35% 2) IADL disability: a) Elderly with high frequency of going outside: 9.3% b) Elderly with moderate frequency of going outside: 16.8% c) Elderly with least frequency of going outside:32% 3) BADL disability: a) Elderly with high	A lower frequency of going outdoors at baseline was associated with a greater incident disability, and a lower recovery at the two-year follow-up.

'Table 2.3, continued'

Author	Study design	Study participants	Study measurement	Main findings		
				Prevalence	Incidence	Risk factors
				frequency of going outside: 2.7% b) Elderly with moderate frequency of going outside: 21.8% c) Elderly with least frequency of going outside:49.4%	frequency of going outside: 3.9% b) Elderly with moderate frequency of going outside: 10.4% c) Elderly with least frequency of going outside:20%	
Abdulraheem et al. (2011) (Nigeria)	Cross sectional study	1824 elderly rural dwellers aged 60 years and above	1) Test for functional limitation: Tinetti performance-oriented mobility assessment tool (TPOMAT) 2) Physical disability assessment: -Barthel Index (10 items) -6 basic ADL -5 basic ADL	1) 10 basic ADL disability: 28.3 (95% CI 25.2–31.5) 2) 6 basic ADL disability: 15.7 (95% CI 13.4–19.8), 3) 5 basic ADL disability: 12.1 (95% CI 9.8–15.3) 4) Functional limitation: 22.5 (95% CI 18.1–24.4).	-	1) Physical disability: • Female gender PR 3.6 (95% CI 1.5–7.4), • Advanced age ≥75 years; PR 22.2 (95% CI 14.5, 36.8), • Arthritis PR 3.7 (95% CI 2.6–4.6), • Stroke PR 4.8 (95% CI 3.7–7.9) • Diabetes PR 6.1 (95% CI 4.3–7.1). 2) Functional limitation: • Advanced age, (≥75 years: PR 10.5; 95% CI 5.4–16.4), • Female gender (PR 9.3; 95% CI 3.7–18.3)

'Table 2.3, continued'

Author	Study design	Study participants	Study measurement	Main findings		
				Prevalence	Incidence	Risk factors
						• Presence of arthritis (PR 5.2; 95% CI 3.5–6.8), • Depressive symptomatology (PR 6.4; 95% CI 4.7–9.2).
Busch et al. (2015) (Brazil)	Cross sectional study	1112 elderly aged 60 years and above	1) 3-metre walking speed test 2) 6 items ADL 3) 5 items IADL	1) Walking speed <0.81 m/s: 54.9% 2) ADL: 24.7% 3) IADL: 33%	-	Low walking speed: • Older ages • Low education • Living alone • Poor self-reported health • Cognitive impairment • Difficulty in IADL • Presence of cardiovascular
Alexandre et al. (2012) (Brazil)	Cohort study (6 years of follow up)	2143 aged 60 years and above	6 items Katz ADL	ADL dependence: 23.8%	ADL dependence: 15.3%	Risk factors for incidence of ADL dependence: • Women • Older age • Less schooling • Chronic lung disease • Stroke • Lower MMSE score • Depressive symptoms • Less grip strength

'Table 2.3, continued'

Author	Study design	Study participants	Study measurement	Main findings		
				Prevalence	Incidence	Risk factors
Chang et al. (2004) (USA)	Cohort study (21 months of follow up)	101 elderly aged 75 to 85 years	1) Mobility disability measurement: 400-m walk test 2) Functional limitation: Short Physical Performance Battery (SPPB)	-	Incidence of mobility disability: 33.9%	1) Strongest predictors of loss of mobility: a) time to complete the 400-m walk at baseline: (OR 1.6 per 1-min difference, 95%CI 1.04-2.45) b) decline in SPPB score over the follow up: (OR 1.4 per 1-point difference, 95%CI 1.01-1.92) 3) Functional limited elderly had a high rate of having mobility disability.
Stenholm et al. (2010) (USA)	Cohort study (6 and half years of follow up)	2984 elderly aged 70-79 years participating in the Health, Ageing, and Body Composition Study	Mobility limitation: walking one-quarter mile or climbing 10 steps	-	Incidence of mobility limitation was a) Women: 55% b) Men: 44 %	Adjusted risk of developing mobility limitation was: a) Women: non-obese participants with metabolic syndrome (MetS) (HR:1.49, 95% CI 1.24-1.80), obese participants without the MetS (HR:1.95, 95%CI 1.51-2.53) and obese participants with MetS (HR:2.16, 95%CI 1.78-2.63) relative to the non-obese without the MetS. b) Men: non-obese participants with MetS (HR:1.07, 95% CI

'Table 2.3, continued'

Author	Study design	Study participants	Study measurement	Main findings		
				Prevalence	Incidence	Risk factors
						a) 0.87-1.32), obese participants without the MetS (HR:1.64, 95%CI 1.19-2.25) and obese participants with MetS (HR:1.41, 95%CI 1.12-1.78) relative to the non-obese without the MetS. Obesity itself, independent of its metabolic consequences, is a risk factor for mobility limitation.
Aguilar-Navarro et al. (2015) (Mexico)	Cohort study (11-year follow up)	5644 elderly	1) Mobility by using modified version of Nagi scale (difficulty to perform 4 tasks: pushing objects, stooping, reaching arms, handling small objetcs) 2) Lawton IADL 3) Katz ADL	1) Mobility disability: 48.3% 2) IADL disability:10.1% 3) ADL disability: 3%	1)Mobility disability: a) Nonfrail elderly: 51.9% b)Prefrail: 67.5% c) Frail:82% 2) IADL disability: a)Nonfrail elderly: 24.2% b)Prefrail:27.1% c)Frail:40.8% 3)ADL disability: a) Nonfrail elderly:	Frail elderly had higher risk of incidenct mobility, IADL and ADL disability. -Fraility measures were: a) unintentional weight loss b) exhaustion c) low walking speed d) weakness e) low physical activity

'Table 2.3, continued'

Author	Study design	Study participants	Study measurement	Main findings		
				Prevalence	Incidence	Risk factors
					19.9% b)Prefrail: 30% c) Frail: 44.6%	
Millan-Calenti et al. (2010)	Cross sectional study	589 elderly aged older than 65 years.	1) ADL items 2) IADL items	1) ADL: 34.6% 2) IADL: 53.5%	-	1) ADL: • Increasing age • Women • Cognitive impairment 2) IADL: • Age • Cognitive impairment
Carriere et al. (2005) (France)	Cohort study	545 elderly women aged 75 years and older	IADL items	-	1) Incidence of disability: a)2nd year= 22.1% b)3rd year=27.4% c) 4th year= 33.7% d)5th year=36.3% e)6th year=42.4% f)7th year=52.1% 2) Incidence of recovery at 7 years =28.4%	1) Increasing age 2) Lower performances in mobility and balance tests 3) Bad perceived health 4) Lower muscle strength 5) Higher BMI 6) Lower educational level 7) Lower physical activity level

'Table 2.3, continued'

Author	Study design	Study participants	Study measurement	Main findings		
				Prevalence	Incidence	Risk factors
Graciani et al. (2004) (Spain)	Cross sectional study	4000 non-institutionalized Spanish population aged 60 years and over.	Self-reported disability : 1) Mobility Activities: -Difficulty in lifting or carrying a shopping bag? -Difficulty in climbing one flight of stairs? -Difficulty in walking several city blocks (a few 100 m)? 2) Agility Activities: -Difficulty in bending or kneeling? 3) IADL 4) basic ADL	72.9% of subjects reported some type of disability: 1) 59.1% in agility, 2) 51.6% in mobility, 3) 40.1% in IADL 4) 19.1% in ADL.	-	Disability showed to be significantly more frequent for: • female gender (OR 1.83; 95%CI 1.53–2.19); • more advanced age (OR 4.54; 95% CI 3.27–6.32); • low/no educational level (OR 2.01; 95% CI 1.67–2.42); • deteriorated cognitive status (OR 1.67; 95% CI 1.24–2.23); • at least two chronic diseases (OR 2.54; 95% CI 2.01–3.20); • poor perceived health status (OR 3.02; 95% CI 2.48–3.69); • little physical activity (OR 2.57; 95% CI 1.94–3.42); • greater use of hospital care (OR 1.34; 95% CI 1.10–1.64).

'Table 2.3, continued'

Author	Study design	Study participants	Study measurement	Main findings		
				Prevalence	Incidence	Risk factors
Martinez-Huedo et al. (2011) (Spain)	Cross sectional study	7835 elderly >65 years old from National Health Surveys (NHS 2006/2007)	1) 5 items ADL 2) 7 items IADL 3) Mobility disability: walking for 1 hour without resting and walking up 10 steps.	1) Elderly with diabetes= a) ADL:20.6% b) IADL: 49.2% c) Mobility disability: 38.2% 2) Elderly without diabetes= a) ADL: 13.1% b) IADL: 37.1% c) Mobility disability: 26.3%	-	General: 1) Advancing age 2) Female 3) Diabetes Risk factors of ADL in diabetic elderly: 1) female 2) age>75 years 3) depression 4) vision loss Risk factors of IADL in diabetic elderly: 1) female 2) age>75 years 3) depression 4) vision loss 5) cardiovascular diseases Risk factors of mobility disability in diabetic elderly: 1) female 2) age>75 years 3) depression 4) vision loss 5) cardiovascular diseases 6) obesity

'Table 2.3, continued'

Author	Study design	Study participants	Study measurement	Main findings		
				Prevalence	Incidence	Risk factors
Tas et al. (2007) Netherlands	Cohort study (6 years of follow up)	4258 elderly aged 55 years and above	The assessment of Disability: The Stanford Health Assessment Questionnaire (HAQ)	Prevalence of disability: 31.8%	Incidence of disability: 26.7% Higher in women (33.2%) compared to men (19.7%).	Predictors for disability for men and women: 1) age 2) self-rated health 3) overweight 4) depression 5) joint complaints 6) medication use Predictors for disability for men: 1) Stroke 2) falling 3) presence of comorbidities Predictors for disability for women: 1) having a partner 2) poor cognitive functioning 3) osteoarthritis 4) morning stiffness
Gobbens et al. (2014) Netherlands	Cohort study (1 year of follow up)	505 community dwelling elderly aged 75 years and above	ADL and IADL disability were assessed by the Groningen Activity Restriction Scale	ADL disability: 14.4% IADL disability: 11.8%	ADL disability: 15.3% IADL disability: 12.5%	1) Gait speed was predictive of both ADL and IADL disability. 2) Small effect of fatigue on IADL disability.

'Table 2.3, continued'

Author	Study design	Study participants	Study measurement	Main findings		
				Prevalence	Incidence	Risk factors
Seidel et al.(2009) (UK)	Cohort study (2 years of follow up)	13004 elderly aged 65 years and above	4 items of IADL	Prevalence of disability: 50%	Incidence of disability recovery: 9%	Risk factors for least likely to recover from disability: a) women (OR 0.4) b) participants aged ≥75 years (OR 0.2) c) poor self-rated health (OR 0.5), d) using at least one medication (OR 0.6) e) having more than or equal to two co-morbidities (OR 0.6).

2.12 Conceptual framework

The conceptual framework was adapted from the disablement process model which was the extension of the Nagi's Disablement Model. This framework was looking particularly from the aspect of predisposing risk factors for functional limitation and physical disability. Risk factors are predisposing phenomena that are present prior to the onset of the disabling event that can affect the presence and severity of the disablement process. These factors may mediate or moderate the relations between the different stages (pathology, impairment, functional limitation and disability) in the disablement model. The risk factors for functional limitation and physical disability were divided into four categories which were: socio-demographic characteristics of the participants, physiological (biological) risk, psychological and environmental risk and lastly lifestyle and behavioural risk. Figure 2.4 shows the schematic conceptual framework for this study.

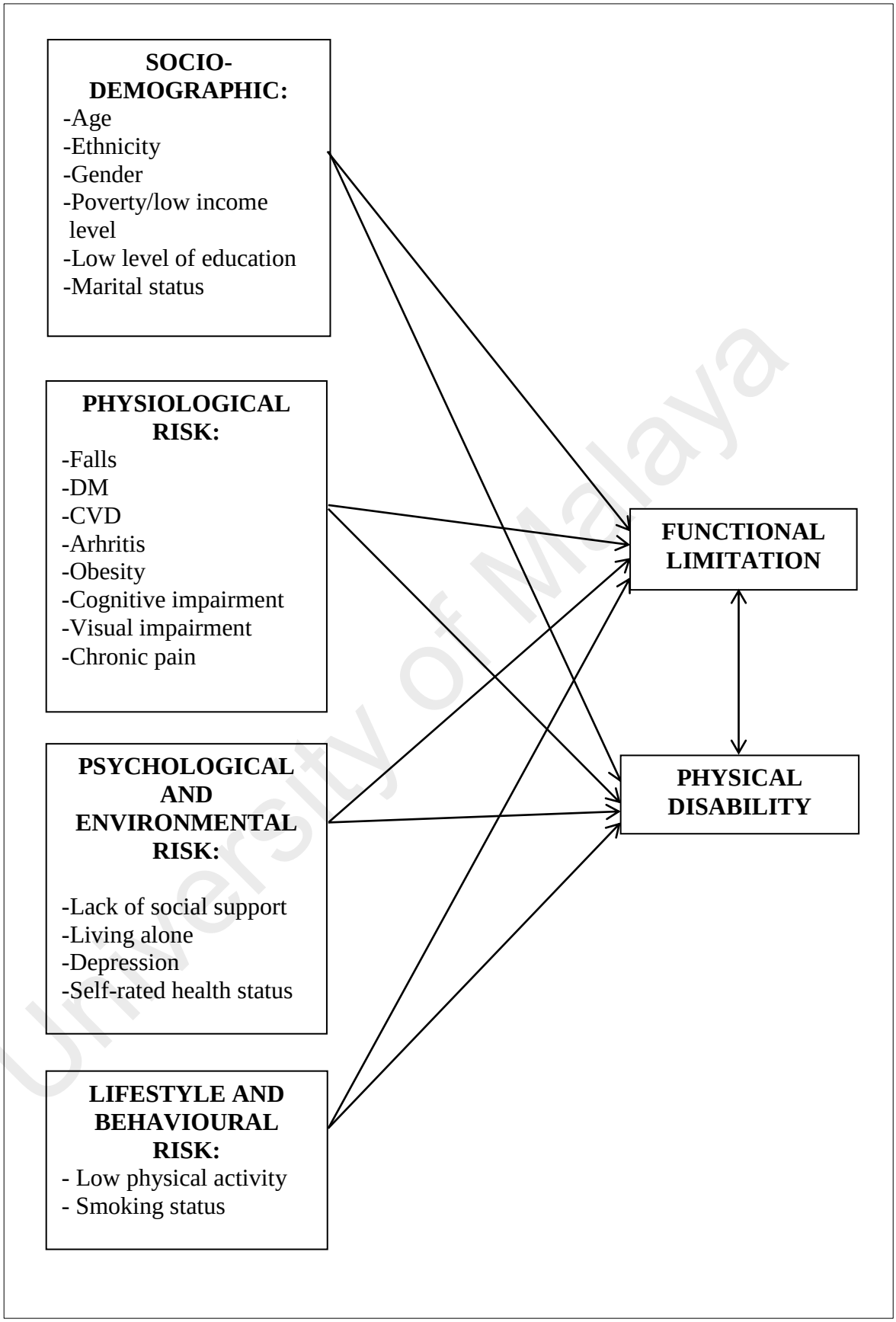


Figure 2.4: Conceptual framework of the present study

CHAPTER 3: METHODS AND MATERIALS

About the chapter

In this Chapter 3, detailed description regarding the methodology of this study is explained according to the subtopics. This chapter covers all aspects of the study method starting from the study design until the statistical analyses used to generate the results.

3.1 Study design

This was an observational population based prospective study with twelve months follow-up. Data collection was conducted in four stages which included:

a) Pilot study
b) Baseline data collection
c) Telephone interviews
d) Follow up data collection at 12 months

3.2 Study area and duration of study

3.2.1 Negeri Sembilan

The study was conducted at Kuala Pilah district in Negeri Sembilan, Malaysia. Negeri Sembilan, is one of Malaysia's thirteen states. It is located in the central region of Peninsular Malaysia. It is bordered in the north by Selangor, in the east by Pahang and in the south by Melaka and Johor. Covering a total area of 6,645 sq km, Negeri Sembilan is mainly an agricultural state (Unit Penyelarasan Projek, Rancangan Tempatan Daerah, 2013). However, the establishment of several industrial estates enhanced the manufacturing sector as a major contributor towards the state's economy. The main agricultural activities are concentrated rubber and oil palm plantations, livestock, fruit orchards and vegetable farming. Manufacturing activity includes

electrical and electronics, textiles, furniture, chemicals, machinery, metalwork and rubber products. The ethnic composition in 2010 was: Malay (590,089 or 57.8%), Chinese (223,271 or 21.9%), Indian (146,214 or 14.3%), Others (3,583 or 0.4%) and Non Citizens (57,907 or 5.7%).

Table 3.1 shows the population distribution for each district in Negeri Sembilan. Based on the National Census data, the total population in Kuala Pilah is 63,874 and total number of elderly aged 60 years and above is 9263 or 14.5% (Department of Statistics, 2010). Kuala Pilah was chosen as a study area because the proportion of elderly aged 60 years and above in Kuala Pilah was the biggest compared to other districts.

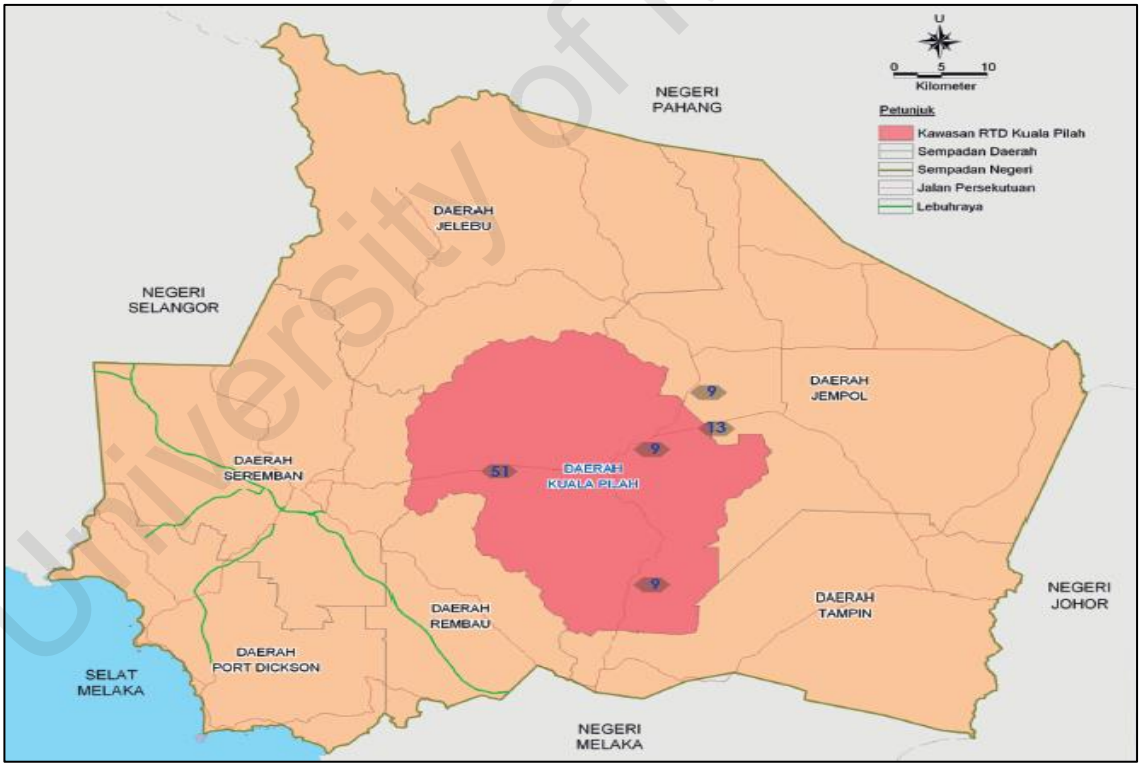


Figure 3.1: Map of Negeri Sembilan (Source: Unit Penyelarasan Projek, Rancangan Tempatan Daerah, 2013).

Table 3.1: Total population and people aged over 60 years in Negeri Sembilan by districts in 2010

Districts	Total population	Population above 60 years	Percentage (%)
Kuala Pilah	63874	9263	14.5
Jelebu	38299	5273	13.8
Rembau	41988	5356	12.8
Tampin	82165	8551	10.4
Jempol	112740	10588	9.4
Port Dickson	110991	8672	7.8
Seremban	536147	41171	7.7
TOTAL	**989204**	**88874**	**9.0**

Source: Department of Statistic, Malaysia (2010). Census 2010: Population Distribution and Basic Demographic Characteristic Report 2010.

3.2.2 Kuala Pilah

Kuala Pilah is one of the seven districts in Negeri Sembilan besides Jelebu, Johol, Tampin, Rembau, Port Dickson and Seremban. It is the third biggest district after Jempol and Jelebu. It is situated in the center of Negeri Sembilan and covers an area of 103,020.76 hectares or 15.5 % of Negeri Sembilan's area (Unit Penyelarasan Projek, Rancangan Tempatan Daerah, 2013).

There are three types of villages in Kuala Pilah which are traditional village (Kampung Tradisional), new village (Kampung Baru) and Aboriginal (Orang Asli) village. Traditional village mainly comprises Malay population where they inherit the land from their ancestors while the population in Kampung Baru usually comprise the three major ethnic groups in Malaysia which is Malay, Chinese and Indian.

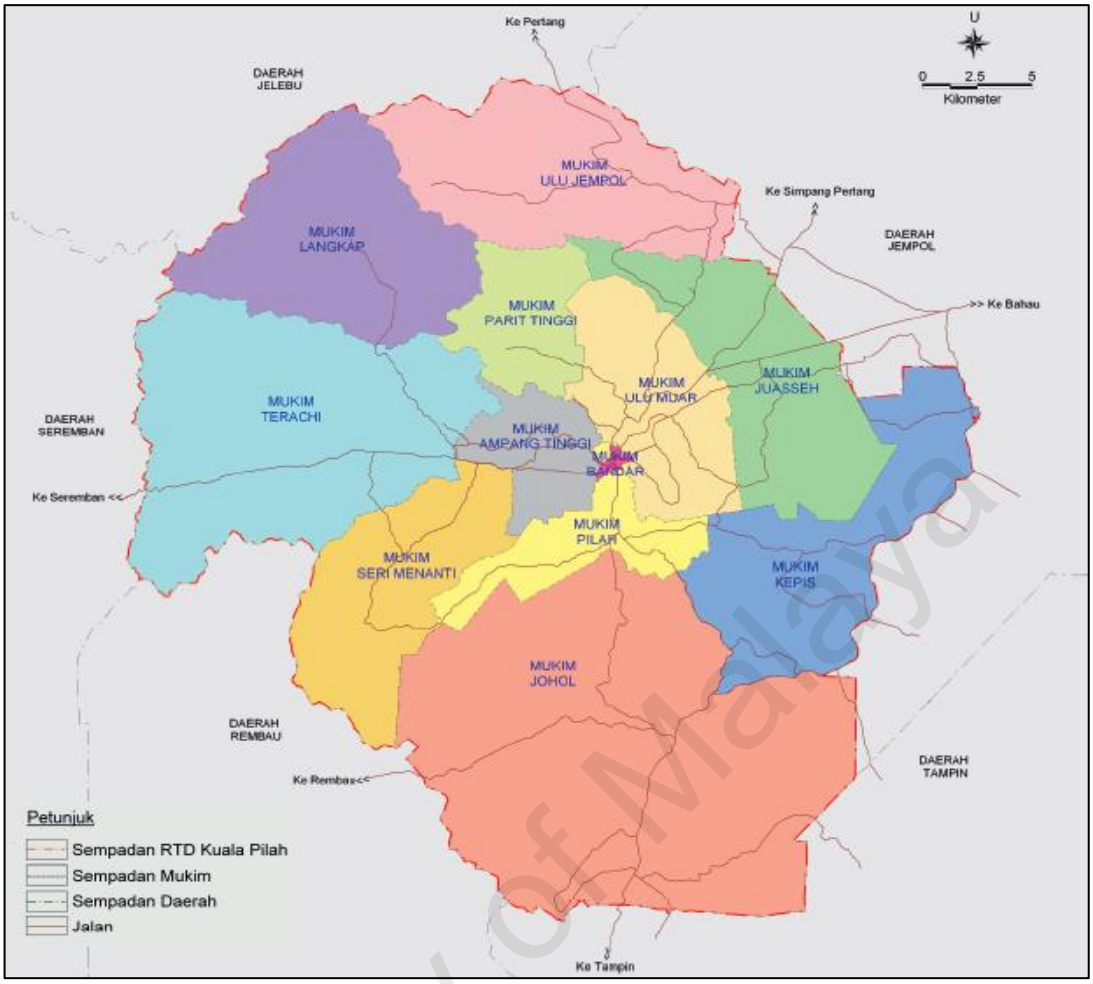


Figure 3.2: Map of Kuala Pilah district (Source: Unit Penyelarasan Projek, Rancangan Tempatan Daerah, 2013).

Kuala Pilah's district is further divided into twelve subdistricts as listed in Table 3.2. Table 3.2 also shows distribution of elderly population aged over 60 years and above according to subdistricts in Kuala Pilah. The highest percentage of elderly is in Sri Menanti, followed by Ulu Jempol and the least percentage is in Langkap subdistrict. Kuala Pilah is still considered as an agricultural district. The population distributions according to ethnic groups reflect the demographics of the the rural areas of Malaysia. Table 3.3 shows the comparison of general population in rural area in Malaysia and general population in Kuala Pilah's district according to gender and ethnicity. Majority of the people living in Kuala Pilah were Malay, followed by Chinese, Indian and Others.

Table 3.2: Population of elderly aged over 60 years according to sub-districts in Kuala Pilah in 2010

Sub-district of Kuala Pilah	Total population (N)	Population above 60 years	Percentage (%)
Ampang Tinggi	11197	1274	11.4
Johol	8586	1391	16.2
Juasseh	9063	1194	13.2
Kepis	3488	536	15.4
Langkap	402	14	3.5
Parit Tinggi	1299	67	5.2
Pilah	12262	1492	12.2
Sri Menanti	3244	841	25.9
Terachi	4748	887	18.7
Ulu Jempol	2768	614	22.2
Ulu Muar	6817	953	14.0
TOTAL	**63874**	**9263**	**14.5**

Source: Department of Statistic, Malaysia (2010). Census 2010: Population Distribution and Basic Demographic Characteristic Report 2010.

Table 3.3: Comparison of elderly population in rural area in Malaysia and general population in Kuala Pilah's district according to gender and ethnicity.

Ethnic group	Total		Male		Female	
	General population in rural area in Malaysia	General population in Kuala Pilah	General population in rural area in Malaysia	General population in Kuala Pilah	General population in rural area in Malaysia	General population in Kuala Pilah
Malay	83.3 %	79.0%	82.7%	77.5%	84.9%	80.4%
Chinese	10.2%	14.8%	10.5%	15.9	10.1%	13.6%
Indian	5.4%	6.0%	5.7%	6.3%	3.8%	5.8%
Others	1.1%	0.2%	1.1%	0.3%	1.1%	0.2%

Source: Department of Statistic, Malaysia (2010). Census 2010: Population Distribution and Basic Demographic Characteristic Report 2010.

3.3 Study period

The study period was 36 months which started from 1st September 2012 until 31st August 2015. Data collection period was 15 months, starting from 11th November 2013 until 8th February 2015.

3.4 Study population

The participants for this study were selected from elderly aged 60 years and above and residents of Kuala Pilah district of Negeri Sembilan.

3.4.1 Inclusion criteria

Eligible participants were those living in Kuala Pilah district for a minimum period of 12 months and who were 60 years of age and older. Their age was verified from their identity card which stated the exact date of birth, place of origin and gender.

