COMPARISON OF ORAL HEALTH AND NUTRITIONAL STATUS BETWEEN HOSPITALISED AND NON-HOSPITALISED ELDERLY IN A SELECTED URBAN MALAYSIAN POPULATION

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DISSERTATION SUBMITTED IN FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF DETAL SCIENCE

DEPARTMENT OF RESTORATIVE DENTISTRY,
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ORIGINAL LITERARY WORK DECLARATION

Name of Candidate: Vaishali Malhotra

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Title of Dissertation/Thesis ("this Work"): Comparison of oral health and nutritional status between hospitalised and non-hospitalised elderly in a selected urban Malaysian population

Field of Study: Special Needs Dentistry, Geriatric Dentistry, Community Dentistry

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ABSTRACT

Introduction

Malaysia is rapidly advancing towards the status of an ageing nation. Demographic transitions pose major challenges for health care providers in planning and providing effective and holistic health care to institutionalized older people. Health authorities are experiencing an increasing public health problem; the growing burden of oral diseases among older people. The concept of oral health has evolved from just having healthy teeth. Holistic oral health includes excellent oral function which is the ability to smile, speak, swallow and chew competently, and without pain; bringing about improvement in general health and increased self-esteem. However, in the present scenario, the oral health of older Malaysians is far from optimal.

Aim

The purpose of this study was to compare the oral health and nutritional status between the hospitalised and non-hospitalised urban elderly population.

Materials and Methods

An observational, comparative cross-sectional study was conducted. Cases were a convenience sample was obtained from the geriatric wards at the University of Malaya Medical Centre while matched controls were selected from the Malaysian Elders Longitudinal Research (MELoR) study. A structured questionnaire was administered face-to-face to obtain socio-demographics, medical history, oral health related knowledge, attitude and practices, and nutrition status. Clinical assessments including dentition status, salivation status and periodontal health status were conducted by trained, calibrated dentists.

Results

148 (74 hospitalised and 74 non-hospitalised) participants, mean age = 80.76 (±7.4) years, 54.1% women, age and gender matched, were recruited. The mean number of missing teeth was 23.12 (±10.1) in the hospitalised group and 17.34 (±5.5) in the non-hospitalised group ($p < .001$). Significantly fewer hospitalised individuals felt it was important to brush daily ($p=0.003$), visited the dentist in the last 2 years ($p<0.001$) and brushed their teeth more than once a day ($p<0.001$). Hospitalised individuals also had fewer sound teeth ($p<0.001$), fewer filled teeth ($p<0.001$) and more missing teeth ($p<0.001$). 67.7% of hospitalized participants and 17.6% of non-hospitalized controls were edentulous. All hospitalised participants who had teeth had chronic periodontal disease compared to 80.2% of non-hospitalised controls ($p<0.001$). Hospitalised participants were significantly more likely to have moderately dry mouths than non-hospitalised controls ($p<0.001$).

Conclusions

The findings of this study reflect that oral health status in both groups was poor but overall it was significantly worse amongst those who were hospitalised. Hospitalised individuals also demonstrated poor knowledge, and more adverse attitudes and practices than non-hospitalised participants on dental care. Our study highlights an association between poor oral health and hospitalisation as a case-control study. Larger prospective study should be conducted to confirm this relationship.

ABSTRAK

Pengenalan

Malaysia dengan perlahan akan terus maju ke arah menjadi negara tertua. Peralihan demografik ini memberi cabaran besar kepada badan penjagaan kesihatan terutama nya bagi golongan warga emas. Lebih-lebih lagi, pihak berkuasa kesihatan tidak lama lagi akan menghadapi masalah kesihatan awam yang semakin meningkat antaranya bebanan terhadap penyakit mulut di kalangan warga emas. Konsep kesihatan mulut telah berubah dari hanya mempunyai gigi yang sihat termasuk lah fungsi lisan yang sangat baik (keupayaan untuk bercakap, senyum, mengunyah dan menelan dengan cekap, dan tanpa rasa sakit), memperbaiki kesihatan awam dan meningkatkan jati diri. Walau bagaimanapun, pada masa kini, kesihatan mulut warga emas rakyat Malaysia jauh lebih baik dari paras optima.

Matlamat

Tujuan kajian ini adalah untuk membandingkan masyarakat yang menerima rawatan dan tidak menerima rawatan bagi warga emas rakyat Malaysia dari segi kesihatan mulut dan kesihatan umum; ilmu pengetahuan, sikap dan amalan ke arah kesihatan mulut dan status nutrisi serta faktor-faktor risiko yang mempengaruhi status pergigian.

Bahan dan Kaedah

Kajian rentas, pemerhatian, kawalan kes penyelidikan telah dijalankan. Kes kemasukan hospital dipilik secara *convenience* daripada wad-wad geriatrik di Pusat Perubatan Universiti Malaya. Peserta-peserta kawalan (kontrol) pula dipilih secara perpadanan dari Projek Kajian Penyelidikan Jangka Panjang Warga Emas Malaysia (MELoR. Soal selidik berstruktur digunakan untuk temuduga secara bersemuka untuk

mendapatkan maklumat sosio-demografi, sejarah perubatan, pengetahuan berkaitan kesihatan mulut, sikap dan amalan; dan status nutrisi. Penilaian klinikal dijalankan oleh doktor gigi yang dilatih dan dikalibrasi untuk menilai status pergigian, status pengeluaran air liur dan status kesihatan periodontal.