3.4.2 Exclusion criteria

Exclusion criteria were:

a) Non-Malaysian citizens,

b) Elderly who resides in nursing homes

c) Elderly who is admitted to hospital during the interview

d) Those who refused to participate

3.5 Sample size

Sample size for this study was determined in two stages:

i) Sample size to determine the prevalence, incidence, incidence recovery and risk factors of functional limitation and physical disability

Sample size calculation was determined by this formula based from estimation of proportion:

$$n = \frac{Z^2 p (1-p)}{e^2}$$

Z is the Z value for the corresponding confidence level. 95% confidence level was chosen and the Z value is 1.96.

p is the estimated value for the proportion of a sample and e is the margin of error.

The prevalence of physical disability of 24.7% (Hairi et al, 2010) and margin of error of 2% (0.02) generates the biggest sample size for this study.

Calculation for the sample size:

$$n = \frac{1.96^2 (0.247)(1-0.247)}{0.02^2} = 1786.26 \approx 1800$$

n = 1800 + 10% attrition rate + 5% missing data + 20% non-response rate

n = 2430 ≈ 2500

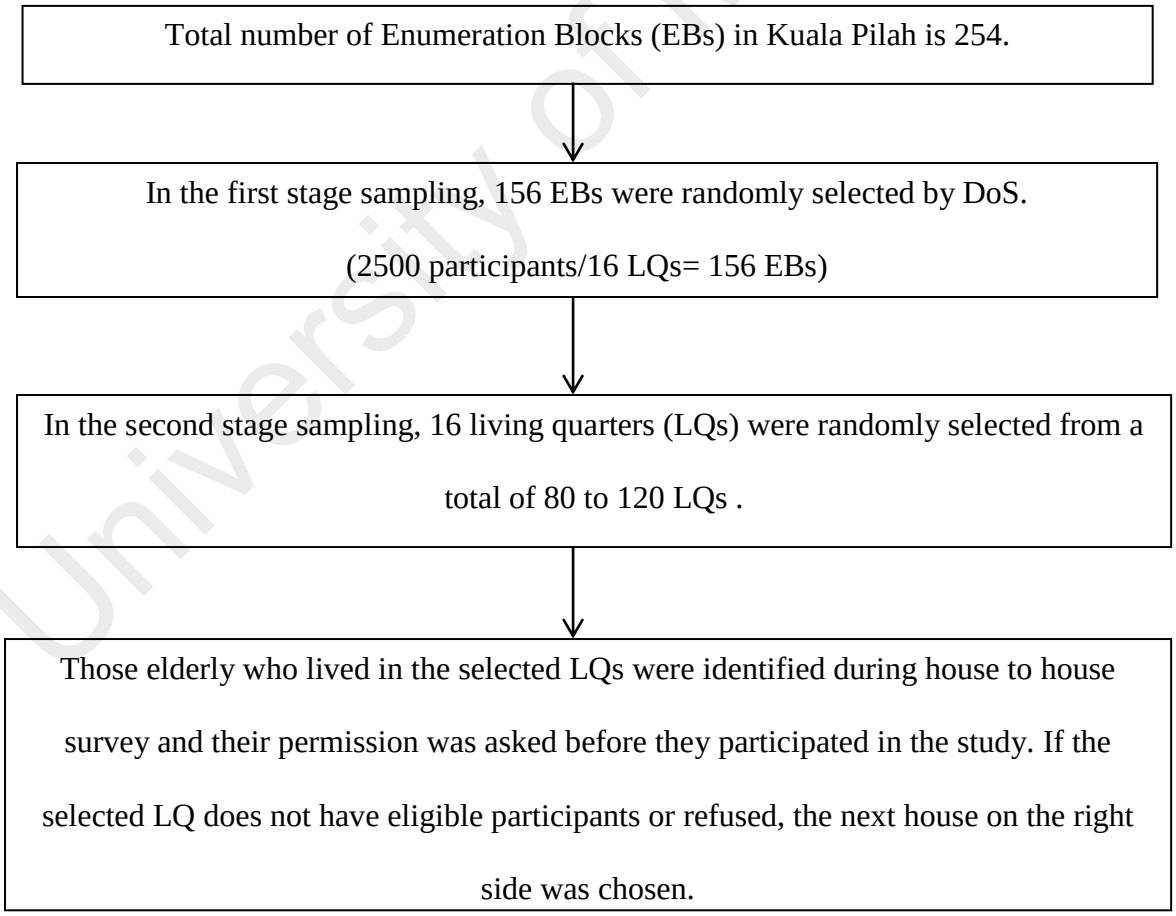
n = 2500 study participants

ii) Sample size to determine the subtypes of physical disability

Only some of the sample population was chosen to receive the telephone interviews for the assessment of subtypes of physical disability. Based on the study findings from Gill et al (2008), this present study estimated that approximately 1000 participants need to be follow up to investigate the subtypes of physical disability. Assuming out of these 1000 participants, 24.7% or 247 (based from prevalence study by Hairi et al., 2010) participants had physical disability at baseline; the remaining 753 were healthy participants without any disability. This sample size was similar with the study conducted by Gill and colleagues (2008).

3.6 Sampling procedures

Study population was randomly selected from all the elderly population aged 60 years and above and lived in Kuala Pilah (n=9263). Sampling was carried out by the Department of Statistics Malaysia (DoS) using a stratified 2-stage sampling design. The whole Kuala Pilah district was divided into artificially created, contiguous geographical areas called Enumeration Blocks (EBs) which constituted as a primary stratum. An EB consisted of 80 to 120 living quarters (LQs) and has specified boundaries (either natural or artificial) that do not straddle administrative boundaries. Percentage of elderly population in one Enumeration Block ranges from 14% to 84%. Department of Statistics, Malaysia had set a value of 16 living quarters (LQs) to be randomly selected in each EB. Details of the sampling were described as flow chart below:



3.7 Study instruments

Below are the lists of questionnaires and tools that were used in the study:

a) Socio-demographic questionnaire.
b) Physical disability : Katz's activities of daily living (ADL), and Instrumental Activity of Daily Living (IADL)
c) Functional limitation : The 4 metres walking speed assessment
d) Depressive symptoms : Geriatric Depression Scale (GDS)
e) Cognitive function: Mini-mental status examination (MMSE)
f) Social support: Duke Social Support Index (DSSI)
g) Physical activity: Physical Activity Scale of the Elderly (PASE)
h) Self-rated health: Self-rated health questionnaire
i) Self-reported visual and hearing impairment
j) Health care utilization questionnaire: National Health and Morbidity Survey (NHMS) questionnaire
k) Anthropometry assessment: Bioelectrical impedance analysis (BIA)
l) Upper body strength: Hand grip assessment

3.7.1 Socio-demographic Questionnaire

Socio-demographic questionnaire included gender, age, ethnicity, education level, marital status, monthly household income, occupation status, smoking status and medical history. Participants were asked if they had any medical history of diabetes, epilepsy, hypertension, heart attack, coronary or myocardial infarction, angina, congestive heart failure, chronic lung disease, asthma, stroke and arthritis.

3.7.2 Measurement for physical disability

3.7.2.1 Katz Activities of Daily Living (ADL)

The scale measure the adequacy of performance of the six functions, namely bathing, dressing, toileting, transferring, continence, and feeding. The score for the above items were grouped into 3 categories; score 2 for elderly able to do the activity by themselves, score 1: need some help and score 0: total unable to do or perform the activity and require help from others. The total scores of 12 means the elderly were totally independent and have no disability in performing ADL. Score less than 12 mean the elderly have disability in performing ADL.

However, The Katz ADL Index assesses basic activities of daily living and does not assess more advanced activities of daily living. Although the Katz ADL Index was sensitive to changes in declining health status, it was limited in its ability to measure small increments of change seen in the rehabilitation of elderly. Due to this, another scale to measure functional status which was the Instrumental Activity of Daily Living (IADL) was used in this study.

3.7.2.2 Instrumental Activities of Daily Living (IADL)

Instrumental's activities of daily living (IADLs) measure the domestic functions of the elderly and there were eight items in this scale: telephone and transportation use, shopping, cooking, house-keeping, medication intake and budgeting. The score for the eight items in IADL were also grouped into 3 categories; score 2 for elderly able to do the activity by themselves, score 1: need some help and score 0: totally unable to do or perform the activity and require help from others. The total scores of 16 indicate that the elderly were totally independent and have no disability in performing IADL. Score less than 16 mean the elderly have disability in performing IADL.

3.7.3 Measurement for functional limitation (Four Metres Walking Speed Test)

In this study, participants were asked to walk at their usual pace for a distance of 4 metres, with a 1 metre start-up before timing (Studenski et al., 2003). Participants were told to stand with their feet touching the starting line and were then given the following instruction ‘‘I want you to walk until you cross that line, at your normal speed, as if you were walking down the corridor’’, and they began walking when they received the simple order: ‘‘start walking’’. Each test was carried out twice; recording the shortest time (in seconds) required to cover each distance. They were allowed to use any technical means of assistance required but not the help of another person. The best time was used for scoring. The cut-off point of 0.8m/s and below was used to indicate frailty (Abellan et al., 2009).

3.7.4 Measurement for cognitive function status

In clinical practice, Mini Mental Status Examination (MMSE) is one of the tools widely recognized as a valid cognitive test to diagnose dementia. It tests a broad range of cognitive functions, including orientation, recall, attention, calculation, language manipulation and constructional apraxia. It is a practical tool to detect cognitive impairment and also to keep track if there are any changes occur in a person’s cognitive status (Harold et al., 1998). The examination is easy and takes approximately seven minutes to complete (Royall et al., 1998) and can be done by nurses and other allied health care providers.

Three versions of the Malay-MMSE (M-MMSE) were validated among the elderly population in Malaysia (Ibrahim et al., 2009). Scores lower than the optimal cut-off scores indicate cognitive impairment. The three versions were M-MMSE-7 referred to serial 7s, M-MMSE-3 referred to serial 3s instead of serial 7s, and M-MMSE-S

referred to asking the patient to spell the word 'DUNIA' (literally means "WORLD") backwards instead of serial 7.

The Mini Mental State Examination (MMSE-7) was translated into Malay language and validated in the previous study with Cronbach's alpha coefficient value of 0.76 (Zarina et al., 2007). The authors also found that all items in MMSE have satisfactory correlation and were suitable for usage among elderly in Malaysia. The status of cognitive function was categorized into 4 severity groups based on MMSE score (see Table 3.4).

Table 3.4: Severity of cognitive impairment based from MMSE

Severity category	MMSE Score
Normal	MMSE 27 to 30
Mild	MMSE 21 to 26
Moderate	MMSE 15 to 20
Moderately severe	MMSE 10 to 14
Severe	MMSE 0 to 9

Source: Clinical Practice Guidelines: Management of Dementia 2nd Edition, 2009E-7 M MMS

3.7.5 Measurement for depressive symptoms

An extensive screening tool used to detect depression among elderly population is the Geriatric Depression Scale (GDS). Originally, the first version (GDS-30) consisted of 30 questions and can be self-administered (Yesavage et al., 1983). However, the shorter version which only comprised 15 questions (GDS-15) was later established. It is easier to use and hence, it has better acceptability (Teh et al., 2004). Both long and short versions of depressive assessment have been validated across diverse clinical settings, cultures and languages (Teh et al., 2004).

Both GDS-30 and GDS-15 had been translated and validated in Malaysia (Teh et al., 2004; Sherina, 2010). The internal reliability for the translated version comprising

30 questions GDS was found to be satisfactory with coefficient alpha of 0.69 (Sherina, 2010). The short version of GDS (Sheikh et al., 1986) was used in this study to measure depression level as it is more suitable to be used in population based study and among the elderly who generally had low attention-span.

Scores of zero to four indicated no depressive symptoms, five to nine indicated mild depression, while 10 and above indicated severe depression (Sheikh et al., 1986). The validation study of GDS-15 done in Malaysia yielded satisfactory reliability values (Cronbach's alpha 0.84, test-retest reliability 0.84) and validity value (ICC 0.68) (Teh et al., 2004).

3.7.6 Measurement for social support level

The Duke Social Support Index (DSSI) measures multiple dimensions of social support and has been used extensively in cross-sectional and longitudinal studies of ageing. Epidemiological studies of chronically ill, frail elderly individuals often include a measure of social support as social support was found to strongly influence health (Panchana et al., 2008). There were strong evidence for reliability and validity of the 11-items Duke Social Support Index, thus supporting its use in aged care research and health promotion strategies (Goodger et al., 1999). The DSSI provides researchers with the opportunity to use a brief measure of social support instead of using a single-item measures or scales which have limited psychometric evidence (Goodger et al., 1999).

In the validity and reliability study to assess this scale, the internal consistency using Cronbach's alpha for the overall index was 0.77 and test-retest reliability scores ranged from 0.70 to 0.81. Construct validity of the DSSI was supported by moderate correlations with health, quality of life and loneliness (Goodger et al., 1999).

3.7.7 Measurement for physical activity level

Physical Activity Scale for the Elderly (PASE) was used in order to quantify the level of physical activity among elderly pertaining to the frequency and duration they were engaged with that activity (Washburn et al., 1993). The scale consist ten items focusing on three domains of activity which are leisure (5 components), household (4 components) and work related activity (1 component) over the past seven days. Leisure time physical activity consisted of walking outside the home; light, moderate, and strenuous sports; and activities aimed at muscle strength/endurance. Work-related physical activity included jobs involving standing or walking. Household physical activity contained light housework, heavy housework, home repairs, lawn work/yard care, outdoor gardening, and caring for another person.

The total PASE score represented total physical activity and was computed by multiplying the amount of time spent (or participation) in each activity by item weights and summed over all activities. Scores of leisure activity was categorized into 4 levels: never, seldom, sometimes and often. Scores for the household and work-related activity was grouped into 2 categories: yes or no. This tool had been pre-tested and validated among community dwelling elderly in Klang Valley before being used in the present study. The Malay version of PASE was shown to have acceptable validity and reliability. Thus this tool is useful for assessing the physical activity level of elderly Malaysians (Ismail et al., 2015).

3.7.8 Measurement for self-rated health status

Self-rated health has been one of the most frequently used variables in gerontological and health research (Jylha et al., 1998). The interesting role of self-rated health is because it was a mediator between human biology and psychology. Although self-rated health is a subjective and general indicator, evidences suggest that self-rated

health is a strong predictor of mortality (Idler et al, 1997; Kaplan et al., 1983; Pijls et al., 1993) and other morbidity outcomes such as hip fracture (Cummings et al., 1995) and ADL disability (Kaplan et al., 1993).

Self-rated health is a useful health outcome in research because it is simple, short, and global. This study adopted the existing self-rated health questionnaire used by Jylha and colleagues (1998). The question was "How would you evaluate your present health?". In this study, the participant's responses were recorded using a 3 point Likert format; "Good", "Average", and "Poor".

3.7.9 Measurement for visual impairment

Participants were asked if they had and/or being diagnosed by the medical practitioners as having visual impairment. The response for those question was categorical, either (yes) or (no).

3.7.10 Measurement for history of falling

Participants were asked if they had any history of falls within twelve months prior to the interview. The response for those question was categorical, either (yes) or (no).

3.7.11 Measurement for chronic pain

The presence of chronic pain was assessed with two questions, "In the last six months prior to this interview, do you have pain every day, or most days, lasting for three months or more?". Those participants who reported having chronic pain were asked further about the impact of pain with the question, "In the last six months, does the pain interfere with your ability to work, study or manage day to day activities?". Responses to this question were categorized using the following Likert scale: "not at

all", "a little bit", "moderately", "quite a lot" and "extremely". These questions have been used previously in other epidemiological studies of pain (Blyth et al., 2001; Hairi et al., 2013; Mohamed Zaki et al., 2014).

3.7.12 Measurement for anthropometry

Body composition is usually assessed for determining body component deficiencies or excesses, such as lean mass and fat mass, which allow an understanding of the individual's nutritional status (Lee et al., 2008). The importance and great benefit of this assessment is that body weight alone does not reflect the true picture of our body composition. Bioelectrical impedance analysis (BIA) is a commonly used method for estimating body composition based on a two-compartment (2C) body composition model (Lee et al., 2008). The 2C models partition the body into fat mass and fat-free mass (FFM), and are the most widely used approach to estimate body composition in adults. BIA measures the impedance or resistance to a small electrical current as it travels through the body's water pool. An estimate of TBW is acquired from which total body FFM is calculated using the assumption that 73% of the body's FFM is water (Lee et al., 2008).

The advantages of BIA assessment include its portability, ease of use, can be conducted by non-medical practitioner and safe (however not recommended for participants with a pacemaker), thus making it appropriate for large-scale studies. Previous study has demonstrated the reliability of impedance measures and validity of BIA equations for estimating free fat mass (FFM) and percentages of body fluid in children and adults (Heyward et al., 2004). Validity of BIA is also influenced by sex, age, disease state, race or ethnicity (Rush et al., 2006), and level of fatness (Pateyjohns et al., 2006). In this study, body composition analyses were determined by using 4-point bioelectrical impedance analysis (BIA) equipment (TANITA TBF-300A, Tanita,

Japan). Height and weight were measured for the elderly. They were instructed to use light clothing with shoes and hat removed. Body mass index (BMI) was calculated in kg/m^2.

3.7.13 Measurement for upper limb strength

Measurement for upper limb strength was used in the pilot study to validate the study instruments which were Physical Activity Scale for Elderly (PASE) and Duke Social Support Index (DSSI). Even if there are different assessors or different brands of dynamometers used in studies, handgrip strength is a reliable measure if standardised methods and calibrated equipment are applied (Mathiowetz, 2002; Schmidt et al., 2002). Although the relationship is not causal, the grip strength is related to and predictive of other health conditions (Angst et al., 2010; Bohannon, 2008).

Longitudinal studies suggest that poor grip strength is predictive of increased mortality from cardiovascular disease and from cancer in men, even when factors of muscle mass and body mass index are adjusted for (Gale et al., 2007; Rantanen et al., 2003) . Hand grip strength is negatively associated with physical frailty even when the effects of body mass index (BMI) and arm muscle circumference are controlled (Syddall et al., 2003). It has been suggested that the factor related to frailty and disability in later life is the manner in which muscles are used, and this can be measured by hand dynamometry (Syddall et al., 2003).

Hand grip strength can be quantified by measuring the amount of static force that the hand can squeeze around a dynamometer (Massy-Westropp et al., 2011). The force commonly measured in kilograms and pounds, but it also can be expressed in millilitres of mercury and in Newtons. In the present study, hand grip strength was measured by using a hydraulic hand dynamometer (JAMAR, Jackson, USA) with participants seated, their elbow by their side and flexed to right angles, and a neutral

wrist position and provision of support underneath the dynamometer. This position, followed by calculation of the mean of three trials of grip strength for each hand, has been well-documented as reliable (Fess, 1992).

3.8 Pretesting and validation of the study instruments

3.8.1 Introduction

A pilot study was conducted among community-dwelling elderly aged 60 years and above residing in low-cost public housings in Klang Valley. These public housings were developed by the Ministry of Urban Wellbeing, Housing and Local Government to provide living facilities for the resettlement of households previously living in squatter areas. These public subsidised high-rise flats ranged from single to 3-bedroom units (650 sf), available for rent at a rate of RM 55 (USD 17) to RM 218 (USD 68) per month depending on the size of the unit. The target population were mainly those of low income group with monthly income below RM 2500 (approximately USD 725).

3.8.2 Study participants and eligibility criteria

Individuals aged 60 years or above who lived independently from eight low cost housing areas around Klang Valley. Malaysian citizens who understand Malay or English language and permanently lived at the selected areas for at least twelve months were invited to participate in the study. Details of the study were described to the participants prior to data collection. Those elderly who had severe cognitive impairment ie scored less than 10 in the Mini Mental Status Examination (Crum et al., 1993), having uncontrolled chronic medical problems and physically disabled were excluded from the study.

3.8.3 Translation of study instruments: PASE and DSSI

Permission to use and translation of the original version of PASE questionnaire was obtained from the New England Research Institute (NERI) which owns the copyright. The DSSI questionnaire and permission was obtained from the owner, Professor Harold G. Koenig, Professor of Psychiatry and Behavioral Sciences from the Duke University Medical Center, Durham, North Carolina. Both PASE and DSSI was translated independently into Malay language using forward and backward translation method by two medical doctors who are proficient in both Malay and English. Both the original and the back-translated English version were compared by a third person who was also a medical doctor to determine the accuracy of the translation. Discrepancies between translations were resolved by discussion between the translators. Face validation was conducted with a panel of experts comprising of public health experts and medical officers to elicit any errors for modification before the validity and reliability study was conducted.

3.8.4 Study procedures

Participants were interviewed face to face by the researcher and trained research assistants who received two days training prior to data collection. The training includes proper technique of questionnaire administration and physical assessment. They interviewed participants to obtain their socio-demographic data including gender, age, ethnicity, education level, marital status, living arrangements and medical history. Participants were asked if they had any of the following diseases: diabetes, epilepsy, hypertension, heart attack, coronary or myocardial infarction, angina, congestive heart failure, chronic lung disease, asthma, stroke and arthritis or specify any other diagnosed diseases. These interviews were carried out in a multi-purpose hall or a common facility room. A repeat interview was carried out three weeks apart with the same group of

interviewers to the same participants in order to evaluate the temporal reliability of the scale.

3.8.5 Study results

Results from this validation and reliability study showed that the Physical Activity Scale for Elderly (PASE) and Duke Social Support Index (DSSI) questionnaires were valid and reliable tools to assess the physical activity and social support among elderly in Malaysia. The mean PASE-M scores at baseline and follow-up were 94.96 (SD 62.82) and 92.19 (SD 64.02). Fair to moderate correlation were found between PASE-M and physical function scale, IADL (r_s = 0.429, P < .001), walking speed (r_s = 0.270, P < .001), right and left hand grip strengths (r_s = 0.313-0.339, P < .001), and perceived health status (r_s = –0.124, P = .016). Test-retest reliability was adequate (ICC = 0.493).

For DSSI, explanatory factor analysis (EFA) yields overall measure of sample adequacy value of 0.873 with 59.2% of explained variation. Confirmatory factor analysis showed that the structure models of DSSI were basically suitable for the original structure of DSSI. Cronbach's alpha for the overall index was 0.78, Intraclass Correlation Coefficient (ICC) was 0.653. Construct validity was supported by the DSSI's correlations with physical function measures; Katz ADL score (r_s=0.117, p= .019), IADL score (r_s=0.105, p= .035), physical activity level (r_s=0.162, p= .001), and psychosocial measures; cognitive function status (r_s=0.106, p= .034) and depressive symptoms (r_s=-0.166, p= .001). Details of the validity and reliability study results are shown in the Appendix E.

3.9 Study variables

The study variables are divided into the following (refer to Table 3.10):

3.9.1 Independent variables

a) Socio-demographic characteristics: age, gender, ethnicity, education level, marital status and living arrangements.

b) Health related variables: status of cognitive function, presence of chronic diseases, depressive symptoms, previous history of falls, visual impairment, self-rated health status, chronic pain and anthropometry.

c) Lifestyle and behavioural variables: smoking status and physical activity level.

d) Social support level.

3.9.2 Dependent variables

a) Functional limitation and physical disability at baseline or at 12 months of follow up.

b) Recovery from functional limitation and physical disability.

c) Subtypes of physical disability at 12 months follow up.

Table 3.5: Operational definition and scale of measurement

Variables	Operational definition	Scale of measurement
Age	Age was determined based from date of birth recorded in participant's identity card.	Self-reported items.
Gender	Gender was categorized into male and female participants.	Self-reported items.
Ethnic	Ethnic group was self reported and categorized as Malay, Chinese, Indian and Others. Others include Aboriginal, Iban or Kadazan/Dusun.	Self-reported items.

'Table 3.5, continued'

Variables	Operational definition	Scale of measurement
Current marital status	Current marital status was grouped into four categories: married, widowed, divorced and never married.	Self-reported items.
Education level	Divided into four categories: tertiary, secondary, primary and no formal education. Participants stated their highest educational level.	Self-reported items.
Living arrangements	Living arrangement was categorized into five groups: living with spouse, living with spouse and children, living with children, living with others or living alone. Participants were asked about their current living arrangement.	Self-reported items.
Presence of chronic diseases	Participants were asked if they received treatment for diseases like cardiovascular diseases (include myocardial infarction, angina, hypertension and stroke), diabetes, arthritis, hyperlipidaemia, epilepsy, cancer, chronic lung disease and asthma? Responses were coded into (Yes) and (No).	Self-reported items.
Smoking status	Smoking status was categorized into 3 responses: Yes, No and Former smoker. Current smoking was defined as current use, at the time of survey, of cigarettes	Self-reported items.

‘Table 3.5, continued’

Variables	Operational definition	Scale of measurement
	smoking included pipes, cigars or chewing tobacco. Former smoker was defined as a person already quit smoking for the past 6 months. Non smoker was a person who never takes up smoking.	
Visual impairment	Participants were asked if they had been previously diagnosed with visual impairments by medical professional or at the present were suffering from deterioration of their vision.	Self-reported items.
Physical disability	Defined as having difficulty performing at least one Activity of Daily Living (score less than 12 in ADL) and/or at least one Instrumental Activity of Daily Living (score less than 16 in IADL).	Katz’s Index (ADL) and IADL items.
Functional limitation	The value below 0.8 m/s in four metre walking speed test is considered as having functional limitation.	The four metres walking speed test.
Depression	Defined as having scores of five or more in GDS.	Geriatric Depression Scale 15 items (GDS).
Self-rated health status	Participant’s evaluation of their own present health in 3 point Likert format; “Good”, “Average” and “Poor”.	Self-reported items.

'Table 3.5, continued'

Variables	Operational definition	Scale of measurement
Cognitive impairment	Cognitive status was categorized into three groups: -Normal: MMSE 27-30 -Impaired (combination of mild and moderate impairments): MMSE 10-26 -Severely impaired: MMSE 0-9	Mini Mental Status Examination (MMSE)
Falls	History of any falls in the last twelve months from the date of interview. Falls were defined as unintentionally coming to the ground or some lower surface and not as a consequence of sustaining a violent blow, loss of consciousness and sudden paralysis as in a stroke incident or epileptic seizure (Azidah et al., 2012).	Self-report items.
Social support	Higher score in Duke Social Support Index (DSSI) indicate higher social support level, with those in the first quartile considered to have low social support level.	Duke Social Support Index (DSSI).
Physical activity	Higher score in the Physical Activity Scale in Elderly (PASE) indicate higher physical activity level, with those in the first quartile considered to have low physical activity level.	Physical Activity Scale in Elderly (PASE).

'Table 3.5, continued'

Variables	Operational definition	Scale of measurement
Chronic pain	Defined as having pain everyday or in most days, lasting for three months or more in the last six months prior to data collection.	Self-reported items.
Body fat	Based from percentages of body fat and categorised into the following groups (Gallagher et al., 1996): a) Elderly male: - Underfat= 0-13% - Normal= 13.1-25% - Overfat= 25.1-30% -Obese= 30.1% and more b) Elderly female: - Underfat= 0-25% - Normal= 25.1-35% - Overfat= 35.1- 42% - Obese= 42.1% and more	Bioimpedance analysis (BIA).

3.10 Study procedures

This was a population-based survey and was conducted in collaboration with the Negeri Sembilan Department of Health and Kuala Pilah District Health Office. The researcher and trained research assistants conducted the data collection. The data collection was divided into two parts. Part 1: Baseline data collection and Part 2: Follow-up data collection after 12 months. The research assistants received two days training that included proper technique of questionnaire administration and physical assessment prior to data collection.

Face to face in-person interviews were conducted to gather the information using structured and validated questionnaires. The interviews were conducted at the participant's house. The research assistants were divided into four teams and the interviews were conducted at different location simultaneously. The collected data were checked from time to time by the principal researcher to minimize missing data and ensure it was collected properly. The duration for first phase data collection took three months starting from 11th November 2013 until 7th February 2014. The duration for second phase was 2 months which started from 8th December 2014 until 8th February 2015.

The subsequent telephone interviews were conducted in the Department of Social and Preventive Medicine, Faculty of Medicine, University of Malaya by the research assistants. The interviews started right after the first baseline data collection was completed. The participants for the telephone interview were selected from the total elderly that participated in the baseline data collection. A total of 1000 participants were randomly selected out of 2405 participants using the random numbers generated by Microsoft Excel. During the interviews, the participants were asked regarding changes in their physical function using Katz ADLs item. The telephone interviews were conducted every three months and for each participant, they received three telephone

calls from our research assistants during the twelve months period before the second survey started. The number of partcipants and loss to follow up for the entire study is shown in Figure 3.3.

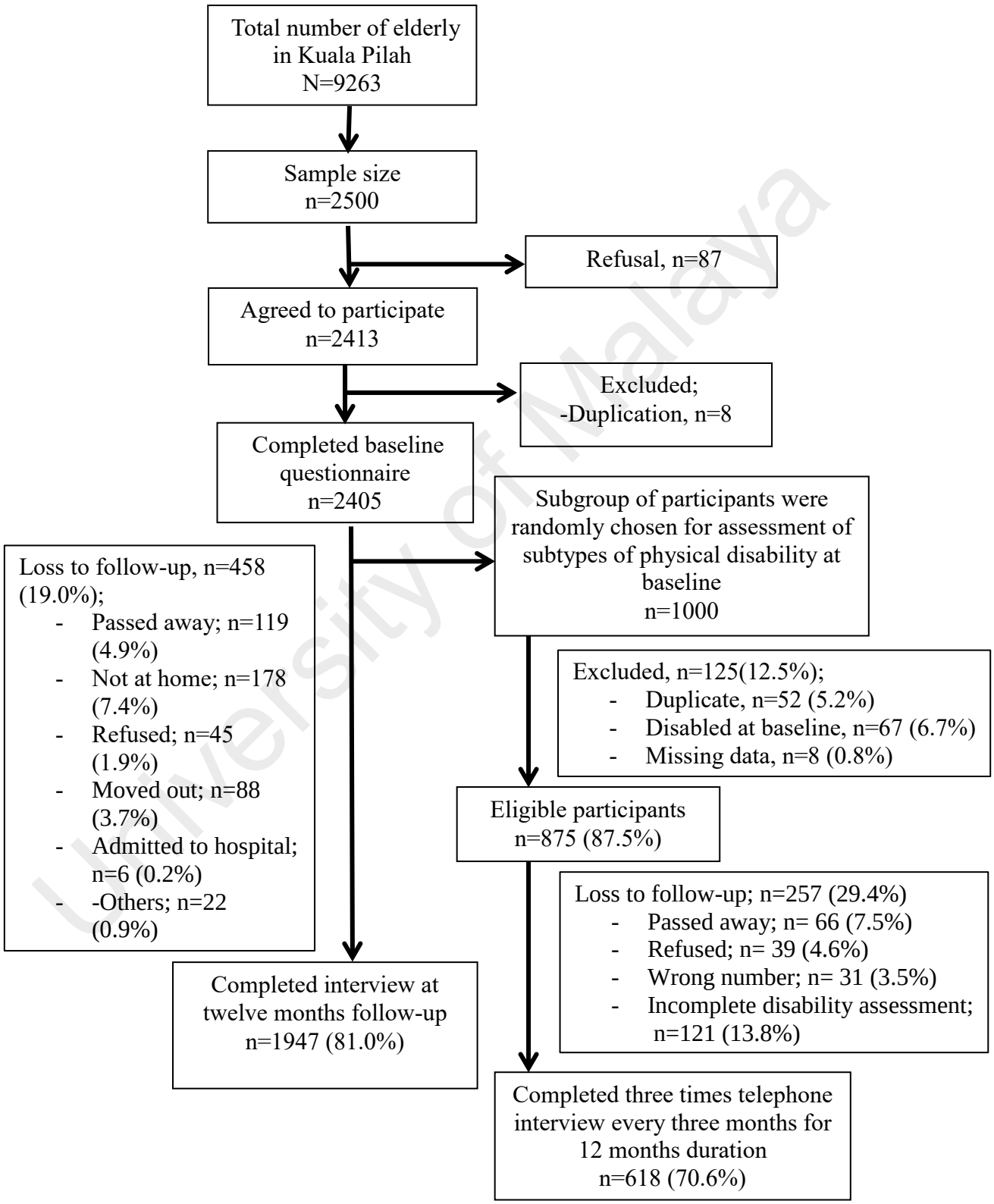


Figure 3.3: Study flow chart

3.11 Statistical analysis

3.11.1 Complex Sampling Design

The data obtained in this study used a complex sample design. The complex sample design involved stratification, using geographical region as a basis to define meaningful clusters of population elements called primary sampling units or PSUs; and one or more stages of subsampling within each PSU. In this study, the PSUs were enumeration blocks (EBs) and for each EB, 16 living quarters (LQs) where selected from out of 80 to 120 living quarters.

The main advantages of complex sample in comparison with a simple random sample are complex sample does not require sampling frame of the population elements. It is more economical and practical and guarantees a representatives sample of the population. However, the main disadvantage was that it was generally less efficient than simple random sampling, i.e., it yields estimates of lower precision for a fixed sample size.

3.11.2 Sampling weights calculation

Weight was applied to the living quarters that were selected in each enumeration block. Weight was not applied to the selected enumeration blocks and selected elderly because universal sampling was applied. The calculation of the sampling weights is as below:

Example of weightage calculation for EB number 1 (EB1);

a) Weight of each EB= Total EBs/ total selected EBs

= 156/156=1

b) Weight of living quarter (LQ) for EB 1= Total LQ in EB1/ Selected LQ

= 100/16

= 6.25

c) Weight of elderly= Total elderly in EB1/ total selected elderly

= 28/28=1

The detailed calculations of weight for each EBs were shown in Appendix F.

3.11.3 Management of missing data

During the baseline data collection, the number of mising data for functional limitation, IADL disability and ADL disability was 5 (0.2%), 184 (7.7%) and 10 (0.4%) out of 2405 eligible participants. At twelve months later, 458 (19.0%) participants were lost to follow up and the reasons for their non-responses are stated as in the Figure 3.3. The number of missing data for those responsed during second interview (n=1948) was 1(0.05%) for functional limitation, 24 (1.2%) for IADL disability and 6 (0.3%) for ADL disability. For the subtype of disability, 875 participants were included in the baseline data analysis and all responded during the first telephone interviews at 3 months. The non-response percentages for 6^{th} month, 9^{th} month and 12^{th} month telephone interviews were 18.3% (n=160), 18.6% (n=163) and 15.5% (n=136) respectively. The reasons for non-responses are shown in Figure 3.3.

In this study, the method used for dealing with all those missing data was complete-case analysis (also known as listwise deletion) where the analysis only includes the participants with complete data on all waves of data collection. By far, this was the most common approach of handling missing data which was simply to omit those cases with missing data and run the analyses of what remains (Karahalios et al., 2012). The advantages of using complete-case analysis were ease of implementation, simple and comparable across analyses. In this study, analysis was conducted and results showed that missing data was missing completely at random (MCAR). This means that participants with missing data were similar to a random sample of those that

were intended to be observed or at least that the likelihood of exposure being missing was independent of the outcome given the exposures.

3.11.4 Data analysis

All data was analysed using the complex sample analysis in PASW version 20 (IBM SPSS, IBM Corp, Armonk, NY, USA). Descriptive statistics were used to describe the socio-demographic characteristics of the study participants. The data was stratified according to gender and all the independent variables were reported in actual numbers and percentages. Comparisons between groups were performed using $\chi 2$ test for categorical data and independent t-test or analysis of variance (ANOVA) for continuous data. Participants with severe cognitive impairment were identified. Those whose scores of less than ten based on the Mini Mental Status Examination (MMSE) were removed from the analysis involving physical disability (n=90) but remained in the analysis of functional limitation. The reason was because physical disability was assessed by self-reported questionnaire which can be influenced by cognitive function but functional limitation was measured with objective performance assessment. The prevalence and incidence of functional limitation and physical disability were reported as proportions. The subtypes of disability were described in actual numbers and percentages.

To establish a temporal relationship between the predictors and the outcomes, the predictors at the baseline were modeled against the outcomes at 12 months follow up. Four models were tested based on the conceptual framework. In model 1, participant's sociodemographic characteristics (age, education, gender, ethnic, marital status and income level) were investigated as predictors of functional limitation and physical disability. In model 2, health related variables (CVD, DM, arthritis, visual impairment, cognitive impairment, chronic pain, history of fall and obesity) were added

as predictors in conjuction with all the covariates from model 1. Model 3 added social support, living arrangement, self-rated health and depressive symptoms, and model 4 (fully adjusted model) added smoking status and physical activity level. Model 4 is the best model as this model adjusted all the available variables. The same four models were repeated for the functional limitation and physical disability recovery outcome. Statistical significance was determined at $p<0.05$ and variables with $p<0.25$ were maintained in the model. Education and gender remained in all models for adjustment purposes. To test for multicollinearity between the independent variables, a bivariate correlation analysis was conducted. The chi square test or Hosmer and Lemeshow's goodness of fit test was used to assess the goodness of model fit.

3.12 Ethics

Ethics approval for this study was granted by the Medical Ethics Committee, University of Malaya Medical Centre, Kuala Lumpur (IRB Reference number: 975.17) and National Medical Research & Ethics Committee (NMRR-13-1259-16413). Participant information sheets were explained and provided. Written informed consent was obtained from all participants.

A series of meetings was convened with the village head prior to the baseline and follow up data collection to ensure that the villagers are aware of our research activities. Kuala Pilah Police Department was also informed regarding this research for safety reason. During the interviews, if the elderly participants were found to be very ill or being screened to have depressive symptoms, they were referred to the nearest health clinic for further investigation and treatment.

CHAPTER 4: RESULTS

About the chapter

This chapter is divided into five sections. The first section presents the response rate of the participants for this study followed by the descriptive analysis of the socio-demographic characteristics, health status, lifestyle behaviour and social support of the study participants. The second section of this chapter reports the prevalence of functional limitation and physical disability. The prevalence of each ADL and IADL items are also described. The third section describes the incidence and risk factors for functional limitation and physical disability at twelve months of follow up. The fourth section documents the incidence of recovery and the associated factors related to the recovery from functional limitation and physical disability. The final section describes the subtypes of disability found in a subgroup of elderly with physical disability.

4.1 Characteristics of study population

4.1.1 Response rate of the study

The response rate at baseline was 96.2% and twelve months of follow up was 81.0%. Most of the elderly participants who were lost to follow up were not at home (7.4%) during the second data collection (minimum number of visits was 3 times), 4.9 % of the participants had passed away, 3.7% had moved out from Kuala Pilah, 1.9% refused to participate and about 1% dropped out due to other reasons (e.g: admitted to hospital and wrong address) (refer to Figure 3.3 on page 92). A summary of the the socio-demographic variables of responders and non-responders is shown in Table 4.1.

Table 4.1: Summary of sociodemographic characteristics between responders and non-responders

Variables	Responder n (%)	Non responder n (%)	Chi-square value	df	p-value
Gender					
Male	738 (37.9)	167 (36.5)	0.736	1	0.382
Female	1209 (62.1)	291 (63.5)			
Age group, years					
60-64	548 (28.1)	99 (21.6)	17.093	4	**0.004**
65-69	391 (20.1)	87 (19.0)			
70-74	388 (20.0)	84 (18.3)			
75-79	370 (19.0)	98 (21.4)			
≥ 80	250 (12.8)	90 (19.7)			
Ethnic Group					
Malay	1882 (96.7)	419 (91.5)	31.790	3	**<0.001**
Chinese	26 (1.3)	20 (4.4)			
Indians	26 (1.3)	18 (3.9)			
Others	13 (0.7)	1 (0.2)			
Education level					
No formal education	311 (16.3)	80 (17.8)	1.532	2	0.510
Primary education	1175 (60.5)	281 (61.4)			
Secondary & tertiary education	456 (23.2)	93 (20.8)			
Household income					
≤ RM499	677 (34.8)	181 (39.5)	2.307	3	0.571
RM 500-999	591 (30.4)	126 (27.5)			
RM 1000-1499	428 (21.9)	95 (20.8)			
≥ RM 1500	251 (12.9)	56 (12.2)			

There were no significant differences (p>0.05) in the proportion of responders and non-responders for gender, education and household income. However, there were significant associations between age and ethnicity and participants' response status (responders and non-responders). The non-responders were older (in particular those in age group 75-79 years old). This was expected as old age increased dependency and mortality rates. Even though the demographics of the participants in the second follow up were slightly different, overall this study managed to achieve high response rate

(>80%) during the second follow-up and there was very low refusal rate (<2 %) among the non-responders.

4.1.2 Socio-demographic characteristics of the study population

A total of 2405 elderly participated in this study. The study population comprised 905 males (39.0%) and 1500 (61.0%) females. The mean age of the study participants was 70.92 years (SD 7.74). The minimum age reported was 60 years and the maximum age of the participants was 101 years. The mean age for elderly male was 70.91 (SD 7.49) while for elderly female it was 70.92 (SD 7.88). The participants were predominantly Malay (95.7%), followed by Chinese (1.9%), Indian (1.8%) and Others (0.6%). More than two thirds had either no education or completed education up to primary level only. Similarly more than two thirds of the elderly participants were in the low socioeconomic group with income less than RM 1000 per month. About 62% of elderly participants were married and almost 90% of them were living with someone (either spouse, children or relatives). Participant's socio-demographic characteristics are summarized in Table 4.2.

Table 4.3 summarise the socio-demographic characteristics of male and female participants. The Pearson's chi-square statistics (χ^2) for age groups and ethnicity suggest no significant difference in the proportions of age groups (p=0.431) and ethnicity (p=0.115) between elderly male and female. There were significant differences in the proportions for living arrangements (p<0.001), educational level (p<0.001), marital status (p<0.001) and income level (p<0.001) found between elderly male and female. More elderly female had no formal education, had low income (≤ RM499), were widowed and lived alone compared to elderly male. Majority of elderly male had at least primary education (>90%), were married (almost 90%), were living with their spouse (almost 50%) and had income between RM500 to RM1499 (almost two-thirds).

Table 4.2: Socio-demographic characteristics of all study participants at baseline (N = 2405).

Variables	Mean (SD)	Median (IQR)	N (%)
Age, in years			
All study participants	70.92 (7.74)	71.00 (12)	-
Male	70.91 (7.49)	71.00 (12)	-
Female	70.92 (7.88)	71.00 (12)	-
Age group, years			
60-64	-	-	647 (26.9)
65-69	-	-	478 (19.9)
70-74	-	-	472 (19.6)
75-79	-	-	468 (19.5)
≥ 80			340 (14.1)
Gender			
Male	-	-	905 (39.0)
Female	-	-	1500 (61.0)
Ethnic Group			
Malay	-	-	2301 (95.7)
Chinese	-	-	46 (1.9)
Indians	-	-	44 (1.8)
Others	-	-	14 (0.6)
Education level			
No formal education	-	-	391 (16.3)
Primary education	-	-	1456 (60.8)
Secondary education	-	-	497 (20.7)
Tertiary education	-	-	52 (2.2)
Marital status			
Married	-	-	1482 (62.0)
Single	-	-	48 (2.0)
Widowed	-	-	810 (33.9)
Divorced	-	-	51 (2.1)
Living Arrangements			
Living with spouse	-	-	809 (33.8)
Living with spouse & children	-	-	1145 (47.8)
Living alone	-	-	304 (12.7)
Living with others	-	-	137 (5.7)

'Table 4.2, continued'.

Variables	Mean (SD)	Median (IQR)	N (%)
Household income			
≤ RM499	-	-	858 (35.7)
RM 500-999	-	-	717 (29.8)
RM 1000-1499	-	-	523 (21.7)
≥ RM 1500	-	-	307 (12.8)

Abbreviation: RM=Ringgit Malaysia, SD=Standard Deviation, IQR= Interquartile Range

Table 4.3: Characteristics of male and female participants

Variables	Men		Women		Chi-square value (χ^2)	df	p-value
	n	%	n	%			
Age group, years							
60-64	233	25.7	414	27.6	4.1	4	0.431
65-69	196	21.7	282	18.8			
70-74	173	19.1	299	19.9			
75-79	171	18.9	297	19.8			
≥ 80	132	14.6	208	13.9			
Ethnic Group							
Malay	861	95.1	1440	96.0	5.2	3	0.115
Chinese	20	2.2	26	1.7			
Indians	20	2.2	24	1.6			
Others	4	0.4	10	0.7			
Education level							
No formal education	23	2.5	368	24.7	223.9	3	**<0.001**
Primary education	596	65.9	860	57.6			
Secondary education	257	28.4	240	16.1			
Tertiary education	28	3.1	24	1.6			

'Table 4.3, continued'.

Variables	Men		Women		Chi-square value (χ^2)	df	p-value
	n	%	n	%			
Marital status							
Married	781	86.7	701	47.0	395.4	3	**<0.001**
Single	17	1.9	31	2.1			
Widowed	94	10.4	716	48.1			
Divorced	9	1.0	42	2.8			
Living Arrangements							
Living with spouse	437	48.4	372	24.9	173.2	3	**<0.001**
Living with spouse & children	386	42.8	759	50.8			
Living alone	54	6.0	250	16.7			
Living with others	25	2.8	112	7.5			
Household income							
≤ RM499	233	25.7	625	41.7	58.5	3	**<0.001**
RM 500-999	291	32.2	426	28.4			
RM 1000-1499	241	26.6	282	18.8			
≥ RM 1500	140	15.5	167	11.1			

χ^2 analysis performed for each characteristics to compare difference in proportions between male and female.

4.1.3 Health status, lifestyle behaviour and social support of the study population

Data related to participants' health status, lifestyle behaviour and social support were collected**.** More than two thirds of the participants reported having cardiovascular disease and diabetes mellitus. More than 50% of the participants still had normal cognitive function. Almost 40% of the study participants reported having depressive symptoms and visual impairment. Less than 20% of the participants had history of falls within the one year period prior to the study interview. Almost 13% of elderly participants were current smokers and the majority were male.

Table 4.4 show the details of the participant's health status, lifestyle behaviour and social support There were significant differences in proportions between elderly male and female with respect to cognitive function ($p<0.001$), smoking status ($p<0.001$), cardiovascular disease ($p<0.001$), arthritis ($p<0.001$), history of falls ($p<0.001$), visual impairment ($p=0.04$), body fat ($p<0.001$) and physical activity score ($p<0.001$).

Majority of elderly male still had intact cognitive status (70.3%) but in female, more than half had impaired cognitive function. Almost two-third of the male participants were current or former smokers while majority of female participants (>90%) were non-smokers. The percentage of elderly male with cardiovascular disease was more compared to female but for arthritis, the percentage was higher among female participants. The same results were observed for visual impairment and history of falls where the percentages were higher in elderly female. More than half of the male participants had normal body fat percentages which was higher than female participants. The percentages of female participants with abnormal body fat (underfat, overfat or obese) were higher than male participants. About one third of female participants reported as having low physical activity level which was higher than male.

Percentages of elderly male and female with diabetes mellitus, chronic pain, depression, self-rated health and social support level were not significantly different (diabetes mellitus: p=0.16, chronic pain: p=0.54, depression: p= 0.78, self rated health: p= 0.28 and social support level: p= 0.17).

Table 4.4: Health status, lifestyle behaviour and social support of the study participants

Variables	Men		Women		Total, n		Chi-square value (χ^2)	df	p-value
	n	%	n	%	n	%			
Presence of chronic disease[1]									
Cardiovascular disease	449	50.4	632	42.4	1081	45.4	32.4	1	**<0.001**
Diabetes mellitus	234	26.1	406	27.4	640	26.9	4.4	1	0.16
Arthritis	141	15.6	354	23.8	495	20.7	25.1	1	**<0.001**
Visual Impairment									
Yes	333	36.9	623	41.6	956	39.8	4.3	1	**0.04**
No	570	63.1	875	58.4	1445	60.2			
Chronic pain									
Yes	185	20.5	349	23.3	534	22.2	2.3	1	0.54
No	707	78.2	1133	75.6	1840	76.6			
History of falls									
Yes	119	13.2	291	19.5	410	17.1	15.9	1	**<0.001**
No	783	86.8	1203	80.5	1986	82.9			
Cognitive Function									
Normal	621	70.3	656	44.7	1277	54.3	146.6	2	**<0.001**
Impaired	246	27.6	759	51.0	1005	42.3			
Severely impaired	18	2.1	60	4.3	78	3.5			

'Table 4.4, continued'.

Variables	Men		Women		Total, n		Chi-square value (χ^2)	df	p-value
	n	%	n	%	n	%			
Depressive Symptoms									
Yes	349	38.6	581	38.7	930	38.7	0.1	1	0.78
No	556	61.4	919	61.3	1475	61.3			
Smoking status									
Current smoker	289	32.0	21	1.4	310	12.9	819.6	2	**<0.001**
Former Smoker	225	24.9	45	3.0	270	11.2			
Non smoker	389	43.1	1433	95.6	1822	75.9			
Self-rated health									
Good	157	17.4	251	16.8	408	17.0	2.5	2	0.284
Average	394	43.7	700	46.9	1094	45.7			
Poor	351	38.9	540	36.2	891	37.3			
Body fat									
Normal	518	57.2	585	39.0	1103	45.9	137.7	3	**<0.001**
Underfat	60	6.6	291	19.4	351	14.6			
Overfat	165	18.2	394	26.3	559	23.2			
Obese	95	10.5	89	15.3	184	7.7			
Social support score									
High	645	71.3	1180	73.9	1753	72.9	1.9	1	0.17
Low	260	28.7	392	26.1	652	27.1			

'Table 4.4, continued'.

Variables	Men		Women		Total, n		Chi-square value (χ^2)	df	p-value
	n	%	n	%	n	%			
Physical activity score									
High	650	77.8	962	69.7	1612	72.7	17.6	1	**<0.001**
Low	185	22.2	419	30.3	604	27.3			

χ^2 analysis performed for each characteristics to compare difference in proportions between male and female.
[1] reference group: no disease.

4.2 Prevalence of functional limitation and physical disabilty

4.2.1 Prevalence of functional limitation

The overall prevalence of functional limitation was 62.8% (95% CI[60.8, 64.8]). In this study, functional limitation was defined as having walking speed less than 0.80 metre/second (m/s) for a 4-metre walking speed test. Table 4.5 show the average walking speed of the study participants. The average walking speed of the subjects was 0.69 m/s (95% CI[0.68, 0.71]). The mean walking speed was significantly higher in men (p<0.001), 0.76 m/s (95% CI [0.73, 0.80]) compared to women, 0.64 m/s (95% CI[0.63, 0.66]). It was observed that mean walking speed significantly decreased with advancing age (p<0.001): 60-64 years (0.78 m/s, 95% CI[0.75, 0.81]), 65-69 years (0.73 m/s, 95% CI[0.71, 0.76]), 70-74 years (0.67 m/s, 95% CI[0.65, 0.70]), 75-79 (0.61 m/s, 95% CI[0.58, 0.63]) and 80 years and above (0.54 m/s, 95% CI[0.47, 0.62]).

Table 4.5: Mean walking speed of the study participants

Variable	Mean (m/s)	Confidence Interval, 95% CI	p-value
All study participants	0.69	0.68, 0.71	
Gender			
Male	0.76	0.73, 0.80	**<0.001**
Female	0.64	0.63, 0.66	
Age group, years			
60-64	0.78	0.75, 0.81	**<0.001**
65-69	0.73	0.71, 0.76	
70-74	0.67	0.65, 0.70	
75-79	0.61	0.58, 0.63	
80 years and above	0.54	0.47, 0.62	

Independent sample t-test was performed to compare the difference in mean of walking speed between gender and age groups.

The prevalence of functional limitation increased with age and the highest prevalence was among elderly aged 75-79 years (see Table 4.6). However, the overall prevalence decreased among the oldest age group (80 years and above). A similar prevalence pattern was observed among elderly female when subgroup analysis was

applied. The highest prevalence of functional limitation was among elderly female aged 75-79 years and the prevalence decreased in elderly female aged more than 80 years. Among elderly male, the prevalence increased with age and the highest prevalence was noted among the oldest age group (80 years and above). Elderly female had significantly higher prevalence of functional limitation compared to elderly male (χ^2=68.9, df=1, p<0.001).

4.2.2 Prevalence of physical disability

The prevalence of instrumental activity of daily living (IADL) disability for elderly aged 60 years and more was 32.7% (95% CI[30.8, 34.7]) and activity of daily living (ADL) disability was 7.1% (95% CI[6.1, 8.2]). Overall, the prevalence of IADL and ADL disability increased with advancing age and the highest prevalence of both disabilities was found among the oldest age group (80 years and above).

The overall prevalence of functional and physical disability was stratified according to age group and gender subgroups as shown in Table 4.6. A similar pattern was observed among elderly female in the subgroups analysis. In male, the prevalence of both IADL and ADL disability increased with age and the highest prevalence of both disabilities were found among those aged 80 years and older although there was a slight decrease in the prevalence rates among the elderly aged 75-79 years. The prevalence of IADL disability was significantly higher in female compared to male (p<0.001). However, there was no significant difference in the prevalence of ADL disability among elderly male and female (p=0.77).

Table 4.6: Prevalence of functional limitation and physical disability at baseline (n=2405) among elderly in Kuala Pilah, Malaysia

Variables	Functional Limitation		Physical Disability			
			ADL disability		IADL disability	
	Unweighted count	Weighted prevalence (95%C1)	Unweighted count	Weighted prevalence (95% CI)	Unweighted count	Weighted prevalence (95% CI)
Overall						
≥ 60	1520	62.8 (60.8, 64.8)	172	7.1 (6.1, 8.2)	749	32.7 (30.8, 34.7)
≥ 65	1190	67.2 (64.8, 69.4)	160	9.1 (7.8, 10.6)	650	39.4 (37.0, 41.7)
≥ 70	912	70.7 (68.0, 73.2)	139	10.7 (9.0, 12.5)	538	44.6 (41.8, 47.5)
≥ 75	583	71.7 (68.3, 74.9)	115	13.8 (11.5,16.5)	378	49.7 (46.0, 53.3)
≥ 80	235	67.7 (62.7, 72.3)	77	22.0 (17.9, 26.7)	191	62.4 (56.8, 67.7)
Age group						
60-64	329	51.1 (47.2, 55.1)	12	1.6 (0.9, 2.9)	99	15.8 (13.1, 18.8)
65-69	278	57.6 (53.0, 62.2)	21	4.8 (3.1, 7.4)	112	25.3 (21.4, 29.7)
70-74	329	69.0 (64.5, 73.1)	24	5.3 (3.5, 7.9)	160	36.2 (31.7, 40.9)
75-79	348	74.7(70.3, 78.6)	38	7.7 (5.6, 10.6)	187	40.8 (36.1, 45.6)
80 and over	236	67.8 (62.3, 72.8)	77	21.9 (17.7, 26.8)	191	62.4 (56.3, 68.1)
Male						
Overall (≥ 60)	477	52.0 (48.8,55.2)	62	7.1 (5.5, 9.0)	207	23.7 (21.1, 26.6)
60-64	84	36.8 (31.0, 43.1)	8	2.9 (1.5, 5.7)	18	7.7 (5.1, 11.3)
65-69	82	41.2 (34.3, 48.4)	14	8.6 (5.1, 14.2)	33	18.1 (13.0, 24.4)
70-74	99	56.1 (48.4, 63.5)	12	7.7 (4.3, 13.3)	47	30.8 (23.9, 38.6)
75-79	114	67.3 (56.4, 76.6)	11	5.4 (2.9, 9.8)	50	27.9 (21.5, 35.4)
80 and over	98	71.1 (62.4, 78.5)	18	13.4 (8.4, 20.7)	59	47.1 (38.0, 56.4)

'Table 4.6, continued'.

Variables	Functional Limitation		Physical Disability			
			ADL disability		IADL disability	
	Unweighted count	Weighted prevalence (95%C1)	Unweighted count	Weighted prevalence (95% CI)	Unweighted count	Weighted prevalence (95% CI)
Female						
Overall (≥ 60)	1043	69.4 (67.0, 71.6)	109	7.0 (5.8, 8.5)	542	38.3 (35.9, 40.8)
60-64	245	59.1 (54.2, 63.9)	4	0.9 (0.3, 2.6)	81	20.4 (16.7, 24.6)
65-69	196	69.2 (63.3, 74.5)	7	2.1 (1.0, 4.6)	79	30.4 (24.9, 36.6)
70-74	230	76.5 (71.1, 81.1)	12	3.9 (2.2, 6.8)	113	39.5 (33.9, 45.4)
75-79	234	79.6 (74.5, 83.8)	27	9.1 (6.1, 13.2)	137	48.4 (42.4, 54.4)
80 and over	138	65.7 (58.7, 72.0)	59	27.3 (21.5, 34.1)	132	72.8 (64.7, 79.7)

Weightage has been applied to the sample to adjust for the complex sample design.