Keputusan

148 (74 menerima rawatan dan 74 tidak menerima rawatan) peserta julat umur = 80.76 (± 7.4) tahun, 45.9% lelaki dan 54.1% wanita, umur dan jantina yang dipadankan, telah menerima pemeriksaan saringan kesihatan mulut. Purata bilangan gigi yang hilang ialah 23.12 (± 10.1) dalam kumpulan yang dirawat di hospital dan 17.34 (± 5.5) dalam kumpulan tidak menerima rawatan hospital ($p < .001$). Individu dari hospital kurang kemungkinannya menyedari kepentingan menggosok setiap hari ($p=0.003$), melawat doktor gigi dalam masa dua tahun yang terdekat ($p<0.001$) dan menggosok gigi lebih daripada satu kali sehari ($p<0.001$). Individi yang masuk hospital juga kekurangan gigi yang sempurna ($p<0.001$), gigi yang dirawat ($p<0.001$) dan lebih gigi yang hilang ($p<0.001$). 67.7% peserta dari hospital dan 17.6% peserta kawalan dari luar hospital tiada gigi. Semua peserta hospital yang berkepunyaan gigi ada penyakit gusi kronik berbanding dengan 80.2% peserta kawalan luar hospital ($p<0.001$). Peserta hospital juga lebih mengalami masalah mulut kering yang sederhana berbanding dengan peserta kawalan yang tidak masuk hospital ($p<0.001$).

Kesimpulan

Penemuan menunjukkan bahawa kesihatan mulut dalam kedua-dua kumpulan adalah rendah dan keadaan menjadi lebih buruk di kalangan mereka yang menerima rawatan. Kajian ini juga mempamerkan kekurangan pengetahuan, dan sikap yang buruk berutamanya mereka yang masuk hospital, terhadap kesihatan gigi. Jadi, kesihatan

mulut yang buruk mungkan berkena mengena dengan kemasukan hospital di golongan warga emas. Analisasi *multivariate* untuk menyelaraskan faktor-faktor yang mungkin menganggu perhubungan diantara kesihatan mulut dan gigi dengan kemasukan hospital perlu dijalankan. Kajian selanjutnya, yang harus dijalankan secara prospektif juga diperlukan untuk menentukan perhubungan ini.

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF SYMBOLS AND ABBREVIATIONS

BPE	:	Basic Periodontal Examination
BM	:	Bahasa Melayu
COPD	:	Chronic Obstructive Pulmonary Disease
CGA	:	Comprehensive Geriatric Assessment
MELoR	:	Malaysian Elders Longitudinal Research
MNA	:	Mini Nutritional Assessment
NOHSA	:	National Oral Health Survey of Adults in Malaysia
PIS	:	Patient information sheet

CHAPTER 1: INTRODUCTION

1.1 Background

Twenty first century has faced an irreversible by-product of demographic transition referred to as "Population Ageing" (Kinsella & Velkoff, The demographics of agina, 2002). According to the World Population Prospects, the 2017 Revision, the world's total population is numbered at nearly 7.6 billion, with sixty percent of the world's population is living in Asia (4.5 billion) (United Nations, 2017). The results of World Population Prospects, the 2017 Revision are summarized in Table 1.1. Survey statistics indicate that dwindling fertility rates and increased life expectancy contributed in part by accessible health programs and refined health conditions, population in the age bracket of 60 years or over is growing faster than all younger age groups (Pinelli, De Mattos Mda, Bezzon, & Ribeiro, 1998) (Samir & Lutz, 2017). Though, the phenomenon of 'Population Ageing' is well accepted and publicized in the developed nations, the cause of concern today is the steeply rising pace of ageing in developing nations (National Research Council, Committe on Population, 2001). With 80% of the older population residing in developing nations, it has become a tremendous challenge for the health and social policy planners because of the contemporaneously shifting disease patterns. The health implications of ageing need to be thoroughly decoded, better exemplified and understood (Issrani, Ammanagi, & Keluskar, 2012). Throughout lifespan, oral health is integral to general health and quality of life (Steele et al., 2004). Globally, poor oral health among older people is reported as having either or a combination of these issues such as high level of tooth loss (Natto, Aladmawy, Alasqah, & Papas, 2014), dental caries experience (Holm-Pedersen, Schultz-Larsen, & Avlund, 2008), high prevalence rate of periodontal disease (Eke, BA, Wei, Thorton-Evans, & Genco, 2012), xerostomia (Edgar, O'Mullane, & Dawes, 2004), and oral precancer/ cancer (Gonsalves, Wrightson, & Henry, 2008). It is further reported that oral health,

diet and nutrition are found to be closely linked (El Osta, Hennequin, Tubert-Jeannin, Naaman, El Osta, & Geahchan, 2014). Impaired oral health could lead to disability (Yu, Lai, Cheung, & Kuo, 2011), weaker handgrip strength (Hämäläinen, Rantanen, Keskinen, & Meurman, 2004), lower nutrient intake (Andrade, Caldas Junior, Kitoko, & Zandonade, 2011) and weight loss (Lee, et al., 2004). The cumulative burden of oral health problem has been shown to have considerable social impact on older people's daily life, ranging from minor pain and discomfort to severe limitation in performing everyday activities. This interferes with an individual's capacity to chew, bite, speak, smile, and negatively influences one's psychosocial well-being (Yap, 2017). Likewise, the above mentioned factors can also be attributed as a consequence of an individual's educational, economic, dietary, psychological, cultural, and chronologically specific cohort experiences (John, Mani, & Azizah, 2004). Despite the stated, the older people are considered as scapegoats for rising healthcare costs neglecting the quantification of the actual burden of dental diseases. The sphere of importance for the older members of society is provision of good quality of life through intergenerational relationship and it is the need of the hour worldwide (Saxena & Yadav, 2011).

Malaysia, in the past decade, has undergone a diametric shift in the demographics towards being an ageing nation. Longer life expectancy, declining mortality and fertility rates are contributing factors for this apparent shift (Hamid, 2015). Although, the escalation in the proportion of its ageing population is not as phenomenal as in countries such as China and Singapore, it is notably rapid and huge. Such increase in the proportion of older people would make it impossible for the government to ignore the marked effect on social and economic changes which will be brought about by population ageing (United Nations, 2017).