4.2.3 Prevalence of physical disability in each item of the IADL

For instrumental activity of daily living, 749 (32.7%) of the elderly participants reported as having IADL disability (i.e: score less than 16 in Lawton IADL scale). Table 4.7 show the prevalence of physical disability for each IADL item. The main IADL item disability was difficulty in shopping groceries (22.5%), followed by difficulty in doing housework (21.2%) and the least prevalent IADL item disability was responsibility for taking own medication (11.8%). The more advanced the age, the higher the prevalence of physical disability in each IADL item (all p values were <0.001 except for responsibility for own medication, p<0.04). There was no significant difference in the prevalence of physical disability for each IADL item between elderly male and female (all were p >0.05).

Figure 4.1 show the percentages of elderly participants according to the number of IADL disability items reported. Overall, elderly participants who reported one IADL item disability was 23.8%, followed by two items (18.6%) and the least was five items (7.1%). In male, the highest percentage of IADL disability was eight items (20.9%), followed by one item (19.3%) and the least was six items (7.2%). Among female, the highest percentages of elderly with one IADL item disability was 25.4%, followed by two items (19.8%) and the least were four and five items (6.9%). There was significant difference in the number of reported items (p<0.001) between male and female. Males were more likely to report higher number of IADL disability items than females.

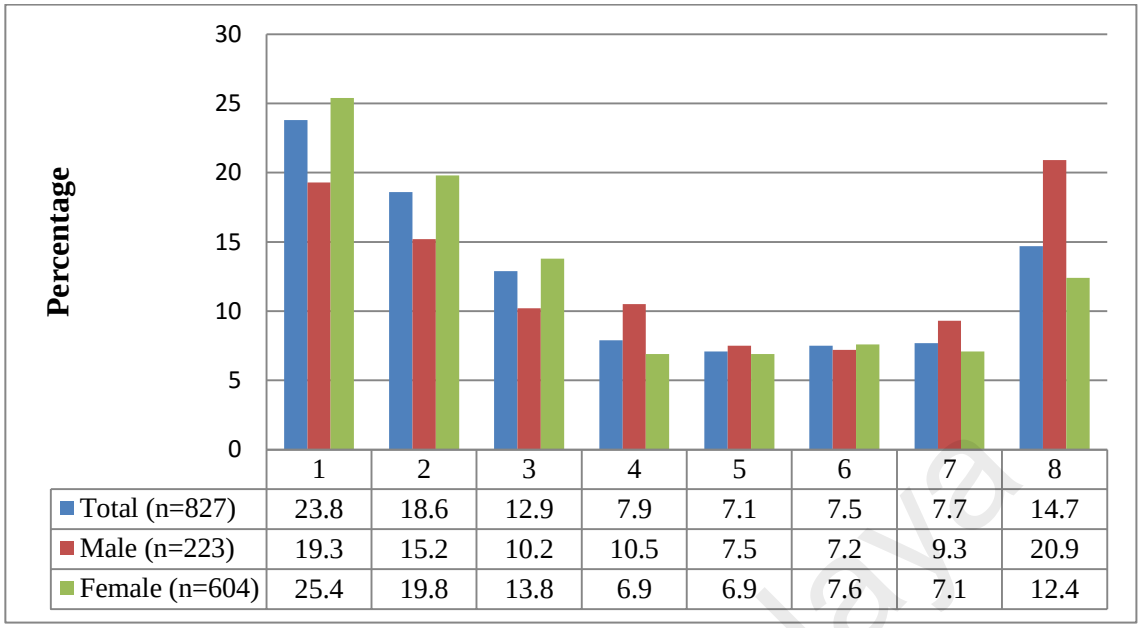
Table 4.7: Prevalence of physical disablity in each item of instrumental daily living (IADL) among study population stratified by age and gender

IADL items	All samples (N=749) %	Age groups						Gender		
		60-64 (n=99) %	65-69 (n=112) %	70-74 (n=160) %	75-79 (n=187) %	≥ 80 (n=191) %	p-value	Male (n=207) %	Female (n=542) %	p-value
Food preparation	15.2	6.0	6.0	14.3	24.6	36.5	<**0.001**	19.4	12.5	0.10
Do housework	21.2	8.1	7.6	20.2	41.4	43.5	<**0.001**	21.0	21.3	0.95
Do laundry	14.9	7.2	4.5	14.1	27.5	31.9	<**0.001**	20.0	11.6	0.05
Responsibility for medication	11.8	5.9	6.7	11.2	18.5	24.1	**0.04**	15.2	9.5	0.18
Transport	21.0	8.8	13.0	22.8	32.4	41.3	<**0.001**	21.1	21.0	0.98
Shopping	22.5	9.1	12.4	20.7	31.7	55.3	<**0.001**	21.3	23.2	0.67
Handle finances	15.6	7.0	9.9	13.5	21.9	36.5	<**0.001**	17.2	14.6	0.53

'Table 4.7, continued'

IADL items	All samples (N=749) %	Age groups						Gender		
		60-64 (n=99) %	65-69 (n=112) %	70-74 (n=160) %	75-79 (n=187) %	≥ 80 (n=191) %	p-value	Male (n=207) %	Female (n=542) %	p-value
Using of telephone	18.4	8.7	11.9	16.1	23.5	44.3	**<0.001**	16.5	19.5	0.50

Weightage has been applied to the sample to adjust for the complex sample design.
All estimates in table presented as percentage (%) except p value as indicated.



	1	2	3	4	5	6	7	8
Total (n=827)	23.8	18.6	12.9	7.9	7.1	7.5	7.7	14.7
Male (n=223)	19.3	15.2	10.2	10.5	7.5	7.2	9.3	20.9
Female (n=604)	25.4	19.8	13.8	6.9	6.9	7.6	7.1	12.4

Figure 4.1: Percentages of elderly participants according to number of IADL item disability

4.2.4 Prevalence of physical disability in each item of the ADL

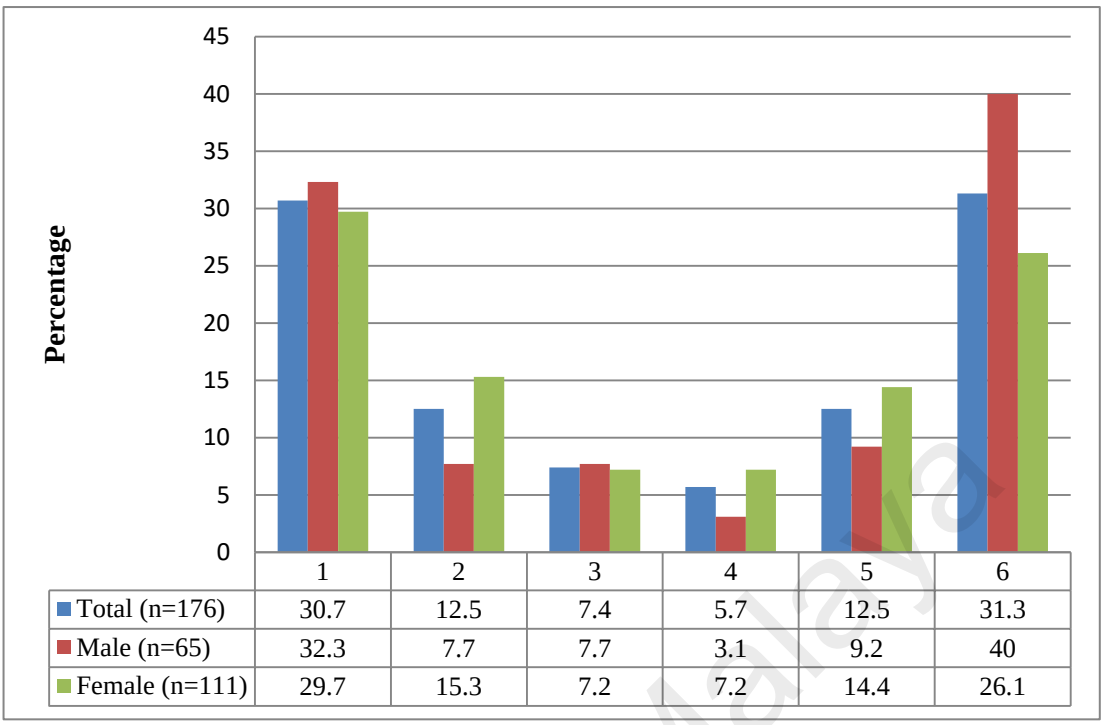
For activity of daily living, a total of 172 (7.1%) elderly reported as having disabled in at least one ADL (i.e: score less than 12 in Katz ADL scale). The overall prevalence of physical disability for each ADL item is shown in Table 4.8. The highest disability ADL item was toileting (7.5%), followed by chair/bed transfer (7.2%), feeding (6.3%) and three other items (dressing, bathing and incontinence) were 6.0%. There was no significant difference noted between advancing age and prevalence of physical disability for each ADL item except for urine and bowel incontinence, the prevalence increased with increasing age (p=0.01). Similar findings were noted where no significant differences in the proportion were found between gender and prevalence of physical disability for each ADL item (all p value >0.05) except for urine and bowel incontinence, the prevalence was significantly higher in elderly male compared to female (p=0.03).

Figure 4.2 show the percentages of elderly participants according to the number of ADL item disability. In total, the highest percentages of elderly participants had six ADL items disability (31.3%), followed by one item (30.7%) and the least was four items (5.7%). In male, the highest percentage of ADL item disability was six items (40.0%), followed by one item (32.3%) and the least was four items (3.1%). In female, the highest percentages of elderly had one ADL item disability (29.7%), followed by six items (26.1%) and the least were three and four items (7.2%). There was no significant difference in the proportion of elderly male and female (χ^2=0.799, df=1, p=0.371) in the number of reporting ADL items.

Table 4.8: Prevalence of physical disablity in each item of actitity daily living (ADL) among study population stratified by age and gender

ADL items	All samples (n=172) %	Age groups						Gender		
		60-64 y (n=12) %	65-69 y (n=21) %	70-74 y (n=24) %	75-79 y (n=38) %	≥ 80 y (n=77) %	p-value	Male (n=63) %	Female (n=109) %	p-value
Feeding	6.3	5.2	3.7	5.1	5.4	15.3	0.15	8.0	5.2	0.35
Dressing/ Undressing	6.0	5.2	4.1	5.1	4.9	13.0	0.35	8.0	4.7	0.27
Self bathing	6.0	5.2	4.1	5.1	4.9	13.0	0.35	8.2	4.6	0.22
Chair/bed transfer	7.2	5.6	3.7	6.8	6.8	16.9	0.11	7.8	6.8	0.73
Toileting	7.5	5.6	4.1	11.0	4.3	16.1	0.17	10.6	5.4	0.18
Urine and bowel incontinence	6.0	2.6	4.2	5.6	6.2	16.0	**0.01**	9.4	3.8	**0.03**

Weightage has been applied to the sample to adjust for the complex sample design.
All estimates in table presented as percentage (%) except p value as indicated



	1	2	3	4	5	6
Total (n=176)	30.7	12.5	7.4	5.7	12.5	31.3
Male (n=65)	32.3	7.7	7.7	3.1	9.2	40
Female (n=111)	29.7	15.3	7.2	7.2	14.4	26.1

Figure 4.2: Percentages of elderly participants with number of ADL item disability.

4.3 Incidence and risk factors of functional limitation and physical disability

4.3.1 Incidence of functional limitation at 12 months follow up

In the baseline data analysis, 880 elderly were having normal walking speed (>0.8m/s) and categorized as not functionally limited. The overall incidence of functional limitation at 12 months of follow up among those elderly was 38.4% (95% CI[34.8, 42.2]). The overall incidence of functional limitation increased with advancing age and the highest incidence was recorded among elderly in age group 75-79 years. The incidence rate of functional limitation decreased among elderly aged 80 years and above. Similar incidence of functional limitation pattern was noted among elderly male. Among elderly female, the incidence rates increased with advancing age but the highest incidence was recorded in the earlier age group (70-74 years). The incidence rate dropped in the more advanced age groups (75 years and above). The incidence of functional limitation in female was significantly higher compared to male (p=0.02).

4.3.2 Incidence of physical disability at 12 months follow up

The incidence of instrumental activity of daily living (IADL) disability was 24.8% (95% CI[22.5, 27.4]) among 1442 participants who were not having IADL disability at baseline. Among 2223 elderly participants who were free of ADL at baseline, the incidence of ADL disability at 12 months follow up was 4.8% (95% CI[3.9, 5.9]). The overall incidence of IADL and ADL disability increased in the more advanced age group. The highest incidence for both IADL and ADL disability was reported among the elderly aged 80 years and above. The incidence of IADL disability was significantly higher in female compared to elderly male (p<0.001). There was no significant difference in the proportion of incidence of ADL disability among elderly male and female (p=0.39). The overall incidences were stratified according to age group and gender subgroups as described in Table 4.9.

Table 4.9: Incidence of functional limitation and physical disability at 12th months follow up

Variables	Functional Limitation (n=880)		Physical Disability			
			ADL Disability (n=2155)		IADL Disability (n=1442)	
	Unweighted count	Weighted incidence (95%C1)	Unweighted count	Weighted incidence (95%CI)	Unweighted count	Weighted incidence (95%CI)
Overall (years)						
≥ 60	276	38.4 (34.8, 42.2)	88	4.8 (3.9, 5.9)	290	24.8 (22.5, 27.4)
≥ 65	194	43.3 (38.5, 48.1)	79	6.2 (5.0, 7.7)	205	27.6 (24.4, 30.9)
≥ 70	128	45.4 (39.3, 51.5)	64	7.0 (5.5, 9.0)	159	33.0 (29.1, 37.2)
≥ 75	76	45.2 (37.6, 53.0)	55	10.2 (7.8, 13.2)	107	41.1 (35.6, 46.9)
≥ 80	31	42.4 (32.2, 53.4)	31	15.6 (11.1, 21.4)	36	48.6 (37.7, 59.7)
Age group						
60-64	82	30.1 (24.7, 36.1)	9	1.5 (0.8, 3.0)	85	20.1 (16.5, 24.2)
65-69	66	39.6 (32.2, 47.4)	15	4.1 (2.4, 6.9)	46	16.9 (12.7, 22.1)
70-74	52	45.6 (36.5, 55.1)	9	2.3 (1.2, 4.5)	52	22.9 (17.8, 28.9)
75-79	45	47.7 (37.2, 58.4)	24	6.8 (4.6, 10.1)	71	37.9 (30.9, 45.4)
80 and over	31	42.4 (31.5, 54.2)	31	15.5 (10.9, 21.6)	36	48.6 (37.5, 59.9)
Male						
Overall (≥ 60)	116	33.7 (28.9, 38.9)	30	4.6 (3.2, 6.6)	59	12.7 (9.9, 16.1)
60-64	30	25.8 (18.4, 34.9)	3	1.7 (0.5, 5.1)	12	8.1 (4.6, 13.9)
65-69	30	30.1 (21.5, 40.3)	6	4.6 (2.1, 9.5)	8	6.1 (3.0, 12.1)
70-74	24	39.0 (27.4, 51.9)	3	2.4 (0.8, 7.3)	11	12.0 (6.7, 20.6)
75-79	21	49.4 (35.2, 63.8)	5	3.6 (1.5, 8.4)	13	16.9 (9.8, 27.5)
80 and over	11	41.5 (24.0, 61.3)	13	15.4 (9.0, 25.2)	15	36.8 (23.7, 52.1)

'Table 4.9, continued'.

Variables	Functional Limitation (n=880)		Physical Disability			
			ADL Disability (n=2155)		IADL Disability (n=1442)	
	Unweighted count	Weighted incidence (95%C1)	Unweighted count	Weighted incidence (95%CI)	Unweighted count	Weighted incidence (95%CI)
Female						
Overall (≥ 60)	160	42.7 (37.8, 47.9)	58	4.9 (3.8, 6.4)	231	34.2 (30.8, 37.8)
60-64	52	33.5 (26.4, 41.4)	6	1.5 (0.7, 3.2)	73	27.5 (22.6, 33.1)
65-69	36	51.8 (40.1, 63.3)	9	3.8 (1.9, 7.5)	38	25.9 (19.3, 33.9)
70-74	28	53.2 (39.8, 66.2)	6	2.3 (1.0, 5.0)	41	30.9 (23.4, 39.5)
75-79	24	45.9 (32.1, 60.5)	19	9.0 (5.7, 13.9)	58	56.3 (44.6, 65.6)
80 and over	20	42.9 (29.6, 57.2)	18	15.6 (9.7, 24.0)	21	65.3 (47.3, 79.8)

Weightage has been applied to the sample to adjust for the complex sample design

4.3.2 Risk factors associated with the incidence of functional limitation and physical disability at twelve months follow up

4.3.2.1 Functional limitation

Table 4.10 shows the unadjusted and adjusted relative risks (RRs) of the analyses for the outcome of functional limitation. In the univariate logistic regression analysis, the variables that had higher unadjusted RR of having functional limitation at twelve months were: elderly female, advancing age (70-74 years and 75-79 years), no formal education, elderly who lived alone and poor self-rated health status.

In model 1, only advanced age (70-74 years & 75-79 years) was significant as a risk factor for functional limitation. In model 2, besides age (3 age groups; 65-69 years, 70-74 years and 75-79 years), those elderly with severe cognitive impairment had higher risk of having functional limitation at twelve months of follow up. In model 3, the significant risk factors were elderly female, no formal education, aged 70 years old and older and severe cognitive impairment.

In the fully adjusted model (model 4) which is the best model, advancing age (70 years and above), severe cognitive impairment and elderly with no formal education remained to be significant predictors of functional limitation at twelve months of follow up. As age increased, the risk of having functional limitation increased; the highest RR was observed among oldest age group. The risk of having functional limitation among those elderly with no formal education was four times higher than those with secondary or tertiary education. The RR of elderly with severe cognitive impairment having functional limitation at twelve months was 3.5 times higher than those with normal cognitive function.

Table 4.10: Risk factors associated with incidence of functional limitation at 12 months follow up (n=880)

Variables	Functional limitation		Unadjusted RR (95% CI)	Model 1	Model 2	Model 3	Model 4
	Yes, n(%)	No, n(%)		RR (95% CI)	RR (95% CI)	RR (95% CI)	RR (95% CI)
Gender							
Male	116 (33.7)	227 (66.3)	1.0	1.0	1.0	1.0	1.0
Female	160 (42.7)	217 (57.3)	**1.5 (1.1, 2.0)***	1.3 (0.9, 1.9)	1.0 (0.9, 2.1)	**1.6 (1.1, 2.4)***	1.6 (0.9, 2.9)
Level of education							
Secondary education and above	72 (31.2)	157 (68.8)	1.0	1.0	1.0	1.0	1.0
Primary education	156 (38.3)	250 (61.7)	1.4 (1.0, 1.9)	1.1 (0.8, 1.7)	1.1 (0.8, 1.7)	1.2 (0.8, 1.8)	1.1 (0.7, 1.8)
No formal education	47 (56.5)	36 (43.5)	**2.9 (1.7, 4.9)****	1.9 (1.0, 3.7)	1.8 (0.9, 3.7)	**3.0 (1.4, 6.3)***	**4.2 (1.3, 13.7)***
Age group (years)							
60-64	82 (30.1)	183 (69.9)	1.0	1.0	1.0	1.0	1.0
65-69	66 (39.6)	102 (60.4)	1.5 (1.0, 2.3)	1.6 (1.0, 2.4)	**1.7 (1.1, 2.6)****	1.6 (1.0, 2.5)	1.6 (0.9, 2.7)
70-74	52 (45.6)	66 (54.4)	**1.9 (1.2, 3.1)***	**2.0 (1.2, 3.3)***	**2.4 (1.4, 4.0)****	**2.6 (1.5, 4.4)****	**2.3 (1.2, 4.2)****
75-79	45 (47.7)	47 (52.3)	**2.1 (1.3, 3.5)***	**1.9 (1.1, 3.4)***	**2.3 (1.3, 4.1)****	**2.5 (1.3, 4.6)****	**3.0 (1.4, 6.5)****
80 and above	31 (42.4)	46 (57.6)	1.7 (1.0, 3.0)	1.4 (0.8, 2.7)	1.9 (1.0, 3.6)	**2.5 (1.3, 5.1)****	**4.7 (1.8,12.3)****
Ethnicity							
Malay	270 (38.7)	430 (61.3)	1.0	1.0	1.0	1.0	1.0
Others	6 (30.5)	14 (69.5)	0.7 (0.3, 1.6)	0.8 (0.3, 1.9)	0.8 (0.3, 2.0)	0.9 (0.4, 2.4)	1.9 (0.5, 7.5)

'Table 4.10, continued'.

Variables	Functional limitation		Unadjusted RR (95% CI)	Model 1	Model 2	Model 3	Model 4
	Yes, n(%)	No, n(%)		RR (95% CI)	RR (95% CI)	RR (95% CI)	RR (95% CI)
Marital status							
Married	188 (36.3)	330 (63.7)	1.0	1.0	1.0	1.0	1.0
Others	88 (43.9)	114 (56.1)	1.4 (1.0, 1.9)	0.7 (0.4, 1.3)	0.7 (0.4, 1.3)	0.7 (0.4, 1.2)	1.0 (0.5, 1.9)
Household income							
≥ RM 1500	37 (30.8)	87 (69.2)	1.0	1.0	1.0	1.0	1.0
RM 1000-1499	72 (37.3)	120 (62.7)	1.3 (0.8, 2.2)	1.3 (0.7, 2.3)	1.5 (0.9, 2.6)	1.8 (1.0, 3.0)	2.1 (1.0, 4.2)
RM 500-999	92 (42.0)	127 (58.0)	1.6 (1.0, 2.7)	1.6 (1.0, 2.8)	1.8 (1.0, 3.1)	1.9 (1.0, 3.2)	2.4 (1.0, 4.9)
≤ RM499	75 (40.9)	110 (59.1)	1.6 (0.9, 2.6)	1.5 (0.9, 2.5)	1.4 (0.8, 2.6)	1.6 (0.9, 2.8)	2.1 (0.9, 4.6)
Presence of chronic disease[1]							
Cardiovascular disease	130 (35.7)	239 (64.3)	0.8 (0.6, 1.1)	-	0.8 (0.6, 1.1)	0.8 (0.6, 1.2)	0.8 (0.6, 1.3)
Diabetes mellitus	76 (39.2)	107 (60.8)	1.0 (0.7, 1.5)	-	1.2 (0.8, 1.7)	1.2 (0.8, 1.8)	1.2 (0.8, 1.2)
Arthritis	37 (32.4)	79 (67.6)	0.7 (0.5, 1.1)		0.7 (0.5, 1.1)	0.7 (0.4, 1.1)	0.5 (0.3, 1.1)
Cognitive Assessment							
Normal	166 (36.5)	289 (63.5)	1.0	-	1.0	1.0	1.0
Impaired	97 (45.3)	118 (54.7)	0.7 (0.5, 1.0)	-	1.2 (0.7, 1.8)	1.1 (0.7, 1.7)	1.2 (0.7, 1.7)
Severely impaired	6 (21.6)	21 (78.4)	2.1 (0.8, 5.3)	-	**4.5 (1.6, 12.6)***	**3.7 (1.3, 10.4)***	**3.5 (1.1, 10.7)***
Visual problem							
No	177 (39.9)	265 (60.1)	1.0	-	1.0	1.0	1.0
Yes	98 (36.1)	177 (63.9)	0.9 (0.6, 1.2)	-	0.8 (0.5, 1.1)	0.8 (0.5, 1.2)	0.8 (0.5, 1.3)

'Table 4.10, continued'.

Variables	Functional limitation		Unadjusted RR (95% CI)	Model 1	Model 2	Model 3	Model 4
	Yes, n(%)	No, n(%)		RR (95% CI)	RR (95% CI)	RR (95% CI)	RR (95% CI)
Chronic Pain							
No	234 (40.4)	346 (59.6)	1.0	-	1.0	1.0	1.0
Yes	40 (30.1)	92 (69.9)	0.6 (0.4, 1.0)	-	0.6 (0.4, 1.0)	0.7 (0.4, 1.1)	0.7 (0.4, 1.4)
History of fall							
No	247 (39.5)	379 (60.5)	1.0	-	1.0	1.0	1.0
Yes	29 (32.0)	63 (68.0)	0.7 (0.5, 1.1)	-	0.6 (0.4, 1.1)	0.6 (0.3, 1.0)	0.6 (0.3, 1.2)
Body fat							
Normal	120 (37.4)	200 (62.6)	1.0		1.0	1.0	1.0
Underfat	33 (48.4)	38 (51.6)	1.6 (0.9, 2.6)	-	1.0 (0.5, 1.8)	0.9 (0.5, 1.7)	1.0 (0.5, 2.1)
Overfat	79 (48.3)	87 (51.7)	1.6 (1.0, 2.3)	-	1.5 (0.9, 2.3)	1.5 (1.0, 2.3)	1.2 (0.8, 1.9)
Obese	19 (35.0)	36 (65.0)	0.9 (0.5, 1.7)	-	0.9 (0.4, 1.7)	0.9 (0.4, 1.7)	1.1 (0.5, 2.1)
				-			
Depressive Symptoms							
No	174 (38.7)	276 (61.3)	1.0	-	-	1.0	1.0
Yes	102 (38.0)	168 (62.0)	1.0 (0.7, 1.3)	-	-	0.9 (0.6, 1.3)	0.9 (0.6, 1.4)

'Table 4.10, continued'.

Variables	Functional limitation		Unadjusted RR (95% CI)	Model 1	Model 2	Model 3	Model 4
	Yes, n(%)	No, n(%)		RR (95% CI)	RR (95% CI)	RR (95% CI)	RR (95% CI)
Living Arrangements							
Living with spouse	90 (33.5)	179 (66.5)	1.0	-	-	1.0	1.0
Living with spouse and children	139 (40.2)	211 (59.8)	1.3 (0.9, 1.9)	-	-	1.4 (1.0, 2.1)	1.5 (1.0, 2.3)
Living with others	14 (40.0)	18 (60.0)	1.3 (0.6, 2.8)	-	-	1.7 (0.8, 3.3)	1.8 (0.9, 3.6)
Living alone	32 (48.8)	32 (51.2)	**1.9 (1.1, 3.3)***	-	-	1.3 (0.5, 3.5)	1.9 (0.6, 5.5)
Self-rated health							
Good	65 (43.0)	86 (57.0)	1.0	-	-	1.0	1.0
Average	134 (39.4)	208 (60.6)	1.5 (0.9, 2.6)	-	-	1.9 (0.9, 3.9)	2.0 (1.0, 4.2)
Poor	75 (34.6)	142 (65.4)	**2.0 (1.1, 3.5)***	-	-	1.9 (1.0, 4.0)	1.6 (0.7, 3.5)
				-	-		
Social support level							
High	206 (39.6)	322 (60.4)	1.0	-	-	1.0	1.0
Low	70 (35.2)	122 (64.8)	1.2 (0.8, 1.7)	-	-	1.1 (0.7, 1.7)	1.1 (0.7, 1.7)
Smoking status							
Nonsmoker	206 (39.7)	315 (60.3)	1.0	-	-	-	1.0
Former Smoker	43 (34.5)	82 (65.5)	0.9 (0.5, 1.5)	-	-	-	1.0 (0.5, 1.9)
Smoker	27 (36.4)	47 (63.6)	0.8 (0.5, 1.2)	-	-	-	1.1 (0.5, 2.6)

'Table 4.10, continued'.

Variables	Functional limitation		Unadjusted RR (95% CI)	Model 1	Model 2	Model 3	Model 4
	Yes, n(%)	No, n(%)		RR (95% CI)	RR (95% CI)	RR (95% CI)	RR (95% CI)
Physical activity level							
High	196 (38.3)	309 (61.7)	1.0	-	-	-	1.0
Low	61 (37.7)	105 (62.3)	1.0 (0.7, 1.4)	-	-	-	1.3 (0.7, 2.5)

Model 1 adjusted for age, sex, ethnicity, education, income level and marital status.
Model 2 adjusted for all covariates from Model 1plus health variables (CVD, DM, arthritis, cognitive impairment, visual impairment, chronic pain, history of fall and obesity).
Model 3 adjusted for all covariates from Model 2plus depressive symptoms, living arrangement, self-rated health and social support.
Model 4 fully adjusted model (adjusted for all covariates from Model 3 plus smoking and physical activity level).
[1]reference group: no disease.
*p-value <0.05
**p-value <0.01

4.3.2.2 IADL Disability

Table 4.11 shows the unadjusted and adjusted relative risks (RRs) of the analyses for the outcome of IADL disability. The univariate logistic regression analysis showed that the variables: elderly female, advancing age (>75 years and older), primary and no formal education, non-married elderly (either widowed, single or divorced), low income (<RM 500), having cardiovascular disease, cognitive impairment, current and former smoker, underfat and low physical activity level had significant unadjusted RR of having IADL disability at twelve months follow up.

In model 1, the variables that were significant risk factors of IADL disability were female, low educational level (primary and no formal education), advanced age groups (75 years and older) and low income level. In model 2, the same variables (female, low educational level, advanced age and low income level) remained significant as risk factors of IADL disability. In model 3 however, income became insignificant after adjustment for psychological and environmental risk. The significant risk factors were female, low educational level, advanced age and lived alone. In the fully adjusted model (model 4), besides elderly female, low education level, advanced age groups and lived alone, lifestyle factors such as smokers and low physical activity level were significant risks factors for IADL disability at twelve months of follow up.

Among these variables, those with no formal education has almost 5 times the risk of IADL disability compared to those with above secondary education level. Female were 4 times at higher risk of having IADL disability compared to males. The elderly in the advanced age group (75-79 years) were having 3 times the risk of IADL disability and the risk increased by 4 times among the oldest elderly (80 years and above) compared to the youngest elderly group (60-64 years). Elderly who lived alone and smokers were 2.5 times more likely to have IADL disability. Elderly participants who reported as having low physical activity level had almost 2 times the risk for

having IADL disability at twelve months of follow up compared to those with high physical activity level.

Table 4.11: Risk factors associated with incidence of IADL disability at 12 months follow up (n=1442)

Variables	IADL disability		Unadjusted RR (95% CI)	Model 1	Model 2	Model 3	Model 4
	Yes, n(%)	No, n(%)		RR (95% CI)	RR (95% CI)	RR (95% CI)	RR (95% CI)
Gender							
Male	57 (12.4)	466 (87.6)	1.0	1.0	1.0	1.0	1.0
Female	223 (33.7)	451 (66.3)	**3.6 (2.6, 5.0)****	**4.6 (3.1, 6.7)****	**4.7 (3.1, 6.9)****	**4.4 (2.9, 6.7)****	**3.9 (2.4, 6.2)****
Level of education							
Secondary education and above	36 (10.4)	314 (89.6)	1.0	1.0	1.0	1.0	1.0
Primary education	183 (26.3)	540 (73.7)	**3.1 (2.1, 4.6)****	**2.3 (1.5, 3.6)****	**2.4 (1.5, 3.7)****	**2.3 (1.5, 3.7)****	**2.4 (1.5, 4.0)****
No formal education	60 (52.5)	60 (47.5)	**9.5 (5.7, 15.8)****	**4.1 (2.3, 7.4)****	**4.6 (2.5, 8.5)****	**4.3 (2.3, 8.0)****	**4.9 (2.4, 9.9)****
Age group (years)							
60-64	82 (19.6)	350 (80.4)	1.0	1.0	1.0	1.0	1.0
65-69	45 (16.6)	221 (83.4)	0.8 (0.5, 1.2)	0.9 (0.6, 1.4)	0.9 (0.6, 1.4)	0.9 (0.6, 1.4)	0.9 (0.5, 1.4)
70-74	49 (22.3)	178 (77.7)	1.2 (0.8, 1.8)	1.1 (0.7, 1.8)	1.0 (0.6, 1.5)	1.0 (0.6, 1.5)	1.0 (0.6, 1.6)
75-79	70 (38.0)	124 (62.0)	**2.5 (1.7, 3.7)****	**2.8 (1.8, 4.5)****	**2.8 (1.7, 4.5)****	**2.7 (1.7, 4.3)****	**2.9 (1.7, 5.0)****
80 and above	34 (47.1)	44 (52.9)	**3.6 (2.2, 6.1)****	**6.1 (3.3, 11.5)****	**5.3 (2.8, 10.2)****	**4.8 (2.5, 9.4)****	**3.6 (1.7, 7.5)****
Ethnicity							
Malay	273 (24.5)	897 (75.5)	1.0	1.0	1.0	1.0	1.0
Others	7 (23.3)	20 (76.7)	0.9 (0.4, 2.1)	1.3 (0.5, 3.4)	1.5 (0.6, 3.8)	1.4 (0.6, 3.6)	2.0 (0.7, 5.9)

'Table 4.11, continued'.

Variables	IADL disability		Unadjusted RR (95% CI)	Model 1	Model 2	Model 3	Model 4
	Yes, n(%)	No, n(%)		RR (95% CI)	RR (95% CI)	RR (95% CI)	RR (95% CI)
Marital status							
Married	171 (21.2)	684 (78.8)	1.0	1.0	1.0	1.0	1.0
Others	109 (32.2)	233 (67.8)	**1.8 (1.3, 2.4)****	1.2 (0.7, 1.9)	1.1 (0.7, 1.8)	1.1 (0.7, 1.8)	1.2 (0.7, 2.1)
Household income							
≥ RM 1500	31 (17.7)	154 (82.3)	1.0	1.0	1.0	1.0	1.0
RM 1000-1499	61 (19.7)	252 (80.3)	1.1 (0.7, 1.9)	1.3 (0.8, 2.3)	1.4 (0.8, 2.4)	1.4 (0.8, 2.3)	1.4 (0.8, 2.7)
RM 500-999	82 (23.0)	295 (77.0)	1.4 (0.9, 2.2)	1.5 (0.9, 2.4)	1.5 (0.9, 2.5)	1.4 (0.8, 2.4)	1.2 (0.7, 2.2)
≤ RM499	106 (34.6)	216 (65.4)	**2.5 (1.5, 4.0)****	**1.8 (1.1, 2.9)***	**1.9 (1.1, 3.2)***	1.7 (1.0, 3.0)	1.2 (0.7, 2.3)
Presence of chronic disease[1]							
Cardiovascular disease	102 (18.9)	459 (81.1)	**1.8 (1.3, 2.4)****	-	1.4 (1.0, 2.0)	1.4 (1.0, 2.0)	1.4 (1.0, 1.9)
Diabetes mellitus	86 (27.7)	235 (72.3)	1.3 (0.9, 1.7)	-	1.3 (0.9, 1.9)	1.3 (0.9, 1.9)	1.3 (0.9, 2.0)
Arthritis	41 (23.3)	130 (76.7)	0.9 (0.6, 1.4)	-	0.9 (0.5, 1.4)	0.8 (0.5, 1.3)	0.8 (0.5, 1.5)
Cognitive Assessment							
Normal	151 (18.7)	660 (81.3)	1.0	-	1.0	1.0	1.0
Impaired	129 (48.1)	257 (63.7)	**2.5 (1.9, 3.3)****	-	1.2 (0.8, 1.7)	1.2 (0.8, 1.7)	1.1 (0.8, 1.6)

'Table 4.11, continued'.

Variables	IADL disability		Unadjusted RR (95% CI)	Model 1	Model 2	Model 3	Model 4
	Yes, n(%)	No, n(%)		RR (95% CI)	RR (95% CI)	RR (95% CI)	RR (95% CI)
Visual problem							
No	190 (24.4)	614 (75.6)	1.0	-	1.0	1.0	1.0
Yes	89 (24.5)	301 (75.5)	1.0 (0.8, 1.4)	-	1.0 (0.7, 1.4)	1.0 (0.7, 1.4)	1.2 (0.8, 1.8)
Chronic Pain							
No	224 (23.3)	776 (76.7)	1.0	-	1.0	1.0	1.0
Yes	50 (29.0)	130 (71.0)	1.3 (0.9, 1.9)	-	1.2 (0.7, 1.8)	1.2 (0.8, 1.8)	1.1 (0.7, 1.7)
History of fall							
No	235 (23.7)	796 (76.3)	1.0	-	1.0	1.0	1.0
Yes	44 (28.9)	118 (71.1)	1.3 (0.9, 1.9)	-	1.0 (0.6, 1.5)	0.9 (0.6, 1.4)	1.0 (0.6, 1.5)
Body fat							
Normal	119 (21.5)	472 (78.5)	1.0	-	1.0	1.0	1.0
Underfat	47 (32.0)	111 (68.0)	**1.7 (1.1, 2.6)****	-	1.2 (0.7, 1.9)	1.2 (0.8, 2.0)	1.3 (0.8, 2.1)
Overfat	81 (26.1)	231 (73.9)	1.3 (0.9, 1.8)	-	1.3 (0.9, 1.8)	1.3 (0.9, 1.8)	1.3 (0.9, 1.9)
Obese	21 (18.7)	87 (81.3)	0.8 (0.5, 1.4)	-	1.0 (0.6, 1.8)	1.1 (0.6, 1.9)	1.0 (0.6, 1.8)
Depressive Symptoms							
No	176 (22.8)	615 (77.2)	1.0	-	-	1.0	1.0
Yes	104 (27.3)	302 (72.7)	1.3 (1.0, 1.7)	-	-	1.2 (0.9, 1.7)	1.1 (0.8, 1.6)

'Table 4.11, continued'.

Variables	IADL disability		Unadjusted RR (95% CI)	Model 1	Model 2	Model 3	Model 4
	Yes, n(%)	No, n(%)		RR (95% CI)	RR (95% CI)	RR (95% CI)	RR (95% CI)
Living Arrangements							
Living with spouse	103 (22.9)	373 (77.1)	1.0	-	-	1.0	1.0
Living with spouse and children	125 (25.5)	392 (74.5)	1.2 (0.9, 1.6)	-	-	1.1 (0.8, 1.7)	1.1 (0.7, 1.8)
Living with others	15 (26.2)	42 (73.8)	1.2 (0.6, 2.2)	-	-	1.6 (0.7, 3.7)	1.5 (0.6, 3.7)
Living alone	37 (26.1)	103 (73.9)	1.2 (0.8, 1.9)	-	-	**2.2 (1.2, 3.9)***	**2.2 (1.1, 4.2)***
Self-rated health							
Good	58 (20.6)	223 (79.4)	1.0	-	-	1.0	1.0
Average	149 (26.0)	444 (74.0)	1.2 (0.7, 2.0)	-	-	1.0 (0.6, 1.9)	1.0 (0.5, 1.9)
Poor	73 (23.8)	245 (76.2)	1.0 (0.6, 1.8)	-	-	1.2 (0.6, 2.3)	1.1 (0.5, 2.1)
Social support level							
High	216 (24.2)	725 (75.8)	1.0	-	-	1.0	1.0
Low	64 (25.1)	192 (74.9)	1.1 (0.8, 1.4)	-	-	1.0 (0.7, 1.5)	1.1 (0.8, 1.7)
Smoking status							
Nonsmoker	253 (29.1)	645 (70.9)	1.0	-	-	-	1.0
Former Smoker	14 (14.0)	113 (86.0)	**2.5 (1.4, 4.5)****	-	-	-	1.7 (0.8, 3.6)
Smoker	13 (7.4)	158 (92.6)	**5.2 (2.8, 9.5)****	-	-	-	**2.4 (1.1, 5.5)***

'Table 4.11, continued'.

Variables	IADL disability		Unadjusted RR (95% CI)	Model 1	Model 2	Model 3	Model 4
	Yes, n(%)	No, n(%)		RR (95% CI)	RR (95% CI)	RR (95% CI)	RR (95% CI)
Physical activity level							
High	199 (22.0)	747 (78.0)	1.0	-	-	-	1.0
Low	64 (40.8)	97 (59.2)	**2.4 (1.7, 3.5)****	-	-	-	**1.8 (1.2, 3.0)****

Model 1 adjusted for age, sex, ethnicity, education, income level and marital status.
Model 2 adjusted for all covariates from Model 1plus health variables (CVD, DM, arthritis, cognitive impairment, visual impairment, chronic pain, history of fall and obesity).
Model 3 adjusted for all covariates from Model 2plus depressive symptoms, living arrangement, self-rated health and social support.
Model 4 fully adjusted model (adjusted for all covariates from Model 3 plus smoking and physical activity level).
[1]reference group: no disease.
*p-value <0.05
**p-value <0.01

4.3.2.3 ADL Disability

Table 4.12 shows the unadjusted and adjusted relative risks (RRs) of the analyses for the outcome of ADL disability. In the univariate analysis, the following variables: elderly female, advancing age (>75 years and older), Other ethnicities, primary and no formal education, marital status (either widowed, single or divorced), living with spouse and children, living with others and lived alone, low income (<RM500), having cardiovascular disease, diabetes mellitus, arthritis, visual impairment, history of fall, chronic pain, cognitive impairment, depressive symptoms, current and former smoker, average to poor self-rated health, underfat, low social support and low physical activity level had significantly higher unadjusted RR of ADL disability at twelve months follow up.

In model 2, the significant risk factors for ADL disability were female, low educational level, advanced age (70 years and older), Other ethnicities and low income level. In model 2, it included the five variables mentioned above plus having cardiovascular disease and chronic pain remained significant as risk factors for ADL disability at twelve months of follow up. In model 3, the significant risk factors were female, low educational level, advanced age, other ethnicities, cardiovascular disease, chronic pain and those elderly who lived alone.

In the fully adjusted model (model 4), chronic pain was not significant after adjusting for lifestyle and behavioural variables. The risks factors that remained significant of having higher RR for ADL disability were elderly female, advancing age, low educational level, Other ethnicities, lived alone, cardiovascular disease and low physical activity level.

Elderly female were four times at risk of having ADL disability at twelve months of follow up compared to elderly male. Those with primary education were having 2 times risk of ADL disability compared to those with above secondary

education. The risk increased to four times for elderly with no formal education. Elderly from Other ethnic groups were having three times the risk of ADL disability. Cardiovascular disease was also an important variable as those elderly diagnosed with cardiovascular disease had almost two times higher risk of ADL disability. Similar findings were observed among elderly who lived alone and had low physical activity level. Elderly who lived alone and had low physical activity level were having twice the risk of ADL disability.

Table 4.12: Risk factors associated with incidence of ADL disability at 12 months follow up (n=2155)

Variables	ADL disability		Unadjusted RR (95% CI)	Model 1	Model 2	Model 3	Model 4
	Yes, n(%)	No, n(%)		RR (95% CI)	RR (95% CI)	RR (95% CI)	RR (95% CI)
Gender							
Male	26 (4.1)	659 (95.9)	1.0	1.0	1.0	1.0	1.0
Female	50 (4.3)	1040 (95.7)	**3.5 (2.8, 4.5)****	**4.3 (3.2, 5.8)****	**4.3 (3.1, 5.9)****	**4.0 (2.9, 5.5)****	**3.8 (2.7, 5.6)****
Level of education							
Secondary education and above	10 (2.4)	428 (97.6)	1.0	1.0	1.0	1.0	1.0
Primary education	49 (4.4)	1025 (95.6)	**2.7 (2.0, 3.7)****	**1.8 (1.3, 2.6)****	**1.9 (1.3, 2.7)****	**1.8 (1.2, 2.5)****	**1.8 (1.2, 2.7)****
No formal education	17 (6.5)	241 (93.5)	**10.7 (7.4, 15.5)****	**3.6 (2.3, 5.6)****	**4.0 (2.5, 6.5)****	**3.3 (2.0, 5.4)****	**3.8 (2.2, 6.6)****
Age group (years)							
60-64	7 (1.2)	524 (98.8)	1.0	1.0	1.0	1.0	1.0
65-69	13 (3.5)	354 (96.5)	1.1 (0.8, 1.6)	1.2 (0.9, 1.7)	1.1 (0.8, 1.5)	1.1 (0.8, 1.5)	1.1 (0.7, 1.6)
70-74	8 (2.0)	348 (98.0)	1.6 (1.2, 2.1)	**1.6 (1.1, 2.3)****	1.4 (1.0, 1.9)	1.3 (0.9, 1.8)	1.3 (0.9, 1.9)
75-79	23 (6.8)	305 (93.2)	**3.1 (2.3, 4.2)****	**3.2 (2.2, 4.6)****	**3.0 (2.0, 4.3)****	**2.8 (1.9, 4.0)****	**2.7 (1.7, 4.1)****
80 and above	25 (13.0)	168 (87.0)	**6.2 (4.3, 8.9)****	**9.0 (5.8, 13.9)****	**8.1 (5.1, 12.9)****	**7.1 (4.4, 11.4)****	**5.2 (3.0, 9.0)****
Ethnicity							
Malay	73 (4.1)	1651 (95.9)	1.0	1.0	1.0	1.0	1.0
Others	3 (5.4)	48 (94.6)	**1.7 (1.0, 2.8)***	**2.4 (1.3, 4.2)****	**2.5 (1.4, 4.4)****	**2.3 (1.3, 4.1)****	**3.0 (1.5, 5.9)****

'Table 4.12, continued'.

Variables	ADL disability		Unadjusted RR (95% CI)	Model 1 RR (95% CI)	Model 2 RR (95% CI)	Model 3 RR (95% CI)	Model 4 RR (95% CI)
	Yes, n(%)	No, n(%)					
Marital status							
Married	39 (3.4)	1123 (96.6)	1.0	1.0	1.0	1.0	1.0
Others	37 (5.6)	576 (94.4)	**2.3 (1.9, 2.9)****	1.2 (0.8, 1.8)	1.2 (0.8, 1.8)	1.2 (0.8, 1.7)	1.2 (0.8, 1.8)
Household income							
≥ RM 1500	5 (2.2)	236 (97.8)	1.0	1.0	1.0	1.0	1.0
RM 1000-1499	11 (2.6)	387 (97.4)	1.1 (0.7, 1.6)	1.4 (0.9, 2.1)	1.4 (0.9, 2.2)	1.4 (0.9, 2.1)	1.2 (0.7, 1.9)
RM 500-999	23 (4.0)	529 (96.0)	1.5 (1.0, 2.1)	1.5 (1.0, 2.2)	1.5 (1.0, 2.3)	1.4 (0.9, 2.1)	1.3 (0.8, 2.1)
≤ RM499	37 (2.1)	547 (93.7)	**2.6 (1.8, 3.8)****	**1.6 (1.1, 2.3)***	**1.7 (1.1, 2.6)***	1.5 (1.0, 2.3)	1.3 (0.8, 2.1)
Presence of chronic disease							
Cardiovascular disease	24 (3.1)	792 (96.9)	**2.1 (1.7, 2.6)****	-	**1.8 (1.4, 2.3)****	**1.8 (1.4, 2.4)****	**1.6 (1.2, 2.2)****
Diabetes mellitus	23 (4.6)	446 (95.4)	**1.3 (1.0, 1.6)***	-	1.2 (0.9, 1.6)	1.2 (0.9, 1.6)	1.2 (0.8, 1.6)
Arthritis	21 (5.2)	333 (94.8)	**1.9 (1.5, 2.4)****	-	1.1 (0.8, 1.5)	1.0 (0.7, 1.4)	0.9 (0.6, 1.3)
Cognitive Assessment							
Normal	31 (1.7)	1014 (97.2)	1.0	-	1.0	1.0	1.0
Impaired	41 (5.6)	668 (94.4)	**3.4 (2.8, 4.2)****	-	1.5 (0.9, 2.7)	1.5 (0.8, 2.6)	1.3 (0.7, 2.4)

'Table 4.12, continued'.

Variables	ADL disability		Unadjusted RR (95% CI)	Model 1	Model 2	Model 3	Model 4
	Yes, n(%)	No, n(%)		RR (95% CI)	RR (95% CI)	RR (95% CI)	RR (95% CI)
Visual problem							
No	37 (3.5)	1045 (96.5)	1.0	-	1.0	1.0	1.0
Yes	39 (5.3)	650 (94.7)	**1.5 (1.3, 1.9)****	-	1.1 (0.9, 1.5)	1.1 (0.8, 1.4)	1.2 (0.9, 1.6)
Chronic Pain							
No	39 (2.7)	1356 (97.3)	1.0	-	1.0	1.0	1.0
Yes	33 (8.8)	326 (91.2)	**2.1 (1.7, 2.7)****	-	**1.5 (1.1, 2.1)****	**1.5 (1.1, 2.1)****	1.3 (1.0, 1.8)
History of fall							
No	54 (3.5)	1420 (96.5)	1.0	-	1.0	1.0	1.0
Yes	18 (6.2)	257 (93.8)	**1.5 (1.1, 1.9)****	-	1.1 (0.8, 1.5)	1.1 (0.8, 1.4)	1.0 (0.7, 1.5)
Body fat							
Normal	30 (3.5)	836 (96.5)	1.0	-	1.0	1.0	1.0
Underfat	11 (4.4)	245 (95.6)	**2.1 (1.5, 2.8)****	-	1.0 (0.5, 2.3)	1.0 (0.5, 2.3)	1.1 (0.5, 2.5)
Overfat	15 (2.9)	424 (97.1)	1.3 (1.0, 1.6)	-	1.0 (0.5, 1.9)	1.0 (0.5, 1.9)	0.9 (0.4, 1.9)
Obese	5 (2.4)	144 (97.6)	1.2 (0.8, 1.7)	-	0.9 (0.3, 2.6)	1.0 (0.3, 2.6)	0.9 (0.3, 2.6)
Depressive Symptoms							
No	38 (3.3)	1075 (96.7)	1.0	-	-	1.0	1.0
Yes	34 (4.9)	607 (95.1)	**1.4 (1.1, 1.7)****	-	-	1.2 (0.9, 1.5)	1.1 (0.9, 1.5)

'Table 4.12, continued'.

Variables	ADL disability		Unadjusted RR (95% CI)	Model 1	Model 2	Model 3	Model 4
	Yes, n(%)	No, n(%)		RR (95% CI)	RR (95% CI)	RR (95% CI)	RR (95% CI)
Living Arrangements							
Living with spouse	20 (3.1)	625 (96.9)	1.0	-	-	1.0	1.0
Living with spouse and children	42 (5.0)	768 (95.0)	**1.5 (1.2, 1.9)****	-	-	1.1 (0.8, 1.4)	1.0 (0.7, 1.4)
Living with others	5 (4.5)	90 (95.5)	**1.8 (1.1, 2.7)****	-	-	1.5 (0.8, 2.7)	1.4 (0.7, 2.7)
Living alone	9 (4.1)	208 (95.9)	**1.5 (1.1, 2.1)****	-	-	**2.0 (1.2, 3.1)***	**1.9 (1.1, 3.1)***
Self-rated health							
Good	11 (3.3)	321 (96.7)	1.0	-	-	1.0	1.0
Average	27 (3.3)	807 (96.7)	**1.7 (1.1, 2.8)****	-	-	0.6 (0.1, 2.7)	0.9 (0.5, 1.7)
Poor	38 (6.3)	563 (93.7)	**2.2 (1.4, 3.7)****	-	-	0.9 (0.2, 3.9)	1.0 (0.5, 1.8)
Social support level							
High	51 (3.7)	1301 (96.3)	1.0	-	-	1.0	1.0
Low	25 (5.8)	398 (94.2)	**1.2 (1.0, 1.5)***	-	-	1.3 (0.7, 2.3)	1.4 (0.8, 2.6)
Smoking status							
Nonsmoker	59 (4.2)	1300 (95.8)	1.0	-	-	-	1.0
Former Smoker	11 (6.2)	170 (93.8)	**3.6 (2.4, 5.3)****	-	-	-	1.5 (0.9, 2.5)
Smoker	6 (2.7)	227 (97.3)	**2.0 (1.4, 2.9)****	-	-	-	1.3 (0.7, 2.2)

'Table 4.12, continued'.

Variables	ADL disability		Unadjusted RR (95% CI)	Model 1	Model 2	Model 3	Model 4
	Yes, n(%)	No, n(%)		RR (95% CI)	RR (95% CI)	RR (95% CI)	RR (95% CI)
Physical activity level							
High	26 (2.1)	1279 (97.9)	1.0	-	-	-	1.0
Low	46 (13.1)	288 (86.9)	**3.3 (2.6, 4.3)****	-	-	-	**2.1 (1.5, 3.1)****

Model 1 adjusted for age, sex, ethnicity, education, income level and marital status.
Model 2 adjusted for all covariates from Model 1plus health variables (CVD, DM, arthritis, cognitive impairment, visual impairment, chronic pain, history of fall and obesity).
Model 3 adjusted for all covariates from Model 2plus depressive symptoms, living arrangement, self-rated health and social support.
Model 4 fully adjusted model (adjusted for all covariates from Model 3 plus smoking and physical activity level).
[1]reference group: no disease.
*p-value <0.05
**p-value <0.01

4.4 Incidence and risk factors of recovery from functional limitation and physical disability

4.4.1 Incidence of recovery from functional limitation at 12 months follow up

The overall incidence of recovery from functional limitation among those elderly who were functionally limited at baseline (n=1520) was 31.5% (95% CI[28.9, 34.2]). The highest incidence was among elderly aged 60-64 years old. The incidence of recovery from functional limitation decreased in the more advanced age groups and the lowest incidence was recorded among elderly aged 75-79 years. However, there was an increase in incidence of recovery from functional limitation among elderly in the oldest age group (80 years and above).

In subgroup analysis, the incidence of recovery from functional limitation among elderly female had a similar pattern where the highest incidence was noted among elderly female age 60-64 years and the lowest was among elderly female aged 75-79 years old. There was an increase in the incidence of recovery among elderly female aged 80 years and above. The incidence of recovery from functional limitation in elderly male was highest among those in the age group 60-64 years and lowest among the oldest (80 years and above).

4.4.2 Incidence of recovery from physical disability at 12 months follow up

The overall incidence of recovery from IADL disability among those 749 IADL-disabled elderly at baseline was 34.2% (95% CI[30.4, 38.2]) and the overall incidence of recovery from ADL disability among 172 ADL-disabled elderly at baseline was 43.9% (95%CI=35.6, 52.4). The highest incidence of recovery from IADL disability was found among elderly in youngest age group (60-64 years) and the lowest incidence was among elderly aged 80 years and above. The incidence of recovery from IADL disability decreased in advancing age. In subgroup analysis, the incidence of recovery from IADL disability among elderly female showed a similar pattern where the highest

incidence was noted among elderly female aged 60-64 years and the lowest was among elderly female aged 80 years and above. In elderly male, the highest incidence was among those aged 65-69 years and the lowest was among those aged 80 years and above.

The highest incidence of recovery from ADL disability was among elderly in the youngest age group (60-64 years) and the lowest incidence was among elderly aged 80 years and above. The incidence of recovery from ADL disability also decreased in the more advanced age group. In subgroup analysis, the highest incidence of recovery from ADL disability in elderly female was noted among those aged 60-64 years and the lowest was among those aged 80 years and above. In elderly male, the highest incidence was among those aged 60-64 years and the lowest was among those aged 75-79 years. The details regarding the incidence of recovery from functional limitation and physical disability are shown in the Table 4.13.