Survey statistics indicate that with an upward trend in the ageing population, the number of adults with multifarious health issues is increasing (World Population Ageing, 2009). The dentition status in the older population has seen a change in trend from denture wearing towards the retention of natural teeth, the need for various types of dental services continues to increase (Emami, de Souza, Kabawat, & Feine, 2013). Compromised oral health is one of many barriers to achieve holistic health in older age. Several regional based studies, for instance, the study conducted in Kelantan to evaluate the dental caries experience living in "Pondok" indicated that dental caries status of elderly people was unsatisfactory with high percentage of edentulism, contributing to the high value of the mean DMFX(T) index 29.3 (SD 6.63) (Seman, Manaf, & Ismail, 2007). Likewise, a high prevalence of edentulism 55.9% was reported in elderly Muslim females in Kota Baru, Kelantan, Malaysia (Shamdol, Ismail, Hamzah, & Ismail, 2008). Therefore, optimization of an individual's oral health is important.

Table 1.1: Population of the world according to medium-variant projections

Region	**Population (millions)**			
	2017	**2030**	**2050**	**2100**
World	7550	8551	9772	11184
Africa	1256	1704	2528	4468
Asia	4504	4947	5257	4780
Europe	742	739	716	653
Latin America and the Caribbean	646	718	780	712
Northern America	361	395	435	499
Oceania	41	48	57	72

Source: United Nations, Department of Economic and Social Affairs, Population Division (2017). World Population Prospects: The 2017 Revision. New York: United Nations.

1.2 Aim of the Study

To compare the oral health and nutritional status between hospitalised and non-hospitalised urban elderly population.

1.3 Research Objectives

The specific objectives of the current study are as stated below;

1. To compare the oral health (dentition status, periodontal status, denture wearing status and salivation status) between the hospitalised and non-hospitalised urban elderly population.
2. To compare oral health related knowledge, attitude and practices between hospitalised and non-hospitalised urban elderly population.
3. To compare the nutritional status between the hospitalised and non-hospitalised urban elderly population.
4. To determine whether hospitalisation is one of the predictor of the dentition status.

1.4 Research Significance

The specific aim of our geriatric dental research was based mostly on two main groups of older adults:

1. Community-dwelling functionally independent older adults

2. Institutionalized functionally dependent older adults (hospitalized in the Geriatric Ward, UMMC).

There is limited knowledge on the oral health of the frail hospitalized versus the community -dwelling older people as they are unable to participate in epidemiological studies owing to age, compounded by issues of declining functional status and medical

status, and other complications of declining cognitive status, reduced effective functioning, increased need for social support, increased caregiver burden, frequent hospitalizations and increased socioeconomic dependence. Moreover, barriers to dental care are encountered, like ease of accessibility to dental clinics; treatment costs, lack of basic dental screenings upon hospitalization, difficulty in establishment of set ups in the geriatric wards for the provision of basic dental treatment and oral health education by trained dental staff. Studies have revealed that most community-dwelling functionally independent older adults have generally good oral health whilst they can access dental services; however, individuals who are at higher risk for some oral diseases and conditions, include functionally dependent individuals with dementia, Parkinson's disease and chronic mental illness (Chalmers, Carter, & Spencer, 2003).

As foreseen, an increase in percentage of the institutionalized and/ or non-institutionalized older population will result in Malaysia becoming an ageing nation by the year 2020. As estimated, 9.8% of the entire population will be in the elderly bracket. This is a clear indication of the crucial need to learn about the oral health of the aging population and its consequences. It is hoped that the outcome of this research will channel to assist the oral health care providers to offer enhanced oral health care for the older sector of the society. It is henceforth imperative to tend to the goal of 'Successful Ageing' whereby, he/she can maintain healthy oral tissues and natural functional dentition throughout his/her remaining adult life with all the social and biological benefits such as aesthetics, comfort, ability to chew, swallow, taste, speak competently and be free from oral pain.

1.5 Null Hypothesis

The null hypothesis of the study was:

- No difference is expected to be present in the oral health (dentition status, periodontal status, denture wearing status and salivation status) between hospitalised and non-hospitalized urban elderly population.
- There is no expected difference in the oral health related knowledge, attitude and practices between hospitalised and non-hospitalised urban elderly population.
- No difference is expected in the nutritional status between hospitalised and non-hospitalised urban elderly population.
- Hospitalisation will not be one of the predictor of the dentition status.

1.6 Field of Research

"Geriatric Dentistry or Gerodontics is the delivery of dental care to older individuals involving the diagnosis, prevention, and treatment of problems associated with normal ageing and age-related diseases as a part of an inter-disciplinary team with other health care professionals" (Issrani, Ammanagi, & Keluskar, 2012).

CHAPTER 2: LITERATURE REVIEW

2.1 Ageism and Ageing: Framework

The perception of ageing has changed throughout the history. In the year 1969, Robert Butler, first director of the National Institute of Ageing, a division of the U.S. National Institutes of Health, located in Maryland, coined the term "Ageism"; defining it as a process of systematic stereotyping and discrimination against people because they are old (Scully, 2000). Ageism can be distinctly categorized into two contexts, based on beliefs about the impact of biological ageing on people of all ages. Firstly, the chronological age, the numbers used for employment retirement, celebrating birthdays to maintain social identity (Gilliard & Higgs, 2000). Secondly, as defined by Butler, ageism is like sexism and racism is used to discriminate old people from the younger population who categorize them as senile, rigid, old-fashioned, inferior, and so on (Bytheway, 2005). Therefore, ageism is established in the social personality of the individual, both a bureaucratically overseen character and a character passed on by the physical appearance of the body (Bytheway, 2005). Numerous terms have since been used by researchers to describe people considered old, but they also acknowledge the immense diversity inherent to this term (Saxena & Yadav, 2011). Moreover, all societies use age, sex, economic status, and ethnicity to classify individuals (Johnson, 1995).

In entirety, albeit thoughtfully the contribution of age generalization in age separation is inescapable, the negligible actuation of age generalizations is in no way, shape or form an adequate condition for the event of age segregation. A full comprehension of the complexities of these relations requires structures that consolidate logical imperatives and furthermore consider the area of age generalizations and age segregation (Ayalon & Tesch-Romer, 2018).