Table 4.13: Incidence of recovery from functional limitation and physical disability at twelve months follow up

Variables	Functional limitation (n=1520)		Physical disability			
			ADL Disability (n=172)		IADL Disability (n=749)	
	Unweighted count	Weighted incidence of recovery (95%C1)	Unweighted count	Weighted incidence of recovery (95%C1)	Unweighted count	Weighted incidence of recovery (95%C1)
Overall						
≥ 60	372	31.5 (28.9, 34.2)	50	43.9 (35.6, 52.4)	199	34.2 (30.4, 38.2)
≥ 65	262	29.1 (26.2, 32.2)	46	42.2 (34.0, 50.9)	155	31.0 (27.1, 35.2)
≥ 70	189	27.5 (24.3, 31.0)	36	37.2 (29.1, 46.1)	117	28.5 (24.3, 33.0)
≥ 75	118	26.5 (22.4, 31.1)	26	33.3 (25.2, 42.5)	63	22.2 (17.7, 27.4)
≥ 80	49	28.5 (22.2, 35.9)	15	30.7 (22.1, 40.9)	18	13.6 (8.6, 20.8)
Age group						
60-64	110	39.4 (33.5, 45.6)	4	80.8 (33.1, 97.3)	44	55.0 (43.7, 65.8)
65-69	73	34.5 (28.1, 41.7)	10	70.9 (41.0, 89.5)	38	42.2 (32.3, 52.8)
70-74	71	29.2 (23.9, 35.1)	10	51.2 (29.6, 72.3)	54	41.7 (33.3, 50.7)
75-79	69	25.2 (20.1, 31.2)	11	38.4 (24.7, 54.2)	45	31.0 (23.9, 39.1)
80 and over	49	28.4 (21.8, 36.0)	15	30.7 (21.0, 42.5)	18	13.6 (8.7, 20.7)
Male						
Overall (≥ 60)	150	39.9 (35.2, 44.8)	19	61.2 (47.2, 73.5)	77	47.1 (40.7, 53.5)
60-64	35	51.3 (39.8, 62.7)	2	70.5 (47.9, 86.1)	7	51.0 (33.3, 68.4)
65-69	33	50.7 (38.7, 62.7)	6	65.1 (41.3, 83.1)	15	56.3 (40.0, 71.3)
70-74	29	36.0 (26.2, 47.0)	6	69.6 (29.0, 92.8)	23	53.5 (38.2, 68.1)
75-79	33	35.4 (26.2, 45.9)	2	29.3 (7.6, 67.6)	21	51.5 (37.6, 65.1)
80 and over	20	29.3 (19.6, 41.4)	3	65.4 (33.7, 87.5)	11	28.8 (16.7, 44.8)

'Table 4.13, continued'.

Variables	Functional limitation (n=1520)		Physical disability			
			ADL Disability (n=172)		IADL Disability (n=749)	
	Unweighted count	Weighted incidence of recovery (95%C1)	Unweighted count	Weighted incidence of recovery (95%C1)	Unweighted count	Weighted incidence of recovery (95%C1)
Female						
Overall (≥ 60)	222	27.5 (24.5, 30.7)	31	36.2 (27.3, 46.1)	122	29.3 (25.1, 33.9)
60-64	75	35.3 (28.9, 42.3)	2	100 (-)	37	55.8 (43.3, 67.6)
65-69	40	27.4 (20.7, 35.3)	4	85.9 (69.1, 94.3)	23	36.8 (25.8, 49.4)
70-74	42	25.9 (19.8, 33.1)	4	35.9 (15.9, 62.5)	31	35.9 (26.4, 46.6)
75-79	36	20.0 (14.6, 26.8)	9	40.9 (25.7, 58.1)	24	23.0 (15.8, 32.4)
80 and over	29	27.7 (19.4, 37.8)	12	26.3 (16.4, 39.4)	7	7.5 (3.5, 15.5)

Weightage has been applied to the sample to the sample to adjust for the complex sample design

4.4.3 Risk factors associated with the recovery of functional limitation and physical disability at twelve months of follow up

4.4.3.1 Recovery from functional limitation

Table 4.14 shows the unadjusted and adjusted relative risks (RRs) of the analyses for the outcome of recovery from functional limitation. In univariate analysis, the significant unadjusted RRs for higher incidence of recovery from functional limitation were elderly male, younger age group (60-64 years), higher educational level (primary, secondary and tertiary), elderly without cardiovascular disease and diabetes mellitus, and non-smokers. Widowed, divorced and never married elderly had significantly lower unadjusted RR of functional limitation recovery compared to married elderly.

In model 1 and model 2, only male and younger age (60-64 years) group had significant higher RR to recover from functional limitation. In model 3 and in the fully adjusted model (model 4), the two risk factors mentioned above remained significant as well as those elderly without diabetes mellitus. In model 4, besides elderly in age group 60-64 years, those aged between 65-69 years had significant higher RR of functional limitation recovery.

Elderly males were twice more likely to recover from functional limitation compared to elderly female. Younger participants were more likely to recover from functional limitation. The elderly in the age group 65-69 years were two times more likely to recover from functional limitation compared to the oldest elderly (80 years and above). Elderly in the youngest group (60-64 years) were almost three times more likely to recover. Elderly without diabetes mellitus were also more likely to recover from functional limitation by two times compared to those elderly diagnosed with diabetes mellitus.

Table 4.14: Risk factors associated with the recovery from functional limitation at twelve months of follow up (n=1520)

Variables	Functional limitation recovery		Unadjusted RR (95% CI)	Model 1	Model 2	Model 3	Model 4
	Yes, n(%)	No, n(%)		RR (95% CI)	RR (95% CI)	RR (95% CI)	RR (95% CI)
Gender							
Female	222 (27.5)	608 (72.5)	1.0	1.0	1.0	1.0	1.0
Male	150 (39.9)	243 (60.1)	**1.8 (1.3, 2.3)****	**1.9 (1.4, 2.5)***	**1.9 (1.4, 2.6)***	**1.9 (1.4, 2.5)****	**1.7 (1.2, 2.4)****
Level of education							
No formal education	50 (21.4)	178 (78.6)	1.0	1.0	1.0	1.0	1.0
Primary education	235 (31.9)	532 (68.1)	**2.5 (1.7, 3.9)****	1.5 (0.9, 2.6)	1.6 (0.9, 2.7)	1.4 (0.8, 2.5)	1.4 (0.8, 2.6)
Secondary education and above	87 (40.8)	138 (59.2)	**1.7 (1.2, 2.5)****	1.4 (0.9, 2.0)	1.3 (0.9, 2.0)	1.3 (0.8, 1.9)	1.2 (0.8, 2.0)
Age group (years)							
80 and above	49 (28.4)	124 (71.6)	1.0	1.0	1.0	1.0	1.0
75-79	69 (25.2)	208 (74.8)	0.9 (0.5, 1.3)	0.9 (0.6, 1.4)	0.9 (0.5, 1.4)	0.9 (0.5, 1.4)	1.1 (0.6, 1.9)
70-74	71 (29.2)	198 (70.8)	1.0 (0.7, 1.6)	1.1 (0.7, 1.8)	1.1 (0.7, 1.8)	1.1 (0.7, 1.4)	1.5 (0.8, 2.6)
65-69	73 (34.4)	150 (65.6)	1.3 (0.8, 2.1)	1.5 (0.9, 2.4)	1.6 (1.0, 2.7)	1.6 (1.0, 2.6)	**2.3 (1.3, 4.1)****
60-64	110 (39.4)	171 (60.6)	**1.6 (1.1, 2.5)****	**1.8 (1.1, 2.9)****	**1.9 (1.1, 3.1)****	**1.8 (1.1, 3.0)****	**2.8 (1.5, 5.1)****
Ethnicity							
Malay	356 (31.3)	822 (68.7)	1.0	1.0	1.0	1.0	1.0
Others	16 (36.0)	29 (64.0)	1.2 (0.7, 2.3)	1.2 (0.6, 2.2)	1.3 (0.7, 2.4)	1.3 (0.7, 2.4)	1.3 (0.7, 2.5)

'Table 4.14, continued'.

Variables	Functional limitation recovery		Unadjusted RR (95% CI)	Model 1	Model 2	Model 3	Model 4
	Yes, n(%)	No, n(%)		RR (95% CI)	RR (95% CI)	RR (95% CI)	RR (95% CI)
Marital status							
Married	236 (33.8)	493 (66.2)	1.0	1.0	1.0	1.0	1.0
Others	136 (28.1)	358 (71.9)	**0.8 (0.6, 0.9)***	0.8 (0.6, 1.3)	0.9 (0.6, 1.4)	0.9 (0.6, 1.4)	1.0 (0.6, 1.7)
Household income							
≤ RM499	140 (29.8)	350 (70.2)	1.0	1.0	1.0	1.0	1.0
RM 500-999	115 (32.0)	257 (68.0)	1.1 (0.8, 1.5)	0.9 (0.7, 1.2)	1.0 (0.7, 1.3)	0.9 (0.7, 1.3)	0.9 (0.6, 1.3)
RM 1000-1499	71 (30.5)	165 (69.5)	1.0 (0.7, 1.5)	0.8 (0.6, 1.2)	0.8 (0.6, 1.2)	0.8 (0.5, 1.2)	0.7 (0.4, 1.1)
≥ RM 1500	46 (38.4)	79 (61.6)	1.5 (1.0, 2.3)	1.4 (0.9, 2.1)	1.4 (0.9, 2.2)	1.3 (0.8, 2.0)	1.1 (0.7, 1.9)
Presence of chronic disease[1]							
Cardiovascular disease	89 (33.5)	180 (66.5)	**1.4 (1.1, 1.8)***	-	1.2 (0.9, 1.6)	1.2 (0.9, 1.6)	0.9 (0.7, 1.3)
Diabetes mellitus	132 (37.1)	223 (62.9)	**1.5 (1.1, 2.0)****	-	1.4 (1.0, 2.0)	**1.4 (1.1, 2.1)***	**1.7 (1.2, 2.4)****
Arthritis	117 (38.0)	196 (62.0)	1.3 (1.0, 1.8)	-	1.2 (0.8, 1.6)	1.2 (0.8, 1.6)	1.0 (0.7, 1.5)
Cognitive Assessment							
Severely impaired	6 (22.0)	20 (78.0)	1.0	-	1.0	1.0	1.0
Impaired	142 (25.2)	428 (74.8)	1.2 (0.4, 3.2)	-	1.2 (0.4, 3.9)	1.3 (0.4, 4.4)	1.4 (0.4, 4.4)
Normal	221 (37.7)	397 (46.5)	2.2 (0.8, 5.9)	-	1.7 (0.5, 5.5)	1.9 (0.6, 6.6)	2.0 (0.6, 6.7)

'Table 4.14, continued'.

Variables	Functional limitation recovery		Unadjusted RR (95% CI)	Model 1	Model 2	Model 3	Model 4
	Yes, n(%)	No, n(%)		RR (95% CI)	RR (95% CI)	RR (95% CI)	RR (95% CI)
Visual problem							
Yes	143 (29.9)	351 (70.1)	1.0	-	1.0	1.0	1.0
No	299 (32.6)	499 (67.4)	1.1 (0.9, 1.5)	-	1.0 (0.8, 1.4)	1.0 (0.7, 1.3)	1.0 (0.7, 1.3)
Chronic Pain							
Yes	88 (31.5)	201 (68.5)	1.0	-	1.0	1.0	1.0
No	281 (31.8)	637 (68.2)	1.0 (0.8, 1.4)	-	1.2 (0.9, 1.7)	1.2 (0.9, 1.7)	1.4 (0.9, 2.0)
History of fall							
Yes	57 (25.0)	172 (75.0)	1.0	-	1.0	1.0	1.0
No	314 (33.0)	676 (67.0)	1.5 (1.0, 2.1)	-	1.4 (0.9, 1.9)	1.3 (0.9, 1.8)	1.6 (1.0, 2.3)
Body fat							
Obese	29 (28.2)	74 (71.8)	1.0	-	1.0	1.0	1.0
Overfat	87 (30.0)	205 (70.0)	1.1 (0.7, 1.8)	-	1.3 (0.8, 2.3)	1.3 (0.8, 2.3)	1.3 (0.7, 2.4)
Normal	189 (33.0)	406 (67.0)	1.0 (0.6, 1.8)	-	1.7 (1.0, 2.9)	1.7 (1.0, 2.9)	1.7 (1.0, 3.0)
Underfat	55 (28.8)	152 (71.2)	1.3 (0.8, 2.0)	-	1.7 (0.9, 3.3)	1.7 (0.9, 3.2)	2.0 (1.0, 3.9)

'Table 4.14, continued'.

Variables	Functional limitation recovery		Unadjusted RR (95% CI)	Model 1	Model 2	Model 3	Model 4
	Yes, n(%)	No, n(%)		RR (95% CI)	RR (95% CI)	RR (95% CI)	RR (95% CI)
Depressive Symptoms							
Yes	149 (33.6)	310 (66.4)	1.0	-	-	1.0	1.0
No	223 (30.1)	541 (69.9)	1.2 (0.9, 1.5)	-	-	1.3 (1.0, 1.7)	1.4 (1.0, 1.9)
Living Arrangements							
Living with spouse	130 (31.9)	290 (68.1)	1.0	-	-	1.0	1.0
Living with spouse and children	168 (31.2)	393 (68.8)	1.0 (0.7, 1.3)	-	-	1.2 (0.8, 1.6)	1.1 (0.7, 1.6)
Living with others	29 (38.1)	44 (61.9)	0.8 (0.5, 1.3)	-	-	1.1 (0.6, 2.0)	1.2 (0.6, 2.2)
Living alone	44 (27.9)	121 (72.1)	1.3 (0.8, 2.2)	-	-	1.6 (0.8, 3.1)	1.3 (0.6, 2.8)
Self-rated health							
Poor	129 (27.2)	345 (72.8)	1.0	-	-	1.0	1.0
Average	174 (33.1)	378 (66.9)	1.4 (0.6, 3.3)	-	-	1.0 (0.5, 2.1)	1.2 (0.6, 2.6)
Good	68 (36.0)	121(64.0)	1.2 (0.5, 2.6)	-	-	0.8 (0.4, 1.7)	1.0 (0.5, 2.2)
Social support level							
Low	85 (29.9)	214 (70.1)	1.0	-	-	1.0	1.0
High	287 (32.0)	637 (68.0)	1.1 (0.8, 1.5)	-	-	1.0 (0.8, 1.4)	1.0 (0.7, 1.4)

Smoking status							
Smoker	47 (41.1)	75 (58.9)	1.0	-	-	-	1.0
Former Smoker	274 (29.6)	688 (70.4)	1.2 (0.7, 2.0)	-	-	-	1.1 (0.6, 1.9)
Nonsmoker	51 (37.2)	86 (62.8)	**1.7 (1.1, 2.5)***	-	-	-	1.1 (0.6, 2.0)
Physical activity level							
Low	82 (30.7)	193 (69.3)	1.0	-	-	-	1.0
High	261 (32.1)	580 (67.9)	1.1 (0.8, 1.5)	-	-	-	1.3 (0.9, 1.9)

Model 1 adjusted for age, sex, ethnicity, education, income level and marital status.
Model 2 adjusted for all covariates from Model 1plus health variables (CVD, DM, arthritis, cognitive impairment, visual impairment, chronic pain, history of fall and obesity).
Model 3 adjusted for all covariates from Model 2plus depressive symptoms, living arrangement, self-rated health and social support.
Model 4 fully adjusted model (adjusted for all covariates from Model 3 plus smoking and physical activity level).
[1]reference group: with disease.
*p-value <0.05
**p-value <0.01

4.4.3.2 Recovery from IADL Disability

Table 4.15 shows the unadjusted and adjusted relative risks (RRs) of the analyses for the outcome of recovery from IADL disability. At the level of univariate analysis, all the variables were significant except ethnicity, diabetes mellitus, visual problem, history of fall, depression and social support level. In model 1, male, younger age (≤79 years) and elderly with primary education were more likely to recover from IADL disability. In model 2, the variables mentioned above remained significant except for male. Other significant variables for IADL disability recovery were elderly without cardiovascular disease, no chronic pain and had normal body fat percentages.

In model 3, only younger age groups, no cardiovascular disease, no chronic pain and normal body fat percentages remained significant after adjusting for psychological and environmental risk. Elderly without depressive symptoms, good self-rated health and underfat were the other significant variables in model 3. In the fully adjusted model (model 4), elderly male, younger age groups, having primary education, elderly without cardiovascular disease, no chronic pain, no depressive symptoms, good self-rated health status, non-obese and high physical activity level were the significant variables for IADL disability recovery.

Elderly male were twice more likely to recover from IADL disability compared to females. Elderly who received primary education was 2.5 times more likely to recover than those without formal education. Among these variables, the magnitude of IADL disability recovery was greater with younger participants. The magnitude was three times among elderly in age group 75-79 years and almost six times among the youngest age group (60-64 years). Elderly who did not report of having chronic pain, cardiovascular disease and depressive symptoms were two to three times more likely to recover from IADL disability. Similar finding was observed among elderly who reported as having high physical activity level where they were two times more likely to

recover compared to their counterparts. The other two important variables were obesity and self-rated health. Elderly who had normal body fat percentages and rated their health status as fairly good to very good were five times more likely to recover from IADL disability.

Table 4.15: Risk factors associated with the recovery from IADL disability at 12 months of follow up (n=670)

Variables	IADL disability recovery		Unadjusted RR (95% CI)	Model 1	Model 2	Model 3	Model 4
	Yes, n(%)	No, n(%)		RR (95% CI)	RR (95% CI)	RR (95% CI)	RR (95% CI)
Gender							
Female	119 (32.5)	244 (67.5)	1.0	1.0	1.0	1.0	1.0
Male	75 (48.5)	72 (51.5)	**2.0 (1.3, 2.9)****	**1.9 (1.1, 3.2)***	1.8 (1.0, 3.2)	1.8 (1.0, 3.1)	**2.2 (1.1, 4.4)***
Level of education							
No formal education	21 (18.3)	91 (81.7)	1.0	1.0	1.0	1.0	1.0
Primary education	140 (41.7)	193 (58.3)	**3.2 (1.9, 5.5)****	**1.9 (1.1, 3.5)***	**2.2 (1.2, 4.1)***	2.0 (1.0, 3.9)	**2.4 (1.1, 4.9)***
Secondary education and above	33 (48.6)	31 (51.4)	**4.2 (2.1, 8.6)****	1.5 (0.6, 3.6)	1.9 (0.8, 4.6)	1.4 (0.5, 3.7)	1.6 (0.5, 4.6)
Age group (years)							
80 and above	18 (17.1)	90 (82.9)	1.0	1.0	1.0	1.0	1.0
75-79	43 (33.1)	83 (66.9)	**2.4 (1.3, 4.5)****	**3.0 (1.5, 5.7)****	**2.9 (1.4, 6.0)****	**2.9 (1.4, 6.3)****	**2.8 (1.2, 6.7)***
70-74	53 (43.4)	67 (56.6)	**3.7 (2.0, 7.1)****	**3.7 (1.9, 7.2)****	**3.8 (1.8, 8.2)****	**3.8 (1.8, 8.3)****	**3.6 (1.5, 8.6)***
65-69	36 (43.2)	45 (56.8)	**3.7 (1.9, 7.2)****	**4.1 (2.0, 8.4)****	**4.3 (2.0, 9.4)****	**4.0 (1.8, 8.7)****	**3.3 (1.3, 8.4)***
60-64	44 (56.0)	31 (44.0)	**6.2 (3.2, 12.1)****	**7.0 (3.2, 15.3)****	**6.8 (2.9, 15.6)****	**6.1 (2.6, 14.5)****	**5.8 (2.1, 15.8)***
Ethnicity							
Malay	187 (37.4)	302 (62.6)	1.0	1.0	1.0	1.0	1.0
Others	7 (33.4)	14 (66.6)	0.8 (0.4, 1.6)	0.6 (0.3, 1.3)	0.6 (0.3, 1.2)	0.8 (0.4, 1.5)	0.4 (0.2, 1.1)

'Table 4.15, continued'.

Variables	IADL disability recovery		Unadjusted RR (95% CI)	Model 1	Model 2	Model 3	Model 4
	Yes, n(%)	No, n(%)		RR (95% CI)	RR (95% CI)	RR (95% CI)	RR (95% CI)
Marital status							
Married	129 (45.4)	147 (54.6)	1.0	1.0	1.0	1.0	1.0
Others	65 (27.6)	169 (72.4)	**0.5 (0.3, 0.7)****	1.2 (0.6, 2.4)	0.9 (0.4, 1.7)	0.8 (0.4, 1.6)	0.9 (0.5, 1.9)
Household income							
≤RM499	78 (31.0)	160 (69.0)	1.0	1.0	1.0	1.0	1.0
RM 500-999	63 (40.1)	89 (59.9)	1.5 (1.0, 2.3)	0.9 (0.6, 1.5)	1.0 (0.6, 1.7)	1.0 (0.6, 1.7)	0.9 (0.5, 1.6)
RM 1000-1499	31 (43.2)	41 (56.8)	1.7 (1.0, 2.9)	1.1 (0.6, 2.0)	1.3 (0.7, 2.4)	1.2 (0.6, 2.2)	0.9 (0.5, 1.9)
≥RM 1500	22 (48.4)	26 (51.6)	**2.1 (1.1, 3.9)***	1.6 (0.8, 3.1)	1.8 (0.9, 3.8)	1.7 (0.8, 3.7)	1.3 (0.5, 3.0)
Presence of chronic disease[1]							
Cardiovascular disease	84 (30.5)	184 (69.5)	**2.5 (1.7, 3.7)****		**3.3 (2.0, 5.3)****	**3.3 (2.0, 5.4)****	**2.6 (1.5, 4.6)****
Diabetes mellitus	138 (38.3)	214 (61.7)	1.2 (0.8, 1.8)	-	0.9 (0.6, 1.5)	0.9 (0.6, 1.7)	1.1 (0.6, 1.9)
Arthritis	133 (41.6)	178 (58.4)	**1.7 (1.1, 2.5)***	-	1.2 (0.7, 2.0)	1.2 (0.7, 2.0)	1.5 (0.8, 2.8)
				-			
Cognitive Assessment							
Impaired	97 (29.5)	235 (70.5)	1.0	-	1.0	1.0	1.0
Normal	97 (52.2)	81 (47.8)	**2.6 (1.8, 3.8)****	-	1.6 (1.0, 2.5)	1.6 (1.0, 2.8)	1.7 (1.0, 2.7)

'Table 4.15, continued'.

Variables	IADL disability recovery		Unadjusted RR (95% CI)	Model 1	Model 2	Model 3	Model 4
	Yes, n(%)	No, n(%)		RR (95% CI)	RR (95% CI)	RR (95% CI)	RR (95% CI)
Visual problem							
Yes	105 (35.0)	190 (65.0)	1.0	-	1.0	1.0	1.0
No	89 (40.3)	125 (59.7)	1.3 (0.9, 1.8)	-	1.1 (0.7, 1.7)	1.1 (0.7, 1.7)	1.2 (0.7, 1.9)
Chronic Pain							
Yes	49 (27.0)	130 (73.0)	1.0	-	1.0	1.0	1.0
No	145 (42.9)	185 (57.1)	**2.0 (1.4, 3.0)****	-	**1.9 (1.2, 3.2)****	**2.0 (1.2, 3.2)****	**2.0 (1.1, 3.4)***
History of fall							
Yes	36 (32.4)	77 (67.6)	1.0	-	1.0	1.0	1.0
No	158 (38.5)	239 (61.5)	1.3 (0.8, 2.1)	-	1.1 (0.7, 1.9)	1.1 (0.6, 1.9)	1.0 (0.6, 1.9)
Body fat							
Obese	10 (27.6)	26 (72.4)	1.0	-	1.0	1.0	1.0
Overfat	38 (35.0)	65 (65.0)	1.4 (0.6, 3.2)	-	2.5 (1.0, 6.7)	2.7 (1.0, 7.2)	**3.9 (1.4, 11.2)***
Normal	114 (48.0)	118 (52.0)	**2.4 (1.1, 5.2)****	-	**3.8 (1.5, 9.5)***	**3.9 (1.5, 10.0)***	**5.1 (1.9, 13.9)***
Underfat	27 (30.7)	56 (69.3)	1.2 (0.5, 2.9)	-	2.5 (1.0, 6.7)	**3.3 (1.1, 9.9)***	**4.2 (1.4, 12.9)***
Depressive Symptoms							
Yes	75 (32.6)	150 (67.4)	1.0	-	-	1.0	1.0
No	119 (41.1)	166 (58.9)	1.4 (1.0, 2.1)	-	-	**1.7 (1.1, 2.6)***	**2.0 (1.2, 3.3)***

'Table 4.15, continued'.

Variables	IADL disability recovery		Unadjusted RR (95% CI)	Model 1	Model 2	Model 3	Model 4
	Yes, n(%)	No, n(%)		RR (95% CI)	RR (95% CI)	RR (95% CI)	RR (95% CI)
Living Arrangements							
Living with spouse	71 (47.0)	79 (53.0)	1.0	-	-	1.0	1.0
Living with spouse and children	93 (34.6)	170 (65.4)	**0.6 (0.4, 0.9)***	-	-	1.0 (0.6, 1.8)	0.8 (0.4, 1.5)
Living with others	6 (17.8)	27 (82.2)	**0.2 (0.1, 0.7)***	-	-	1.0 (0.3, 3.3)	1.4 (0.6, 3.5)
Living alone	24 (37.3)	39 (62.7)	0.7 (0.4, 1.3)	-	-	1.6 (0.7, 3.9)	1.3 (0.4, 4.0)
Self-rated health							
Poor	101 (34.9)	188 (65.1)	1.0	-	-	1.0	1.0
Average	77 (39.4)	117 (60.6)	**3.2 (1.4, 7.4)****	-	-	1.8 (0.6, 5.1)	1.6 (0.5, 5.0)
Good	14 (60.1)	10 (39.9)	**7.3 (2.3, 23.7)****	-	-	**4.7 (1.1, 20.1)***	**4.7 (1.1, 19.8)***
				-	-		
Social support level							
Low	60 (36.0)	99 (64.0)	1.0	-	-	1.0	1.0
High	134 (37.7)	217 (62.3)	1.1 (0.7, 1.6)	-	-	1.1 (0.7, 1.9)	1.1 (0.6, 1.8)
Smoking status							
Smoker	35 (55.0)	21 (45.0)	1.0	-	-	-	1.0
Former Smoker	141 (34.9)	259 (65.1)	**2.3 (1.3, 4.1)***	-	-	-	1.1 (0.5, 2.7)
Nonsmoker	18 (35.1)	36 (64.9)	2.3 (1.0, 5.1)	-	-	-	1.0 (0.3, 3.0)

'Table 4.15, continued'.

Variables	IADL disability recovery		Unadjusted RR (95% CI)	Model 1	Model 2	Model 3	Model 4
	Yes, n(%)	No, n(%)		RR (95% CI)	RR (95% CI)	RR (95% CI)	RR (95% CI)
Physical activity level							
Low	37 (20.0)	146 (80.0)	1.0	-	-	-	1.0
High	135 (45.3)	152 (54.7)	**3.3 (2.1, 5.1)****	-	-	-	**2.3 (1.3, 4.3)****

Model 1 adjusted for age, sex, ethnicity, education, income level and marital status.
Model 2 adjusted for all covariates from Model 1plus health variables (CVD, DM, arthritis, cognitive impairment, visual impairment, chronic pain, history of fall and obesity).
Model 3 adjusted for all covariates from Model 2plus depressive symptoms, living arrangement, self-rated health and social support.
Model 4 fully adjusted model (adjusted for all covariates from Model 3 plus smoking and physical activity level).
[1]reference group: with disease.
*p-value <0.05
**p-value <0.01

4.4.3.3 Recovery from ADL Disability

Table 4.16 shows the unadjusted and adjusted relative risks (RRs) of the analyses for the outcome of recovery from ADL disability. In univariate analysis, the variables that had significant unadjusted RRs for recovery from ADL disability were younger age group, elderly without visual problem, normal cognitive function and high physical activity level.

In model 1, only one variable was significant which was elderly with at least primary education. In model 2, the above mentioned variable became insignificant. The only significant variable in model 2 was chronic pain. In model 3, the only significant risk factor for ADL disability recovery was elderly without depression. In the fully adjusted model (model 4), no arthritis, normal cognitive status, no depressive symptoms, average to good self-rated health and those elderly with high physical activity level were the significant variables for ADL disability recovery.

In the analysis of risk factors for recovery from ADL disability, a few adjustments in the model had been made. In the first model, ethnicity had been removed because during the baseline data collection, only six elderly from other ethnic group were ADL-disabled and only three people responded for the second follow up. All those three elderly (2 Chinese, 1 Indian) had recovered from ADL disability. For Malay elderly, 47 people (42.4%) had recovery in their ADL function and 56 (57.6%) remained disabled. Variables such as educational level, age groups, living arrangements, income level, smoking status, self-rated health status and obesity had been recoded into new categories due to small sample size in certain variables categories.

Elderly who received high social support and rated their health as average to very good were three times more likely to recover from ADL disability compared to their counterparts. Elderly without degenerative disease (ie arthritis) were four times

more likely to recover from ADL disability. Depressive symptoms and cognitive function were important variables where those elderly without depressive symptoms and had normal cognitive function were five to six times more likely to recover from ADL disability. Another important variable was physical activity level. Elderly who had high level of physical activity were 8.5 times more likely to recover from ADL disability compared to those with low physical activity level.

Table 4.16: Risk factors associated with incidence of recovery from ADL disability at twelve months of follow up (n=120)

Variables	ADL disability recovery		Unadjusted RR (95% CI)	Model 1	Model 2	Model 3	Model 4
	Yes, n(%)	No, n(%)		RR (95% CI)	RR (95% CI)	RR (95% CI)	RR (95% CI)
Gender							
Female	25 (51.1)	22 (48.9)	1.0	1.0	1.0	1.0	1.0
Male	18 (60.6)	11 (39.4)	1.5 (0.6, 3.5)	1.2 (0.4, 3.5)	1.3 (0.4, 4.7)	1.1 (0.2, 4.8)	1.6 (0.3, 7.4)
Level of education							
No formal education	6 (38.8)	8 (61.2)	1.0	1.0	1.0	1.0	1.0
At least primary education	37 (59.2)	25 (40.8)	2.3 (1.0,.5.3)	**3.3 (1.2, 9.1)***	2.5 (1.0, 6.0)	2.8 (0.9, 8.9)	1.9 (0.7, 5.8)
Age group (years)							
80 and above	11 (45.3)	13 (54.7)	1.0	1.0	1.0	1.0	1.0
70-79	20 (54.2)	15 (45.8)	1.4 (0.6, 3.3)	1.2 (0.5, 3.0)	1.5 (0.6, 3.8)	2.0 (0.6, 7.2)	2.3 (0.5, 9.8)
60-69	12 (69.8)	5 (30.2)	**2.8 (1.2, 6.5)***	2.6 (0.7, 9.5)	3.7 (0.8, 15.8)	3.6 (0.7, 17.9)	1.3 (0.3, 4.9)
Marital status							
Married	26 (59.7)	18 (40.3)	1.0	1.0	1.0	1.0	1.0
Others	17 (48.4)	15 (51.6)	0.6 (0.3, 1.4)	0.8 (0.2, 2.8)	0.6 (0.2, 2.2)	0.9 (0.3, 2.8)	1.0 (0.4, 2.3)
Household income							
≤ RM499	23 (49.9)	21 (50.1)	1.0	1.0	1.0	1.0	1.0
RM 500-999	8 (51.5)	7 (48.5)	1.1 (0.4, 3.0)	0.7 (0.2, 2.5)	0.6 (0.2, 2.5)	0.9 (0.2, 3.7)	0.4 (0.1, 1.6)
≥ RM 1000	11 (27.9)	5 (15.3)	2.2 (0.8, 5.9)	2.1 (0.8, 5.3)	1.4 (0.5, 4.4)	1.3 (0.4, 4.8)	1.3 (0.2, 10.3)

'Table 4.16, continued'.

Variables	ADL disability recovery		Unadjusted RR (95% CI)	Model 1	Model 2	Model 3	Model 4
	Yes, n(%)	No, n(%)		RR (95% CI)	RR (95% CI)	RR (95% CI)	RR (95% CI)
Presence of chronic disease[1]							
Cardiovascular disease	18 (50.4)	16 (49.6)	2.0 (0.7, 5.7)	-	1.2 (0.3, 6.1)	2.3 (0.5, 10.5)	1.9 (0.6, 6.0)
Diabetes mellitus	30 (56.2)	21 (43.8)	1.2 (0.5, 2.6)	-	1.0 (0.4, 2.9)	1.1 (0.3, 3.7)	1.9 (0.4, 8.8)
Arthritis	29 (57.7)	18 (42.3)	1.4 (0.6, 2.9)	-	1.1 (0.4, 3.3)	1.2 (0.5, 3.3)	**4.0 (1.2, 13.3)***
Cognitive Assessment							
Impaired	28 (48.9)	48 (51.1)	1.0	-	1.0	1.0	1.0
Normal	15 (72.2)	5 (27.8)	**2.7 (1.2, 6.0)***	-	0.7 (0.2, 2.7)	2.2 (0.5, 10.5)	**5.6 (1.6, 19.0)***
Visual problem							
Yes	17 (42.4)	22 (57.6)	1.0	-	1.0	1.0	1.0
No	26 (69.1)	11 (30.9)	**3.0 (1.4, 6.7)****	-	2.0 (0.9, 4.4)	2.3 (0.9, 5.6)	1.9 (0.7, 4.9)
Chronic Pain							
Yes	18 (49.2)	19 (50.8)	1.0	-	1.0	1.0	1.0
No	25 (60.5)	14 (39.5)	1.6 (0.8, 3.0)	-	**2.2 (1.1, 4.5)***	2.2 (1.0, 4.8)	2.6 (0.9, 7.9)
History of fall							
Yes	15 (64.8)	9 (35.2)	1.0	-	1.0	1.0	1.0
No	28 (51.7)	23 (48.3)	1.7 (0.7, 4.3)	-	2.7 (0.7, 10.1)	2.7 (0.6, 11.7)	3.6 (0.8, 16.7)

'Table 4.16, continued'.

Variables	ADL disability recovery		Unadjusted RR (95% CI)	Model 1	Model 2	Model 3	Model 4
	Yes, n(%)	No, n(%)		RR (95% CI)	RR (95% CI)	RR (95% CI)	RR (95% CI)
Body fat[#]							
Obese and overfat	26 (47.7)	27 (52.3)	1.0	-	1.0	1.0	1.0
Normal	17 (70.1)	6 (29.9)	2.6 (1.0, 6.7)	-	2.0 (0.7, 6.2)	1.7 (0.6, 5.3)	2.0 (0.6, 7.0)
Depressive Symptoms							
Yes	18 (46.9)	20 (53.1)	1.0	-	-	1.0	1.0
No	25 (63.1)	13 (36.9)	1.9 (0.8, 4.8)	-	-	**3.8 (1.1, 12.9)***	**4.5 (1.1, 18.9)***
Living Arrangements							
Living with spouse	14 (69.3)	7 (30.7)	1.0	-	-	1.0	1.0
Others living arrangements	29 (50.0)	26 (50.0)	0.4 (0.2, 1.1)	-	-	0.4 (0.1, 1.9)	0.4 (0.1, 3.3)
Self-rated health							
Poor	23 (47.3)	27 (52.7)	1.0	-	-	1.0	1.0
Average to good	20 (69.5)	6 (30.5)	2.5 (1.0, 6.3)	-	-	1.5 (0.6, 4.0)	**2.7 (1.1, 6.7)***
Social support level							
Low	15 (45.8)	17 (54.2)	1.0	-	-	1.0	1.0
High	28 (62.8)	16 (37.2)	2.0 (0.9, 4.3)	-	-	1.8 (0.8, 3.9)	2.5 (1.0, 6.2)

'Table 4.16, continued'.

Variables	ADL disability recovery		Unadjusted RR (95% CI)	Model 1	Model 2	Model 3	Model 4
	Yes, n(%)	No, n(%)		RR (95% CI)	RR (95% CI)	RR (95% CI)	RR (95% CI)
Smoking status							
Smoker & former smoker	13 (57.5)	9 (42.5)	1.0	-	-	-	1.0
Nonsmoker	30 (53.9)	24 (46.1)	1.2 (0.5, 2.8)	-	-	-	1.3 (0.5, 3.2)
Physical activity level							
Low	24 (44.6)	27 (55.4)	1.0	-	-	-	1.0
High	14 (82.7)	3 (17.3)	**6.0 (2.3, 15.4)****	-	-	-	**8.5 (3.0, 24.4)***

Model 1 adjusted for age, sex, education, income level and marital status.
Model 2 adjusted for all covariates from Model 1plus health variables (CVD, DM, arthritis, cognitive impairment, visual impairment, chronic pain, history of fall and obesity).
Model 3 adjusted for all covariates from Model 2plus depressive symptoms, living arrangement, self-rated health and social support.
Model 4 fully adjusted model (adjusted for all covariates from Model 3 plus smoking and physical activity level).
[1]reference group: with disease.
[#]Underfat was removed due to very sample size.
*p-value <0.05
**p-value <0.01

4.5 Subtypes of disability among study population

A total of 1000 participants were randomly chosen from the 2405 elderly who participated in this study at baseline and received three monthly telephone interviews to assess for subtypes of ADL physical disability. Out of the 1000 participants, 875 (87.5%) were included in the analysis of disability subtypes. A total of 618 (70.6%) participants completed all the five assessments which were two home-based assessments (at baseline and 12 months) and three telephone interviews (at 3rd, 6th and 9th months). Total loss to follow up was 257 participants (29.4%).

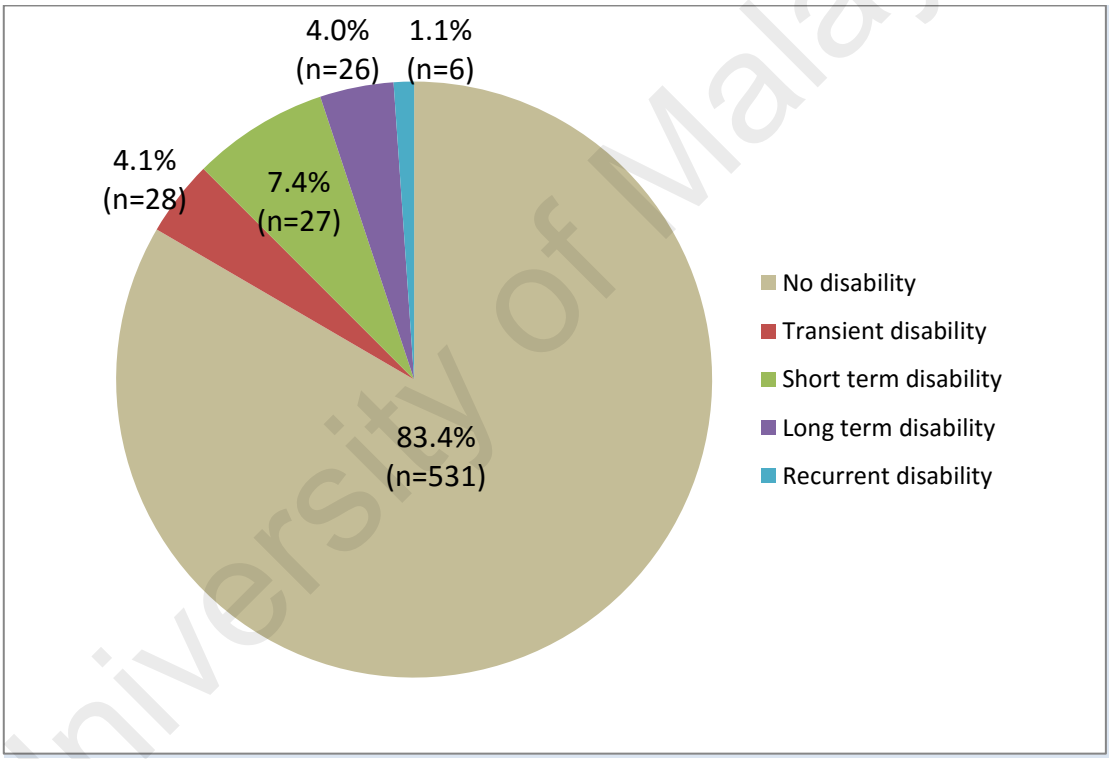


Figure 4.3: Distribution of disability subtypes at 12 months in weighted percentages (n=618).

As shown in Figure 4.3, a total of 531 participants had no disability at all during the 12 months duration, 28 participants had transient disability, 27 had short term disability, 26 had long term disability and 6 participants had recurrent disability.

4.5.1 Descriptive characteristics of the participants according to the disability subtypes

Description of socio-economic characteristics, health related variables and chronic diseases of the participants according to disability subtypes are documented in Table 4.17. Among 531 elderly who had no disability throughtout the 12 months interval, 89% (n=520) were Malay, 4.5% (n=5) were Chinese, 6.1% (n=4) were Indian and 0.4% (n=2) were Other ethnic group. In this group, 57.9% (n=325) of elderly received primary education, 29.2% (n=136) had secondary education, 10.1% (n=59) had no formal education and 2.9% (n=8) received tertiary education.

For transient (n=28) and long term (n=26) disability, all the participants were Malay. In the short term disability category, only one (3.4%) participant was Indian and 26 (96.6%) participants were Malay. Similarly for recurrent disability, only one (21.5%) participant was Chinese and five (78.5%) were Malay. The largest percentage of elderly in transient, short term and long term disability had received at least primary education. In recurrent disability category, half of the elderly participants had no formal education and the other half received at least primary education. There was significant difference in the proportion of level of education among disability subtypes ($p<0.05$).

About half of the participants with transient disability were among elderly aged 70-79 years. For the short term disability, majority of the elderly participants were among those aged 60 to 79 years. Almost half of the elderly with long term disability were among those in the younger age group (60-69 years) in contrast with recurrent disability where half of the elderly were from the oldest age group (80 years and above). There was significant difference in the proportion of age groups among disability subtypes ($p< 0.01$).

More than half of the elderly participants who had transient and recurrent disability were cognitively impaired. This was in contrast with the other two groups (short and long term disability) where more than two third still had intact cognitive

function. There was significant difference in the proportion of cognitive function status among disability subtypes ($p=0.042$). There were no significant differences in the proportion found between other variables (gender, social support level, physical activity level, depressive symptoms, visual impairment and chronic diseases) and disability subtypes ($p>0.05$).

Table 4.17: Descriptive characteristics of the study participants according to the disability subtypes among elderly reported disability (n=87)

Variables	Transient disability (n=28) n, %	Short term disability (n=27) n, %	Long term disability (n=26) n, %	Recurrent disability (n=6) n, %	Chi-square	p-value
Gender						
Male	9 (28.9)	13 (31.9)	10 (48.5)	1 (15.8)	2.751	0.853
Female	19 (71.1)	14 (68.1)	16 (51.5)	5 (84.2)		
Age group						
60-69	12 (42.9)	13 (48.1)	12 (46.2)	1 (16.7)	18.074	**0.006**
70-79	14 (50.0)	13 (48.1)	5 (19.2)	2 (33.3)		
≥ 80	2 (7.1)	1 (3.7)	9 (34.6)	3 (50.0)		
Educational level						
At least primary education	25 (89.3)	26 (96.3)	22 (84.6)	3(50.0)	9.806	**0.020**
No formal education	3 (10.7)	1 (9.1)	4 (15.4)	3 (50.0)		
Cognitive Assessment						
Normal	12 (44.4)	19 (79.2)	15 (62.5)	2 (33.3)	8.169	**0.042**
Impaired	15 (55.5)	5 (20.8)	9 (37.5)	4 (66.7)		

'Table 4.17, continued'.

Variables	Transient disability (n=28) n, %	Short term disability (n=27) n, %	Long term disability (n=26) n, %	Recurrent disability (n=6) n, %	Chi-square	p-value
Social support						
High	20 (71.4)	19 (76.0)	21 (87.5)	2 (40.0)	5.545	0.136
Low	8 (28.6)	6 (24.0)	3 (12.5)	3 (60.0)		
Physical activity level						
High	14 (53.8)	21 (87.5)	15 (60.0)	4 (66.7)	7.111	0.068
Low	12 (46.2)	3 (12.5)	10 (40.0)	2 (33.3)		
Depressive Symptoms						
No	17 (63.0)	18 (66.7)	13 (50.0)	4 (80.0)	2.492	0.477
Yes	10 (37.0)	9 (33.3)	13 (50.0)	1 (20.0)		
Visual impairment						
No	14 (50.0)	16 (59.3)	10 (38.5)	3 (50.0)	2.299	0.513
Yes	14 (50.0)	11 (40.7)	16 (61.5)	3 (50.0)		

'Table 4.17, continued'.

Variables	Transient disability (n=28) n, %	Short term disability (n=27) n, %	Long term disability (n=26) n, %	Recurrent disability (n=6) n, %	Chi-square	p-value
Chronic diseases						
Cardiovascular disease	18 (64.3)	17 (63.0)	19 (73.1)	4 (66.7)	0.719	0.869
Diabetes mellitus	6 (22.2)	6 (22.2)	9 (34.6)	3 (50.0)	2.905	0.407
Arthritis	8 (28.6)	6 (22.2)	11 (42.3)	2 (33.3)	2.618	0.454

Multivariate analysis not conducted due to small sample size.

CHAPTER 5: DISCUSSION

About the chapter

In this chapter, the discussion is in accordance with the study objectives and the result of the study. The discussion chapter comprises five sections. The findings of this study are highlighted and comparisons with the previous studies are included. The last part of this chapter discusses the strengths and limitations of the present study.

5.1 Characteristics of study population

5.1.1 Socio-demographic characteristics of the study population

The mean age of the study participants was 70.92 years with standard deviation of 7.7 years. The average age of the study population was comparable with the current average life expectancy in Malaysia which is 72.3 years for male and 77.2 for female (Zawawi, 2013). This vital statistic showed that women live longer than men reflecting the "feminization" phenomenon of ageing that leaves many women alone in old age. In this study, approximately two-thirds were females. The "feminization" phenomenon was similar to many studies on elderly in other countries (Abdulraheem et al., 2011; Graciani et al., 2014; Busch et al., 2015).

Malaysian citizens consist of multi-ethnic groups which are Bumiputera (67.4%), Chinese (24.6%), Indian, (7.3%) and Others (0.7%) (Department of Statistics, 2010). Malay was the predominant ethnic group in Peninsular Malaysia which constituted about 63.1%. Majority of the study participants were among Malay elderly which was about 95.7% and fewer representatives from Chinese and Indian elderly (less than 2%). This ethnic composition reflects the rural population based on the 2010 National Census data. The proportion of elderly participants according to ethnicity found in this study was also similar with the study conducted by Wan Ahmad and colleagues (2011) among rural elderly in Malaysia.

In Malaysia, elderly are defined as those who are 60 years and above. The study participants were basically born before 1956. As they were born before Malaysia's Independence Day, majority of the study participants (60.8%) received only primary education. About 65.5% of the elderly reported of having household income less than RM1000 per month, this was either their true income which was a reflection of lower educational level or possibly under-reporting of their income especially those living with their children. Perhaps the elderly did not know the exact income of their children.

As age increased, the proportion of elderly who participated in this study decreased. As most study participants were in the younger category, most of them were still married (62.0%) and lived with either their spouse (33.8%) or with their spouse and children (47.8%).

5.1.2 Health status, lifestyle behaviour and social support of the study population

In Malaysia, mortality rates among the elderly group are on the decline, which means there will be more elderly group in the coming decades (Bujang et al., 2012). However, increase in life expectancy and number of elderly result in increasing number of chronic diseases. In this study, cardiovascular disease (45.4%) was the most prevalence chronic disease among the study population. This was followed by diabetes mellitus (26.9%) and arthritis (20.7%). This finding was comparable with previous literature where the most common chronic diseases reported among elderly in Malaysia were cardiovascular and metabolic diseases (Latiffah et al., 2006). This study also found that the prevalence of arthritis was comparable with the prevalence reported by the National Health and Morbidity Study (NHMS) in 2011 where 19.2 % of elderly had reported having arthritis.

The increasing prevalence of chronic diseases among elderly can be explained partially, by the existence of modifiable risk factors, of which smoking is the most

important (Desai et al., 1999). Elderly smokers present higher mortality risk for cancer and cardiovascular disease (WHO, 2012), compared to those who never smoked. Smoking also reduces the quality of life for elderly because it was associated with poorer health status (Tomioka et al., 2014). In this study, the overall prevalence of current elderly smokers was 12.9% where 93.2% were male smokers and 6.8% were female smokers. The prevalence of elderly smokers found in this study was lower compared to the younger population in Malaysia (NHMS, 2011). This pattern is similar with other study where they also found the prevalence of smoking among elderly was lower than that observed in the younger age groups (Peixoto et al., 2005). This probably occurs as a consequence of cessation of the smoking habit with increasing age and/or premature death of smokers (Tomioka et al., 2014).

Visual impairment is common among elderly. The visual impairment increases in frequency with advancing age. The prevalence of visual impairment among Malaysian population (age 18 years and above) as reported by our National Eye Survey in 1996 was 2.73%. Recent study by Thevi and colleagues (2012) found prevalence of visual impairment among general population was 8.2%. There was an exponential increase of visual impairment after the age of 40 years. A total of 48% of visually impaired people were aged 60 years and above (Central Research Committee, 1996). The present study found that 39.8% of elderly reported as having visual impairment.

Prevalence of depression among the elderly varies in different settings. A study in 1999 showed that the prevalence of depression among Malaysian elderly patients attending a primary health care clinic was 18% (Sherina et al., 2003). In this study, the prevalence of depression (38.7%) was higher compared to prevalence found by Izzuna and colleagues (2006) in their cross-sectional study among community living elderly (27.8%). Another study conducted among elderly attending eye clinic in a tertiary hospital also reported lower prevalence of depression which was 20.8% (Hairi et al.,

2009). As Malaysia's population ages, the depressive condition became more severe over the years; hence the increase in the prevalence of depression in the current study. Another reason of high prevalence of depression in this study was due to high proportion of elderly participants having visual impairment. This pattern was similar with previous study findings in Netherlands where they found 29.6% prevalence of depression and a 39.8% prevalence of probable depression among patients attending a low vision clinic (Mogk et al., 2000). Depressive symptoms was found to be associated with disability in both cross sectional studies (Hairi et al., 2010; Feng et al., 2013) and cohort study (Tas et al., 2007).

Chronic pain was another common problem among the elderly in Malaysia and was associated with higher hospitalization rate (Mohamed Zaki et al., 2014). Prevalence of chronic pain among elderly Malaysian from NHMS III data was 15.2% (95% CI: 14.5, 16.8) (Mohamed Zaki et al., 2014) which was lower than the prevalence of chronic pain found in this study (22.2%). Prevalence of chronic pain increased with advancing age, and the highest prevalence in this study was seen among the oldest age group category which was 21.5%.

Cognitive impairment is a common psychiatric problem among the elderly. Cognition declines with older age. Prevalence of dementia which was characterised by a decline in memory, language and other cognitive functions was high in the older population (Keskinoglu et al., 2006). In a local study involving 428 elderly, the prevalence of cognitive impairment was 11% as measured by Elderly Cognitive Assessment Questionnaire or ECAQ (Rashid et al., 2012). The prevalence of cognitive impairment found in the present study was higher possibly due to different measurement tool and population studied.

Prevalence of falls among the elderly varies in different settings. The prevalence of falls has been reported as high as 78% in long-term care facility residents with

diabetes (Maurer et al., 2005) and as low as 13.5% in community dwelling elderly who participated in the Cooperative Health Research in the Region of Augsburg (KORA) study (Helbig et al., 2013). In this study, 17.1% of elderly reported of having falls for the past 12 months. This was higher compared to the KORA study but comparable with the prevalence of falls among elderly in another local study which was 18.8% (Azidah et al., 2012).

A cross sectional study conducted in Malaysia reported about 41.5% of elderly with type 2 diabetes mellitus had low levels of physical activity (Shazwani et al., 2010). The prevalance reported in that study was higher compared to this study which was 27.3% due to usage of different tools in assessing physical activity level and higher proportion of elderly participants were diabetic. Status of cognitive function (Ngai et al., 2012) and degenerative disease such as osteoarthritis (Svege et al., 2012) were among the factors that can affect physical activity level.

More than two-third of the participants in this study reported having high social support level. Social support has been found to play an important role in health and well-being, especially in elderly people (Pachana et al., 2008). Higher social support among elderly has been associated with better physical and mental health and reduced mortality risk (Gray et al., 2012; Uchino, 2006).

5.2 Prevalence and associated factors of functional limitation and physical disability

5.2.1 Prevalence of functional limitation

The overall prevalence of functional limitation was 62.8%. The prevalence of functional limitation found in this study was higher compared to the range of prevalence found in previous studies conducted both in developing countries (range from 19.5% to 54.9%) and developed countries (ranged from 26.3% to 51.6%) as reported in Chapter 2. The reason for the difference in the prevalence rates maybe due to different

assessment tools being used in the studies. It was observed that among studies that used either self-reported items or single assessment to measure functional limitation, they usually reported higher prevalence rates compared to studies that used multiple objective assessments. In this study, only one assessment was used to measure functional limitation which was 4 metres walking speed test.

The prevalence of functional limitation increased with advanced ages and similar findings were reported by others (Hairi et al., 2010; Abdulraheem et al., 2011). In this study, the prevalence was highest among elderly aged 75-79 years but decreased in elderly aged 80 years and above. This pattern is contributed mainly from elderly female where similar prevalence pattern was noted among them but not for elderly men; where the highest prevalence of functional limitation was among oldest age group, those aged 80 years and above. The reason for this pattern was uncertain but it could be postulated. Perhaps, some of the elderly women aged 80 years and above that participated in this study were healthier hence they were able to maintain normal walking speed.

5.2.2 Prevalence of physical disability

The overall prevalence of ADL disability was 7.1% and IADL disability was 32.7%. The prevalence of ADL disability was within the range of prevalence found from previous studies conducted in developing countries (range from 6.5% to 24.7%) but lower from the prevalence range reported by studies from developed countries (range from 13.1% to 34.6%). This was possibly due to the fact that most studies conducted in developed countries usually involved much older participants (aged 65 years and above). The prevalence of IADL disability was within the range of the prevalence reported by previous studies in both developing (range from 7.9% to 33.0%) and developed countries (range 11.8% to 53.5%).

In the previous studies that measured both ADL and IADL disability, they found that the prevalence of disability measured by IADL items was higher than disability measured by ADL items (Seino et al., 2012; Graciani et al., 2003; Busch et al., 2015). Similar finding was observed in this study. This might be explained by the fact that ADL represents severe form of disability which was basic physiological functions of human beings which generally were preserved longer. IADL represents the moderate form of disability and usually became the first to be affected if any event or disease occurred.

5.2.3 Prevalence of physical disability in each item of the IADL and ADL

The prevalence of disability for each IADL items found in this study was comparable with the prevalence found in the Taiwan study that ranged from 16.8% to 24.7% (Hu at al., 2012). About 22.5% of the elderly participants in this study had difficulty in shopping groceries which was the highest prevalence among IADL items. This finding was in contrast with the finding reported by Hu and colleagues (2012) where they found that the highest prevalence was difficulty in transport outdoors (24.7%). The reason for this difference was unknown but most likely due to different characteristics of the study population. However, similar findings were noted where difficulty in taking own medication was the least prevalent. This study found no difference in the prevalence of all IADL disability items between men and women. Contrary with the finding by Hu and colleagues (2012), they noted women had a higher proportion of IADL disability in 5 IADL items (responsibility for own medication, ability to handle finances, shopping, transport outdoors and use of telephone).

The prevalence of disability for each ADL items found in this study was also comparable with the prevalence reported by Hu and colleagues (2012) that range between 7% to 9.3%. In contrast with the finding of this study, Hu and colleagues

(2012) found difficulty in chair/bed transfers was the most prevalence (9.3%) and the least prevalent of ADL disability item was difficulty in feeding (7.0%). This study showed no statistically significant difference in the prevalence of each ADL disability item between male and female (similar with finding noted by Hu and colleagues, 2012) except for urine and bowel incontinence. The prevalence of urine and bowel incontinence was higher in elderly male compared to female. The reason possible due to majority of elderly male in this study reported having all six-ADL items disability which means that they were already had severe ADL disability.

5.3 Incidence of functional limitation and physical disability and its risk factors at twelve months follow-up

5.3.1 Incidence of functional limitation

The overall incidence of functional limitation found in the present study was 38.4%. The incidence of functional limitation in the present study was lower compared to the range reported by one study from developing countries (51.9% to 82%) that examined the incidence of functional limitation among elderly with different frailty status. However, the incidence rate in this study was higher compared to those studies from developed region (range from 5.8% to 33.9%). The reason could be due to lower physical activity level among our elderly participants.

As mentioned earlier, comparison of incidence rates across studies was difficult due to variation in definition, measuring tools and duration of study. At this point, we were unable to compare the incidence rates of functional limitation as there were no reported or published studies that examine the incidence of functional limitation conducted in Malaysia yet. Only one study from developing countries reported on incidence of functional limitation. Most studies conducted in developed region usually involved much older elderly population and longer period of follow up.

Similar with the finding in the prevalence pattern, the incidence of functional limitation increased with age until age 75-79 years and decreased among oldest old elderly (80 years and above). Again the reason for this pattern was unknown but perhaps, the same reason applied for both prevalence and incidence pattern where elderly who able to reach age 80 years and above were healthier thus they were able to maintain lower limbs strength.