The term “Ageing” can be defined in numerous ways. One way to define ageing is as “a natural biological, pathological, psychosocial or a socioeconomic process” (Kalk & Meeuwissen, 1992). The United Nations describes an “ageing population as a decline in the proportion of children and young people and an increase in the proportion of people aged 60 years and above” (World Population Ageing, 2009). The ages of 60 and 65 years have repeatedly been adopted as the beginning of old age despite the fact, the definition of ageing varies across cultures, countries and time, (Kinsella & Velkoff, 2002).

2.2 Age- categorization of the Elderly Population

According to the definition laid down by the UN, older or elderly persons are defined as having attained 60 years of age. Within the elderly population, further classification like oldest old (normally those 80+) and centenarian (100+) and even super-centenarian (110+) are also made (United Nations, 2015).

Conventionally, chronological age of 65 years and above has been used to describe “elderly”. Under this classification, 65 through 74 years old are referred to as “early elderly” whereas, those over 75 years old are termed as “late elderly”. There is insufficient evidence to support this finding (Orimo, Ito, Suzuki, Araki, Hosoi, & Sawaba, 2006).

Older adults can also be classified into three groups based on functional living ability; functionally-independent, frail and functionally-dependent (Yeh, Katz, & Saunder, 2008).

According to the concept of ageism, old people are categorized as senile, rigid in thought and manner, old-fashioned in morality and skills. However, like racism, the

concept of ageing should not be validated as negative stereotyping keeping in mind the factors of frailty, social isolation, physical, and economic dependence (Jonathan, 2008).

2.3 Population Ageing

According to the report published by U.S. Census Bureau in 2010, the number and proportion of world's older population has been increasing for the past so many generations (US Census Bureau Report, 2010). However, the twenty first century has faced the challenge of ageing, popularly termed as "Population Ageing" (Kinsella & Velkoff, The demographics of agina, 2002). According to this concept, the overall health of an individual is both determined by and contributes to broad social trends of globalizing economies, rapidly evolving technology, and transforming family patterns (WHO, 2012).

Along with this phenomenon and other factors, ubiquitously, there has been an unprecedented growth in the number and proportion of people who live to see their 80's or 90's than ever before. The World Health Organization (WHO) guidelines classify a country's population as an ageing population when the population aged 65 and 65+ year's reaches 7.0 % of its total population (WHO, 1989). Malaysia has adopted the United Nations definition of those aged 60 years and above (60+ years) for "older people" as opted by various developing countries belonging to ASEAN community (Cohen, 2003).

Globally, the population of older persons is increasing at a rate of 2.6 % per year (World Population Ageing, 2009). It is expected that by the year 2050, the older population is expected to continue grow more rapidly than the population in other age groups. Improvement in life expectancy has been brought about in part by improved health conditions and more accessible health programs, and reduced fertility and

mortality rates (Mafauzy, 2000). The rise in older cohort will thereby, require far-reaching economic and social adjustments in most countries. However, it is also of interest that marked differences exist between developed and developing regions in the number and proportion of the older persons. In the more developed countries, over a fifth of the population is currently aged 60 years or over and by 2050, nearly a third of the population in the developed countries is projected to be in that age group (Shetty, 2012). Worldwide, the percentage of the population aged 60 years or over increased by 3 points between 1950 and 2009 from 8 to 11 %. Also, it is expected that by the middle of the 21st century, the percentage would increase by 11 percentage points, to 22 per cent (World Population Monitoring & Development, 2008). Likewise, for Malaysia, the population has almost quadrupled in the past five decades, growing to 27.4 million in the year 2010 from 7.4 million in 1957 (Population & Demography Division, 2017). According to the Malaysian Population and Housing Census 2010, 3.3 percent of the population was aged 65 years and over in the year 1970, and almost half of the population (44.5%) was under the age of 14 years. However, in the year 2017, children accounted for less than one-fourth of the total population (24.1%), while those aged 65 years and over comprised 6.2 per cent of the total population. It is estimated that Malaysia is expected to have nearly equal share of the young (18.6%) and older population (14.5%) by the year 2040. Statistically, this will account for three older persons for every 20 people (Population & Housing Census, 2010). Changes in the Malaysian population age structure can further be described as follows: in 1957, the shape of the population pyramid was progressive with a broad base, concave slope, and sharp peak. In 2010, the shape of the pyramid was regressive with a smaller base indicative of low birth rate and a convex slope reflective of low mortality rates of the adult population. The apex being flat and wide indicative of higher percentage of the

elderly population and is expected to remain as such until 2040 (World Population Monitoring & Development, 2008).

2.4 Ageing Index

A concept that represents the number of people aged 65 years and older for every 100 individuals aged 15 years and less. A country having a low ageing index will be having smaller proportion of older individuals at a point in time and concurrently having large number of young's. The scenario is reverse if the country has a higher ageing index (Wan-Ibrahim & Zainab, 2014). According to the 2008 International Population Reports, aging index was highest in Europe and lowest in Africa and the Near East (Kinsella & Wan, An aging world: 2008, 2009). Malaysia too is seeing a rise in the number of baby boomers with a progressive increase in the ageing index from 10.5 in 1957 to 11.6 in 1970 further to 14.6 in 1980 and an estimated value of 18.2 in 2000 (Department of Statistics, Malaysia, 2005) (Oral Health Division, Ministry of Health, 2010).

In tandem with the phenomenon of population ageing, Malaysia's population is rapidly changing in size, composition, and distribution. The changing demographics pose the need to accurately and expeditiously assess and analyze the relationship of this trend with national policy development and implementation.

2.5 The Impact of Aging on Oral and General Health

2.5.1 Aging and General Health

Our world is on the brink of a demographic transition. With improved living conditions, better hygiene and advances in medical care people are aging but often with multiple, debilitating, and chronic mental and physical conditions (World Population Ageing, 2009). Socio-economic development has brought about a transition from high

to low mortality and fertility rates bringing about a shift in the leading causes of disease and death. Demographers and epidemiologists describe this transition as part of an "epidemiologic transition" which is characterized by the waning of infectious and acute diseases and the emerging importance of chronic and degenerative diseases (WHO, 2015).