5.3.2 Incidence of physical disability

The overall incidence of ADL disability was 4.8% and IADL disability was 24.8% at twelve months of follow up. The incidence of ADL disability was comparable with the range of incidence reported by studies from developed region (3.9% to 52.1%) but lower compared to those from other developing countries (11% to 15.3%). The incidence of IADL disability was comparable with the incidence range reported by studies from both developing and developed countries.

Previous literature also found that rates of disability vary by country - less than 1% in Kenya and Bangladesh, 20% in New Zealand (Mont, 2007), and 19% in Latin America and the Caribbean (Rose et al., 2008). The low disability rates reported in poor countries such as Kenya and Bangladesh either reflect the true scenario as most of their people might be involved in more physically demanding jobs (labour) or they might underestimate the disability rate due to lack of health care services provided.

Similarly, comparing incidence rates of ADL and IADL disability was difficult due to different age group of elderly being used as study population, different data collection strategies and also the duration of follow up of the cohort studies.

5.3.3 Risk factors associated with the incidence of functional limitation and physical disability

In this study, the risk of having functional limitation at twelve months of follow up increasing with advanced age. Functional limitation was measured by walking speed test and walking speed was reduced with increasing age. Similar findings were noted by other studies, reduced walking speed occurred with age (Tolea et al., 2010; Ko et al., 2010; Busch et al., 2015) even among the healthy elderly (Watson et al., 2010), and it had a significant impact on one's health and quality of life (Watson et al., 2010; Teixeira-Leite et al., 2012). The change in gait speed was associated with physiological factors (Teixeira-Leite et al., 2012), behavioural factors (Thal et al., 2004), and the presence of diseases (Studenski et al., 2011).

Similar with functional limitation, advancing age increased the risk of having both ADL and IADL disability. Among those elderly, the oldest age group were more likely to experience disability than the young elderly (WHO, 2003). Factors intrinsic to the ageing process, such as sarcopenia and gait disturbances, also have strong effects on the development of disability and declining mobility in elderly people (Santos, 2012).

For physical disability, women also experienced more disability in old age than do men which was similar with findings in other countries (Jagger et al., 2007a; Chappell et al., 2008; Sagardui-Villamor et al., 2005; der Wiel et al., 2001 and Andrade, 2009). Gender differences in functional limitation and physical disability were more frequently observed in older women. Decline in functional performance in ageing may be originally related to biologic variables as muscle fiber type-specific characteristics, circulating hormone concentrations, skeletal muscle mass and strength, and it was different between men and women (Verdijk et al., 2010). These effects on gait are most pronounced in women (Graf et al., 2005; Lang et al., 2009).

In this study, low level of education was consistently found to be associated with incidence of functional limitation and physical disability. The reason for this

association possibly due to low educational level may be interpreted as a proxy for characteristics such as low income or adverse life conditions or limited access to prevention and rehabilitation programs (Carriere et al., 2005; Alexandre et al., 2012; Manton et al., 1997).

Malay elderly were found to have lower risk of having ADL disability at 12 months of follow up compared to other ethnicities (Chinese, Indian and Aboriginal). However this study was unable to determine the specific risk for each ethnicity. In the previous local study (Hairi et al., 2010), the investigators specifically found elderly Indians had the highest prevalence of self-reported physical disability followed by Malays and Chinese. This finding was similar with other international studies on ethnic variation and disability (Ng et al., 2006; Koster et al., 2006; Kelly-Moore et al., 2004). The reason for differences of disability risk found among our ethnic groups is unknown, however Hairi and colleagues (2010) suggested that it might be related with occupational history. Majority of older Indians had worked as manual unskilled workers mainly in the rubber plantations (Hairi et al., 2010). Being unskilled and labour worker reflects on their low educational and socioeconomic status which not only limit their knowledge on availability of curative and preventive medical programs but also accessibility to the health care services.

Elderly who lived alone had higher risk of having both ADL and IADL disability at 12 months of follow up. The association between living alone and disability was similar with the finding in the study conducted by Lee and colleagues (2011). The possible explanation was because elderly who lived alone had less support from other people and may experience demands that exceed their coping resources. This imbalance ultimately affects their health and even functional status.

In this study, cardiovascular disease was a risk factor for incidence of ADL disability. Cardiovascular disease includes hypertension, stroke, myocardial infarction

and angina. Elderly with hypertension were found to have increased risk of having physical disability as reported by Charleston Heart Study (Hajjar et al, 2007) where they found that concurrent and remote systolic blood pressure increases were associated with greater rates of decline in functional abilities. Stroke was found to be associated with physical disability in both cross sectional studies (Hairi et al., 2010; Abdulraheem et al., 2011) and cohort studies (Tas et al., 2007; Alexandre et al., 2012). Occurrence of stroke can lead to either temporary or permanent disability among elderly people depending on the severity of the stroke event.

Cognitive impairment was found to be associated with the incidence of functional limitation. Recent study by Tolea and colleagues (2015) found physical function status was better predicted by baseline cognitive impairment. The model proposed by Nagi suggests that cognitive impairments may be implicated in the process leading to development of disability by increasing the risk of functional limitations (e.g. reduced mobility) which in turn may lead to impairment in the ability to perform ADLs (disability) (Nagi, 1965).

Elderly smokers were found to have higher risk of having IADL disability at 12 months follow up in the present study. Smoking was found to be an important contributing factor to loss of function, mobility and independence among elderly population (Schmitt et al., 2005). The possible mechanism was because smoking was associated with age-related diseases in elderly such as cardiovascular disease, cancer and osteoporosis (Cataldo, 2003; Bernhard et al., 2007) and has been shown to decrease physical strength and performance in this population.

The present study also found significant association between low physical activity level with incidence of ADL and IADL disability. Randomized controlled trials in adults showed that increased physical activity was effective in reducing disability (Pennix et al., 2001; Martin et al., 2009). Elderly who practice healthy lifestyles, avoid

sedentariness, participate in physical exercise (e.g., walking, strength training, or self-adjusted physical activity) were more likely to remain healthy, live independently, and incur fewer health-related costs (Dunlop et al., 2011). Improvements in lifestyle and health behaviour such as greater physical activity (Fries, 2002; Hubert et al., 2002) can help prevent CVD and diabetes, all of which are related to disability in later life. Physical activity also improves muscle strength and protect against the metabolic syndrome thus reducing the incidence of physical disability (Lang et al., 2007).

5.4 Incidence of recovery from functional limitation and physical disability and its risk factors at 12 months follow-up

5.4.1 Incidence of recovery from functional limitation

The overall incidence of recovery from functional limitation at twelve months of follow up was 31.5%. The incidence of recovery from functional limitation was comparable with the findings of Fujita and colleagues, (2006) study in Japan. Their study reported the incidence of recovery ranged from 15% to 46% among elderly with different levels of physical activity.

The incidence of recovery from functional limitation was greater in the youngest and elderly male. The incidence of functional limitation recovery decreased in the more advanced age group. The lowest incidence was found among elderly aged 75-79 years. However, the incidence of recovery increased again among the oldest elderly (80 years and older). This pattern is again contributed mainly by elderly female where similar incidence pattern was noted among them but not among elderly men; where the lowest incidence of recovery was among the oldest (80 years and above). This result is in accordance with the findings in the prevalence and incidence pattern. The most possible reason for the prevalence and incidence pattern of functional limitation observed in this study might be due to higher incidence of recovery among elderly female aged 80 years

and above leading to lower prevalence and incidence of functional limitation among this group of elderly.

5.4.2 Incidence of recovery from physical disability

The overall incidence of recovery from ADL disability was 43.9% and IADL disability was 34.2% at twelve months of follow up. The rate of recovery from ADL disability found in this study was much higher than those that had been reported in previous studies (Manton et al., 1988; Gill et al., 1997; Katz et al., 1983) but lower than the study conducted by Hardy and colleagues (2004) where 81% of their study participants recovered within 12 months of their initial disability episode. For IADL disability, the incidence of recovery was within the range of recovery from 22% to 33.6% as reported by Fujita and colleagues (2006).

The incidence of recovery from IADL disability and ADL disability was also greater in the younger elderly (age less than 70 years) and elderly male. The incidence of recovery from IADL and ADL disability decreased with advancing age and the lowest incidence was among the oldest (80 years and above) participants. Similar pattern was observed among elderly female and male except the lowest incidence of ADL disability recovery in elderly male was seen among those aged 75-79 years. The reason for observed incidence of ADL disability recovery pattern among elderly male was unclear as this study did not examine the detail aspects of treatment and rehabilitation received by these elderly people.

5.4.3 Risk factors associated with incidence of functional limitation and physical disability recovery

This study found that younger age groups had higher risk of recovery from functional limitation and IADL disability similar with others (Becket et al., 1996; Siedel et al., 2009; d'Orsi et al., 2014). The more advanced the age or the more items that

showed functional disability, the greater the possibility of becoming permanently disabled and the lesser the chance to restore their function (Becket et al., 1996).

In this study, elderly male is more likely to recover from functional limitation and IADL disability similar with others (d'Orsi et al., 2014; McMunn et al., 2009). Siedel and colleagues (2009) in their Medical Research Council Cognitive Function and Ageing Study (MRC CFAS) also found that women were less likely to recover from physical disability. The possible explanations include: elderly women were at a disadvantage because of lack of education which was associated with low income and poverty, lower standards of living and less frequent use of health and medical care services.

This study found significant association between elderly with primary education and higher incidence of recovery from IADL disability compared to those with no formal education. Lack of education was known to be associated with low socioeconomic status which was found to be correlated with disability (Koster et al., 2006). Jagger and colleagues (2007b) also found that differences in educational level contribute to the prevalence of disability. In this study, the reason why those elderly with primary education were more likely to recover from IADL disability compared to those without formal education was possibly due to the fact that they had more advantages in term of having higher income, less physically demanding jobs and more accessibility to health and rehabilitative care services compared to those with no formal education.

The present study found elderly without chronic diseases such as diabetes, cardiovascular disease and arthritis had higher chance to recover from functional limitation and physical disability. Siedel and colleagues (2009) found that elderly having two co-morbidities or more were least likely to recover. Diabetes mellitus was

responsible for losing IADL and difficulty in recovering function, as it took almost twice as long to reach this recovery (d'Orsi et al., 2014).

Previous studies had demonstrated established association between chronic diseases such as diabetes with higher risk of having functional limitation and physical disability (Gregg et al., 2000; Gregg et al., 2002; Figaro et al., 2006; Hairi et al., 2010). In each of these studies, further analysis found a significant excess risk of disability associated with diabetes remained, even after controlling for diabetes-related complications. This indicates either that diabetes has an intrinsic influence on disability or that other unmeasured or undiscovered diabetes-related complications influence the risk for disability and also reduced the rates of recovery process from disability. Cardiovascular disease and arthritis basically affect the elderly's general physical fitness and limit the choices of treatment and rehabilitation activities that were essential for the recovery process.

Obese elderly were less likely to recover from IADL disability compared to other groups. Two earlier studies suggested that people with obesity were at higher risk of disability (Wearing et al., 2006; Jensen et al., 2010). High body mass index (BMI) or obesity itself was the strongest explanatory factors of disability among the women with diabetes (Gregg et al., 2000; Gregg et al., 2002). The mechanisms explaining the association between obesity with physical disability were multifactorial and also related with the existence of chronic disease such as arthritis which was common among obese elderly. Most obese elderly also suffered from other chronic diseases and due to this, they were less likely to recover from disability.

In this study, elderly with chronic pain were less likely to recover from IADL disability compared to those without chronic pain. Pain was significantly associated with greater disability as reported by others (Lichenstein et al., 1998; Creamer et al., 2000; Scudd et al., 2000; Horgas et al., 2008). Almost 30% of the study participants

reported having chronic pain which was largely due to high prevalence of chronic health problems such as cardiovascular disease, diabetes and arthritis. As mentioned earlier, elderly with chronic diseases were less likely to recover and usually remained longer in disability state. Elderly with chronic pain were also less likely to exercise. Chronic pain itself can influence the psychological well being of the elderly which can affect their motivation to recover.

Elderly with normal cognitive function were more likely to recover from ADL disability. The mechanism underlying the association between cognitive impairment and disability is most probably due to the existence of concurrent chronic diseases such as diabetes and hypertension which has been found not only to be associated but also predictors for cognitive decline (Strachan et al., 1997; Stewart et al., 1999). The presence of both chronic diseases and cognitive impairment forced certain elderly to stay in a state of ADL dependence for a longer time and less likely to recover.

In this study, elderly wihout depressive symptoms and had good self-rated health were more likely to recover from IADL and ADL disability. Previous studies found that elderly with depressive symptoms have been associated with higher risk of having disability (Guccione et al., 1994; Abdulraheem et al., 2006; Caskie et al., 2010) and less likely to recover (d'Orsi et al., 2014). Two earlier studies reported that elderly stated as having poor self-rated health had significant increased risk of having physical disability (Ng et al., 2006; Caskie et al., 2010) and were less likely to recover (Siedel et al., 2009; d'Orsi et al., 2014). Good self-rated health and having no depressive symptoms provides psychological benefit to the elderly; hence enhancing their recovery process and improving their physical function.

Higher physical activity level was associated with higher rate of recovery from IADL and ADL disability. This is similar with the findings of the study conducted by Fujita and colleagues (2006); higher frequency of going outdoors was significantly

associated with higher physical activity level which helped elderly to recover from IADL and ADL disability. Fujita et al (2006) in their study demonstrated that the frequency of going outdoors had an independent prognostic value not only for prediction of incidence of physical disability but also for disability recovery in community-dwelling elderly. Benefits accrued from exercise even when started later in life; it served to postpone disability.

Berk et al. (2006), Guralnik et al. (2003) and Spirduso et al. (2001) were among the researchers who had demonstrated the benefits of exercise for physical health. A meta-analysis by Conn and colleagues (2002) also confirmed the benefits of exercise. For example, elderly who participated in *tai chi* was shown to have improved cognitive and physical functions (Sun et al., 2015). Dunlop and colleagues (2014) found that increase in daily time spent in physical activity may reduce the risk of disability, irrespective of the intensity of that additional activity. Greater daily physical activity reduced the risk of disability and also increased the rate of recovery, even if the intensity of that additional activity was not increased.

5.5 Subtypes of disability

The most common subtype in the present study was short term disability, followed by transient disability, long-term disability and recurrent disability. This was in contrast to the finding found by Gill and colleagues (2008) where the commonest disability subtypes in their study was transient and followed by long-term disability.

The unstable disability which was defined as three or more episodes of disability, with none lasting 6 or more months was not described in this study. The possible reason was most probably due to the shorter duration and less frequent disability assessments of the present study. Although this study had less frequent assessments as compared to a previous study (Gill et al., 2008), however, during the

three monthly interviews the duration of elderly having disability was noted and this allowed subtypes of disability to be identified. This study found that there were very few changes in the disability process during the three months interval.

The duration of 12 to 24 months was often used by clinicians as the frame for reference when discussing prognosis of their older patients (Hardy et al., 2005; Covinsky et al., 2006; Gill et al., 2003b). Many other longitudinal studies of disability had assessment intervals ranging from 12 to 24 months (Stuck et al., 1999). Similarly with most prior studies, disability was operationalized as a dichotomous state (present vs absent). As the objective of the present study was to describe the disability subtypes, the severity of disability as denoted by the number and specific of disabled activities were not evaluated.

5.6 Strengths and limitations of the study

This was the first study to investigate the incidence of functional limitation, ADL and IADL disability in elderly individuals aged above 60 years in Malaysia. The sample investigated in this study was large, random and representative. This is a prospective study with 12 months follow-up and causal inferences between socio-demographic characteristics, health status, lifestyle behaviour and social support with physical disability and functional limitation can be drawn.

This was also the first study conducted in Malaysia which documents the data on disability at three monthly intervals for 12 months duration. Hopefully these findings will be able to support evidence of an emerging paradigm of disability that is reversible and often recurrent as has been described by other studies over the past several years (Gill et al., 2003a; Hardy et al., 2004; Gill et al., 2002).

This study also used validated measures of disability that fit with theories of ageing. In the Nagi model of disablement, functional limitation precedes disability.

Unlike physical disability, functional limitation represents an outcome that is free of the environmental influences. The disability is a dynamic process and this study had assessed the disability at different point of time in order to detect any changes in the elderly functional status. This also adds new information to the understanding of the dynamics of the pathway from diseases to disability or vice versa.

In this study, those elderly with severe cognitive impairment were excluded in the analysis of risk factors for incidence and incidence of recovery from physical disability to enhance the validity of the results as those with severe cognitive impairment might give incorrect information on their disability status based on self-reported ADL and IADL disability.

This study had several limitations. First, sampling in this study was limited to the community dwelling elderly in Kuala Pilah who were interviewed at their homes. Thus, these study findings are relevant to community dwelling elderly. Elderly individuals staying in nursing institutions or admitted to the hospital were excluded, which may underestimate the prevalence and incidence of functional limitation and physical disability among the elderly population.

Second, the study results may not be generalizable to elderly in other settings. However, our population did reflect the demographic characteristics of the general population in Kuala Pilah, which are comparable to the rural population in Malaysia as a whole. Majority of the elderly participants were from Malay ethnicity and hence less representative of the other ethnicities especially Chinese elderly. Language was the main barrier that this study faced which was a barrier to recruit elderly from other ethnicities. However, generalizability depends not only on the characteristics of the study population, but also on its stability over time (Szklo, 1998). The high participation and follow-up rates in this study enhanced the generalizability of the study findings.

Third, the measurements of ADLs and IADLs were based on self-report and not clinically diagnosed by medical personnel. In this study, both ADL and IADL had been measured because both scales represent different degrees of disability. Functional disability was a matter of degree, ranging from slight to very severe. In this study, IADL represent mild to moderate form of disability while ADL represent severe form of disability. However, because the score was summated, this study could not classify the disability into more clearly defined levels. Besides, these self-reported measures may not always agree with performance-based measures.

Fourth, unlike other studies, this study did not evaluate recovery after a single disease process or injury, such as stroke or hip fracture. Information on the etiology of disability was also not elicited, which may not be readily apparent in the absence of a catastrophic event (Ettinger et al., 1994). Disability, like delirium and other geriatric syndromes, was thought to result from the interaction of predisposing factors and precipitating events (Kempen et al., 1998; Buchner et al., 1992; Verbrugge et al., 1989; Gill et al., 1999). Disability may have either a rapid or gradual onset, and many episodes of disability are not preceded by an acute illness or injury leading to hospitalization (Gill et al., 1999, Ferrucci et al., 1997). This study also had no information on the possible use of restorative interventions among the participants after the onset of disability.

CHAPTER 6: CONCLUSION

6.1 Conclusion

This study found that the prevalence of functional limitation and IADL disability is common among elderly in Malaysia. More than two thirds of the study population had functional limitation and one third had IADL disability. The prevalence of ADL disability however was uncommon as less than ten percent of the study population reported having ADL disability. The incidence of functional limitation, IADL and ADL disability at twelve months of follow up as well as the incidence of recovery were determined. The incidence of functional limitation and IADL disability was also common among elderly as this study found almost thirty to forty percent of the study population were functionally limited and IADL dependent at twelve months of follow up. Similar with prevalence, the incidence of ADL disability was also uncommon as less than five percent of the study population reported as having ADL dependence.

The incidence of recovery from functional limitation and both IADL and ADL disability were common. Thirty to fourty-five percent of the study population had recovered from the above condition at twelve months of follow up. Overall, the prevalence rates of functional limitation and physical disability were comparable to other studies that used the same measurement tool. However, it was quite difficult to draw a conclusion for the comparison of the incidence rates. This was attributed to the variations in the incidence rates due to differences in definition, measurement tools and duration of the study.

The independent risk factors for incidence and incidence of recovery from functional limitation and physical disability were identified. This study was also able to describe the four subtypes of disability based upon ADL items. This study results showed that elderly women, advancing age, low educational level and those with cardiovascular disease were at greatest risk of developing both functional limitation and

physical disability at twelve months follow up. Low physical activity level and living alone were also the predictors for the occurrence of IADL and ADL disability. The risk factors for incidence of recovery from functional limitation and physical disability were in contrary with the risk factors mentioned above. Elderly male and younger age group were more likely to recover from functional limitation and IADL disability and high physical activity level helped the elderly to have faster recovery from physical disability.

6.2 Recommendation

6.2.1 Implication to public health

The findings from the present study are important for targeting appropriate prevention and intervention strategies. It enables our health care professionals to identify elderly at risk of developing physical disability and functional limitation. As a result, these people can be referred for intervention programmes aimed at reducing poor physical function such as health education, visits to the homes of high-risk individuals and physical activity programmes for community-living elderly, such as *tai chi* and aerobic exercises.

The disabled elderly may recover their functional independence with proper rehabilitation treatment (Gitlin et al., 2006a; Gitlin et al., 2006b). Rehabilitation can help the disabled elderly individuals regain independence in certain aspects of daily activities, through muscle-strength training, balance training, adjustment of household environment, and utilization of assistive devices (Dudgeon et al., 2008; Fange et al., 2005). Since it is difficult to help an extremely senile person recover functional independence in all ADL items (Stineman et al., 1993), it is more practical to target the items which have greater impact on health status. Another study suggests that interventions that target an aspect of the home environment related to a specific

functional ability have greater impact than more general interventions (Wahl et al. 2009). Similarly, the more intense and skilled the home modification intervention is (e.g., those that involve more than a 1-day consultation) the greater the improvement is observed (Wahl et al. 2009).

The risk factors for reduced physical function in elderly people are usually related to comorbidities, physical and psychosocial health, environmental conditions, social circumstances and lifestyle (Stuck et al., 1999; Ayis et al., 2006). The need for a preventive strategy based upon identification and treatment of diverse risk factors was identified more than 40 years ago (Williamson et al., 1964) and many trials of complex intervention packages have been reported and reviewed. A complex intervention can be regarded as a combination of interdisciplinary teamwork for health and social problems and elderly people may benefit from assessment and appropriate health and social interventions. Systematic review showed that complex interventions can help elderly people to continue living at home, live safely and independently largely through prevention of the need for nursing-home care, and tailored to meet the individuals' needs (Beswick et al., 2008).

Special attention also should be provided for the elderly with low physical activity because study had shown there was marked association between little or no physical activity and the presence of limitations in IADL, ADL and mobility (Graciani et al., 2004). Participation in physical activity is a low cost, broadly applicable approach to improve health outcomes and reduce the risk of developing chronic disease (Willis et al., 2012; Gill et al., 2012; Larson et al., 2006).

Physical activities that are recommended for the elderly includes leisure time physical activity (for example: walking, dancing, gardening, hiking, swimming), transportation (e.g. walking or cycling), occupational (if the individual is still engaged in work), household chores, play, games, sports or planned exercise, in the context of

daily, family, and community activities. Even in the disabled elderly whom cannot perform the recommended amounts of physical activity due to health conditions, they should be physically active as long as their abilities and conditions allow. This is because elderly who are inactive or who have some disease limitations will have added health benefits when moving from the category of "no activity" to "some levels" of activity. Elderly who currently do not meet the recommendations for physical activity should aim to increase duration, frequency and finally intensity of their physical activity as a target to achieving them.

Overall, the findings in this study provide useful information for the identification of potential targets for research and therapeutic interventions aimed at preventing a decline in functional status of elderly individuals.

6.2.2 Policy

In old age, reduction in physical function can lead to loss of independence, the need for hospitalisation and long-term nursing-home care, and sometimes premature death. Due to this, the importance of physical, functional, psychological, and social factors in realizing a healthy old age is being recognised by not only the health-care professionals (British Geriatric Society, 2005) and policy makers (WHO, 2002) but also the elderly people themselves (Age Concern, 2003; Phelan et al., 2004).

When the Malaysian government formulated the National Policy for the Elderly in 1995, the specific objectives were upgrading the dignity and self-worth of senior citizens within the family, society and nation, and improving the potential of the elderly so that they can continue to be productive in national development. The policy also aims at encourageing the provision of facilities for the elderly to ensure care and protection for them.

As a basic support to the elderly population, medical and health care systems in Malaysia tend to be curative and remedial, rather than preventive and promotional in nature. Other countries such as Japan and Australia have both recognized the importance of health-promotion and illness-prevention programs for keeping elderly out of hospitals and institutions and have established programs both for seniors and the general population (Lilley, 2002). Prevention of functional decline and disability would include not only management of acute episodes of disability and promotion of recovery, but also ongoing evaluation and management of key risk factors for disability and use of preventive interventions. While some interventions designed to prevent recurrent disability may be disease-specific, eg, anticoagulation after embolic stroke, others may be broadly applicable regardless of the specific precipitant of disability, eg, exercise-based programs.

To cope with the future ageing population, Malaysia needs to develop sufficient expertise in a few fields such as acute Geriatric Medicine, rehabilitation of elderly, the management of long-term conditions in elderly with multiple complex problems within primary care and infrastructure for home and institutional care. There is an urgent need to train physicians, nurses, allied health professionals, and care home workers to enable them to deliver a safe and effective system of health and social care for the elderly.

In order to facilitate care at home, our country needs to examine and develop strong support systems for caregivers. These include some form of payment, legal entitlement to respite services, and easy access to both advice and emotional support. For elderly who cannot remain at home, a wide range of facilities must be available such as supportive housing for example hostels, cluster homes, service homes, and special nursing homes.

Another common element of these reforms is the reliance on the private sector for providing many of the supportive services for seniors. While services are purchased

by the government, they are increasingly delivered by private-sector providers, including both for-profit and not for-profit organizations. Both the growing private-sector involvement and the decentralization of services to municipalities should be monitored by specific mechanisms such as national standards and accreditation programs to enhance quality and consistency.

6.2.3 Future research

Further research is warranted to evaluate the effect of specific precipitating events on the recovery process of disability because the likelihood and course of recovery may differ depending on the type of precipitating event (eg, a surgical procedure vs an acute illness vs a stressful life event), particularly to those non-catastrophic events that have received relatively little attention to date. Many elderly, for example, report common symptoms such as pain, weakness, and fatigue as the cause of disability, and recent evidence indicates that events leading to restricted activity are independently associated with decline in ADL function.

Prior studies have shown that disability commonly arises from a combination of predisposing factors that make one vulnerable and intervening illnesses or injuries that act as precipitants. Whether this model applies to each of the disability subtypes is uncertain but should be the focus of future research. Additional research may also be warranted to evaluate the natural history and prognosis of the different disability subtypes. It has previously been demonstrated, for example, that even brief periods of disability have considerable prognostic importance. Ultimately, the results of the current and future research may lead to an improved nosology of disability. As suggested previously, future research should take into account time course, recovery, severity, and modality of onset and, the development of new interventions designed to enhance

independent function among elderly persons. It is hoped that the severity of disability can be incorporated in future studies of disability subtypes.

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LIST OF PUBLICATIONS AND PAPERS PRESENTED

Type	Title	Journal/Venue	Status
Conference Presentation	The Physical Activity Scale for Elderly (PASE): Validity and Reliability among Community Dwelling Elderly in Malaysia	46th Asia Pacific Conference of Public Health in Kuala Lumpur on October 2014	Oral presentation
Publication	The Physical Activity Scale for Elderly (PASE): Validity and Reliability among Community Dwelling Elderly in Malaysia	Asia Pacific Journal of Public Health	Published
Conference Presentation	Prevalence and correlates of tobacco smoking habits among community dwelling elderly in Malaysia	Kuala Lumpur Nicotine Addiction International Conference on 23 April and 24 April 2015.	Poster Presentation (Awarded for best poster presentation)
Conference Presentation	Validity and reliability assessment of Duke Social Support Index (DSSI) among community dwelling elderly in Malaysia.	National Geriatric Conference in Kuala Lumpur	Poster Presentation
Conference Presentation	Prevalence and correlates of functional limiation and physical disability among community dwelling elderly in Malaysia	5th International Public Health Conference in Kuala Lumpur	Poster Presentation
Conference Presentation	Subtypes of physical disabilty among community dwelling elderly in Malaysia	4th Asia Pacific Conference on Public Health in Kuantan	Oral Presentation (Awarded for best oral presentation)
Conference Presentation	Incidence and risk factors of functional limiation and physical disability among community dwelling elderly in Malaysia	6th International Public Health Conference in TH Hotel	Poster Presentation (Awarded for third place poster presentation)