2.5.2 Oral Health and General Health

Oral health is well recognized as an integral part of general health and although not life-threatening or seriously impairing for older adults, can affect quality of life and the management of medical conditions (Petersen & Yamamoto, 2005).

The concept of having good oral health has evolved from just excellent oral functioning of teeth so that all individuals can (Shay & Ship, 1995):

- Eat and talk comfortably
- Feel happy about their appearance
- Maintain social interaction and self-esteem
- Stay pain free
- Maintain habits/standards they have had throughout their life
- To lead a balanced healthy lifestyle

The state of health of the oral cavity can also impact the course and pathogenesis of several systemic conditions.

2.5.3 Pulmonary Diseases

Pulmonary diseases such as pneumonia, chronic obstructive pulmonary diseases (including emphysema), and exacerbations of chronic bronchitis (all involve oral pathogens especially those that are blood-borne or the aspiration of bacteria from the oropharynx into the lower respiratory tract) (Amar & Han, 2003). The human oral

cavity hosts a highly diverse microbial flora. Because of its humidity and temperature, the mouth provides an appropriate environment for the development of organized bacterial communities. These occur as biofilms on both hard surfaces (teeth) as well as the soft tissue of the stomatognathic system (Sachdeo & Socransky, 2008). It should be emphasized that these communities are complex organizations and include a wide variety of different species of bacteria with varying degrees of virulence (Albert, Spiro, Jett, & R, 1999). An infection occurs when the host's defense system is compromised, the pathogen is particularly virulent or the inoculum is overwhelming. The micro-organisms may enter the lung by inhalation, but the most common route of infection is aspiration of what pneumologists have long referred to as oropharyngeal secretions (Filho, Passos, & Cruz, 2010).

2.5.3.1 Atherosclerotic Diseases (Coronary Heart Diseases and Cerebrovascular Diseases)

Atherosclerotic diseases occur due to pathological narrowing of arteries because of accumulation of cholesterol and cholesterol products in vessel walls (Scannapieco, 2005). Several studies have reported that periodontal disease and poor oral hygiene tend to have a strong association with the risk of coronary heart disease and acute myocardial infarction. However, there is insufficient evidence to prove a causal link between them (Kuo, Polson, & Kang, 2008). On the other hand, there is better and substantial evidence to support the causal relationship between poor dental health and cerebrovascular disease (Scannapieco, 2005).

Patients presenting with signs and symptoms of poor oral hygiene, frequent and severe gingival inflammation and frequent bacteremia (periodontal disease) will have an activated host inflammatory response (Amar & Han, 2003), (Pihlstrom, Michalowicz, & Johnson, 2005) (Kuo, Polson, & Kang, 2008). This chronic inflammatory state will

trigger multiple pro-inflammatory cytokines, such as C-reactive protein, tumor necrosis factor α, interleukin 1β, and interleukin 6, which in conjunction with bacteremia and in turn stimulate the process of atherogenesis as well as increase the susceptibility of the vascular endothelium for injury (a precursor to atherogenesis). Moreover, during such episodes of dental bacteremia, streptococci of the viridans group tend to induce platelet aggregation and possibly thrombus formation (Nakajima, et al., 2010). Atherosclerotic cerebrovascular disease plays a major role in the etiology of cerebrovascular accidents (strokes) and transient ischemic attacks (Pihlstrom, Michalowicz, & Johnson, 2005) , (Kuo, Polson, & Kang, 2008).

2.5.3.2 Diabetes Mellitus

Disrupted glycemic control results from a lack of insulin production (type 1) or systemic insulin resistance (type 2) (Kuo, Polson, & Kang, 2008). It was estimated in the year 2008 that 18 million people worldwide had diabetes. The relationship between diabetes and periodontitis is bidirectional, whereby, severe periodontitis can negatively impact glycemic control and vice versa (Garton & Ford, 2012). Advanced glycation end products have a systemic impact that results in the increased excretion of cytokines. This leads to local inflammation and loss of connective tissues. Glycemic control is more difficult in the presence of local inflammation in the mouth, this in turn, increases the risk of infection in the form of systemic effects- explaining the bidirectional relationship of the condition (Amar & Han, 2003). Prolonged hyperglycemia has been reported to have negative effects on the heart, eyes, kidneys, and peripheral nerves, and studies now suggest that periodontal disease should be considered as a major complication of diabetes (Lamster, Lalla, Borgnakke, & Taylor, 2008), (Petersen, Bourgeois, Ogawa, & Ndiaye, 2005).

2.5.3.3 Osteoporosis

An imbalance between bone loss and formation leads to decreased bone mineral density. This decreased density in the jawbone leads to greater alveolar bone resorption, increasing the depth and number of gingival pockets, which in turn allows invasion by periodontal pathogens (Kuo, Polson, & Kang, 2008). Furthermore, in the recent times, studies have supported a positive bidirectional relationship between periodontal health and osteoporosis but still there is lack of evidence to back this argument (Amar & Han, 2003) (Kuo, Polson, & Kang, 2008).

2.5.3.4 Chronic Kidney Diseases

Poor periodontal health lead to systemic inflammation, infection, protein wasting, and the development of atherosclerotic lesions, all of which worsen morbidity and mortality in chronic kidney disease patients (Kuo, Polson, & Kang, 2008).

2.5.3.5 Nutritional Status

Nutrition and oral health have a synergistic relationship. Studies have indicated that impaired oral health is related to disability (Holm-Pedersen et al., 2008), weaker handgrip strength (Hämäläinen et al., 2004), lower nutrient intake (Andrade et al., 2011) (Tsakos, Herrick, Sheiham, & Watt, 2010) and weight loss (J. S. Lee et al., 2004) (Ritchie, Joshipura, Silliman, Miller, & Douglas, 2000). According to the literature, these factors are significantly associated with the pathogenesis of frailty (Fried et al., 2001) which is a term used to denote a multidimensional syndrome involving the loss of reserves (energy, physical ability, cognition and health) that give rise to vulnerability (Rockwood et al., 2005) and is significantly related to mortality (Buchman, Wilson, Bienias, & Bennett, 2009) (Masel, Ostir, & Ottenbacher, 2010). Furthermore, studies suggest that people with a well maintained natural dentition have better nutritional intake than those with full dentures, and those with well-fitting dentures have better

nutritional intake (Suzuki et al., 2005) than those who have either ill-fitting dentures or none at all (Moynihan et al., 2009).

Nutrition is a vital determinant of health in the older population. Over the past decade, the significance of nutritional status has been recognized in a range of morbidities such as cancer, coronary heart disease, and dementia in individuals over the age of 65 (Van, Guedon, Maniere, Manckoundia, & Pfitzenmeyer, 2004). Malnutrition is usually identified in the elderly on the basis of some common indicators which include involuntary weight loss, atypical body mass index (BMI), specific vitamin deficiencies, and lowered dietary intake (Rubenstein, Harker, Salvà, Guigoz, & Vellas, 2001). Malnutrition in older individuals is often underdiagnosed (Gariballa, 2000). For instance, health practitioners may additionally no longer readily understand weight loss in the aged as a morbid symptom of malnutrition because some weight loss might also be associated with age-related discounts in muscle mass (Kane et al., 1994). Similarly, elderly patients with concurrent obesity often have protein under nutrition that also goes undiagnosed (Wells & Dumbrell, 2006).

Although the prevalence of malnutrition among elderly people living in the community is reported to be between 2% and 16%, up to 55% of elderly people admitted to hospital have pre-existing proof of malnutrition (Wells & Dumbrell, 2006). The incidence of protein under nutrition in geriatric rehabilitation is estimated at 57%, not including patients with micronutrient deficiencies (Chandra, 2002). Through their hospital stay, in addition to pre-existing malnutrition, hospitalised patients also experience new nutritional problems like nausea, "nothing by mouth" orders, side effects of medication, vision problems, limited access to snacks and ethnic or religious food preferences all adding up to poor nutritional intake (Milne, Potter, Vivanti, & Avenell, 2009).

Malnutrition is also associated with increased duration of stay, readmission, mortality, skin breakdown, and infection during hospitalization. Compromised nutritional status could also be associated with reduced immunity, breathing and muscle control, and delays in wound healing (Pichard et al., 2004).

In addition to understanding dietary concerns, current medical research confirms the value of executing a treatment plan promptly. Typically, physical examination does not help detect early malnutrition in the elderly, as some of the muscle bulk loss may be due to age-related processes. However, changes in the nail, hair, tongue and angle of the mouth could be due to specific nutrient deficiencies. These findings combined with biochemical studies such as laboratory tests examining complete blood counts with differential, albumin, ferritin, electrolytes, blood urea nitrogen, fasting glucose, and creatinine can provide an objective measure of nutritional status (Reuben et al., 2004).

The Mini-Nutritional Assessment (MNA) is the most commonly used and widely accepted screening tool used by physicians. It contains six questions and is strongly correlated with total MNA score ($r = 0.945$), and is applicable for both community dwelling and hospitalised elderly (Ranhoff, Gjoen, & Mowe, 2005). Another simple office measuring tool designed to identify older people's malnutrition is the Body mass index (BMI= weight in kilograms (kg)/height in meters $(m)^2$). A suitable height estimate is arm length in the elderly. Regular weight monitoring is a quick but effective way to monitor malnutrition during office appointments (Corish, Flood, & Kennedy, 2004). The SCALES evaluation (Nutritional Screening Initiative 2005) is another easy-to-perform mnemonic screening tool. This requires physicians to evaluate older patients with respect to: sadness (depression); levels of cholesterol; albumin (serum levels < 40 g / L); weight loss; eating problems (cognitive and/or physical determinants); and shopping problems or inability to prepare meals. A problem with three or more of these

areas indicates a high risk for malnutrition. Another method is the "Determine Your Nutritional Health Checklist," which in the community setting can be a very useful tool (Nutritional Screening Initiative, 2005). Nevertheless, because it focuses on self-reporting, it may be of limited use for seniors with cognitive impairment or poor vision. A validated tool in the nursing home setting is the amount of food left on the plate of a resident. People who have more than 25% of their food on their plate are most likely to suffer from protein under nutrition (Beck, Ovesen, & Schroll, 2001).

2.5.3.6 Xerostomia (Dry Mouth)

Saliva is a salient component in the maintenance of oral health and thereby, general health. It acts as a source of ions facilitating re-mineralization of calcified tissues, offering physiological and immunological protection (Edgar et al., 2004). Dry mouth hampers eating, swallowing and putting on dentures thus, leading to taste modifications, ulcerations of the oral mucosa, burning sensation of the oral mucosa and inferior oral hygiene (Stookey, 2008). Dry mouth can be triggered by numerous causes such as, dehydration, medication, chemotherapy and radio therapy, salivary gland diseases and aging of human body (Sreebny, Valdini, & Yu, 1989). A reduction in the amount of saliva and the characteristic of saliva exposes the oral cavity to the ill effects of microorganisms causing several oral infections such as caries, gingival inflammation, angular chelitis and candidiasis (Greenspan, 1996).

Also, there is the group of older people who may multiple underlying co-morbidities but are retaining natural teeth with dental diseases requiring various ranges of curative and rehabilitative treatment (John et al., 2004).

2.5.4 Ageing and Oral Health

Dental longitudinal investigations (Kowal et al., 2012) (Murray, 2014) of older adult populations have improvised our database pertaining to the natural history and prevention of oral diseases. It indicates that all oral conditions are not true 'aging' changes in all older adults, reflecting both the accumulation of oral diseases over time and the influence of factors such as stress, trauma, medications, and psychological. For example, 'age-related' changes in the oral cavity would include coronal caries, root caries and periodontal diseases, conditions such as tooth-loss and oral mucosal problems, reflecting both the accumulation of oral diseases over time and the influence of factors such as stress, trauma, medications, and psychological, neurological and medical conditions (Razak et al., 2014). A picture as shown in Figure 2.1 depicts the normal anatomy of the human tooth.

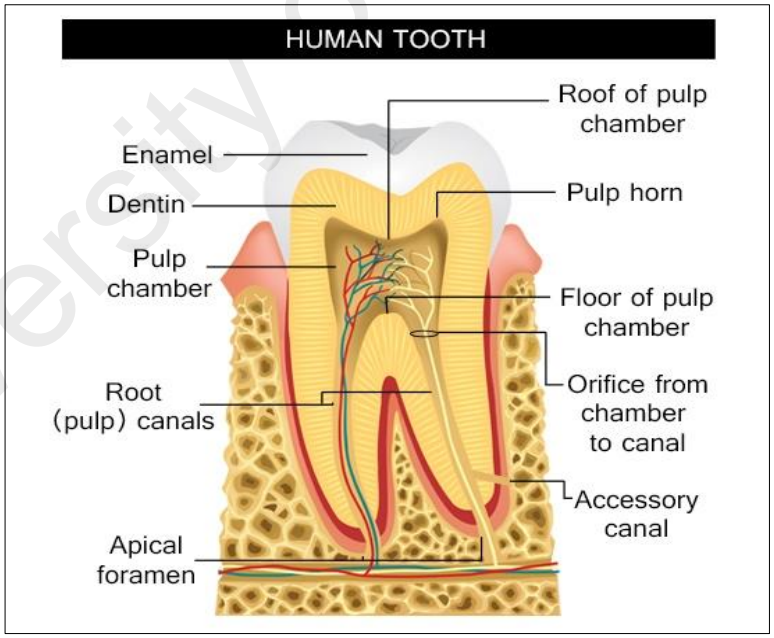


Figure 2.1: Normal Anatomy of the Human Tooth (https://www.pinterest.com/pin/546694842250032145/)

2.5.5 Age Related Dental Changes

2.5.5.1 Teeth

Some aging changes occur in terms of the Appearance of teeth (Guiglia et al., 2010).

A. 'Shortening' of the tooth crown may occur due to occlusal attrition. The perikymata and imbrication lines are lost, giving the enamel surface a flat appearance with less detail than in newly erupted teeth.

B. Teeth darken, become 'yellower' and are less translucent because of:

B.1. Decreased enamel permeability, altering the optical density of the enamel; and

B.2. Increased 'thickness' of dentine, changes in the type of dentine and dentine sclerosis resulting from sedimentation of crystals.

B.3. Pigmentation of anatomical defects, corrosion products and inadequate oral hygiene are contributing factors too (Chalmers, Carter, & Spencer, 2003).

Physiological Changes: The changes in *Enamel* are based on ion-exchange mechanisms. With age, it becomes less permeable and more brittle with age and the nitrogen content of enamel is expected to increase (Atsu, Aka, Kucukesmen, Kilicarslan, & Atakan, 2005). For *Dentin*, two-age change takes place; continued growth, referred to as physiological secondary dentin formation and gradual obturation of the dentinal tubules referred to as dentin sclerosis. The *Dental Pulp* of older individuals has more fibers and lesser cells, and hence reduced volume. Reduction of blood supply especially in the region of subodontogenic plexus is observed (Morse, Esposito, Schoor, Williams, & Furst, 1991). These changes in turn attribute to the low reparative capacity of the pulp as compared to younger teeth. Electron microscopy of the old pulps reveals loss and degeneration of both myelinated and unmyelinated nerve

fibers affecting the healing capacity of the pulp. Pulp calcification (number and size), diffuse calcifications and narrowing of the root canals are found to increase with age. With age, rate of formation of *Cementum* diminishes but cases of hypercementosis (excess amounts of Cementum) are reported as well. This could be associated with accelerated elongation of an unopposed tooth or to an inflammatory stimulus. Furthermore, increase in the fluoride and magnesium content is seen with age (Morse, 1991) (Fejerskov, Larsen, Richards, & Baelum, 1994).

The age changes as shown in Figure 2.2 have important clinical repercussions as they impact/ influence the outcomes of restorative treatments and reparative responses. The dentist need to keep in mind the design of cavity preparations for an ageing tooth; the choices of restorative materials; anatomy and aesthetic appearance of final restoration. Even the radiographic interpretation and diagnosis requires expertise (John et al., 2004).

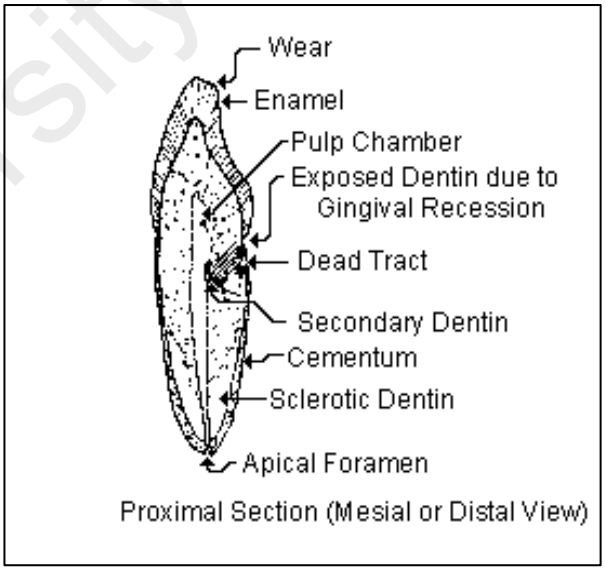


Figure 2.2: Proximal Section Depicting Age-Related Changes of the Human Tooth (https://www.studyblue.com)

2.5.5.2 Oral Mucous Membrane

With age, a decline in protective barrier function of the oral mucosa could expose the host to an army of pathogens and chemicals that could enter the oral cavity during daily activities. The epithelium, and the connective tissue which form the two histologic layers of the oral mucosa, are reported to have important defensive functions. The stratified epithelium, which is made up of closely apposed, attached cells, constitutes a physical barrier that interferes with the entry of toxic substances and microorganism. Mucosal epithelial cells also synthesize several substances that are critical for maintenance of the mucosal surface, such as keratin and laminin (Friedman, 2014).

Also, it is reported that the oral mucosa becomes increasingly thin and smooth with age and that it acquires satin like edematous appearance with loss of elasticity and stippling. In particular, the tongue is reported to show marked clinical changes becoming smoother with loss of filiform papillae. The tendency for development of sublingual varices and increased susceptibility to various pathological conditions such as candidal infections and decreased rate of wound healing is shown to increase with age (Papas, Niessen, & Chauncey, 1991).

Dentists need to evaluate the oral mucosal status in older persons for the use of prosthetic appliances, which has considerable potential to alter mucosal integrity if not maintained properly.

2.5.5.3 Periodontitis

In the older people, periodontal issues do not appear to be specific disease but the result of a chronic periodontitis from adulthood (Jin, Chiu, & Corbet, 2003). Age-related changes have been reported in the periodontium of older people as shown in Figure 2.3; these changes however, do not appear to be the cause of periodontal

diseases. Increased severity of periodontal diseases with age has been attributed to the length of time the periodontal tissues have been exposed to the dento-gingival bacterial plaque and is considered reflective of the individual's cumulative oral history. However, the susceptibility of the periodontium to plaque-induced periodontal breakdown may be influenced by the aging process or by a specific health problems of the aging patient (Rattan & Kassem, 2007).

In older people, at the biological level, changes in structure and function during aging may affect the host response to plaque microorganisms and may influence the rate of periodontal destruction. In the older people, recovery of plaque in greater amounts could be in part, to a larger area for plaque retention because of the gingival recession. Furthermore, the exposed cementum of the root surface and dental enamel influence the plaque formation rate as they constitute two unlike types of hard dental tissues with distinct surface characteristics. Variations in dietary habits, increased flow of gingival exudate from the inflamed gingiva and possible age-related changes in salivary gland secretions may also alter the conditions for growth and multiplication of the plaque microorganisms (Razak et al., 2014).

Epidemiological surveys have reported that the prevalence and severity of periodontal diseases increase with age and the Community Periodontal Index score of 4 (deep pockets) ranges from approximately 5-70% among older people (WHO, 2007). Figure 2.3 reflects some of the age-related changes of the human tooth.

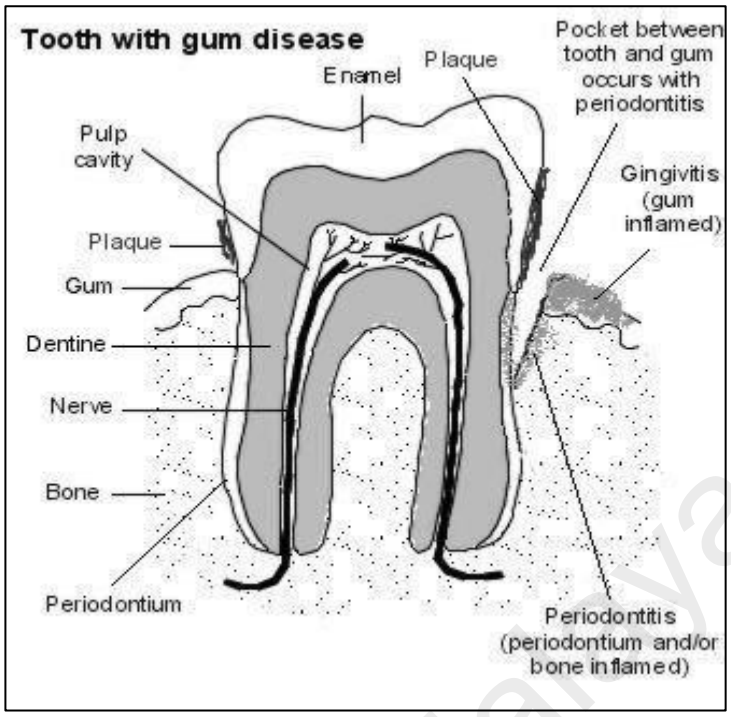


Figure 2.3: Age- Related Changes in the Periodontium of the Human Tooth (https://medical.azureedge.net)

2.5.5.4 Changes in the Salivary Gland and Secretion

Saliva protects the oral cavity, the upper airway and digestive tract and facilitates numerous sensorimotor phenomena. Therefore, the absence of saliva has many deleterious consequences to the host. Aging is associated with atrophy of acinar tissue, a proliferation of ductal elements and some degenerative changes in the major salivary glands. The changes in the gland and its tissue take place linearly with increasing age. It is reported that minor salivary glands also undergo similar degenerative changes with advancing age. This eventually leads to a normal, uniform decrease in the acinar content of salivary gland tissue accompanying the aging process (Vissink, Spijkervet, & Amerongen, 1996).

With advancing age, degradation of quality and decrease in quantity of saliva pre disposes the oral cavity to the action of microorganisms leading to various oral

infections such as caries, gingival inflammation, angular chelitis and candidiasis (Greenspan, 1996).

2.5.6 The Incidence of Oral Diseases and Conditions

In the present day and age, the oral health of elderly people is far from optimal. Their treatment needs per se are high due to conditions like edentulism, missing teeth, caries, periodontal diseases and attrition resulting in impaired oral function and in turn, affecting their quality of life (Ramli et al., 2002). Successive cohorts of older adults are maintaining a greater proportion of teeth into later years whilst continuing to share their unequal burden of problems arising from tooth loss. Therefore, this new cohort of the older population is expected to be highly critical and more demanding when it comes to oral healthcare services (Dolan & Atchison, 1993).

2.5.6.1 Caries

Dental caries or tooth decay clinically is defined as a lesion extending beyond the surface of enamel or cementum. It could affect the coronal as well as the roots of the teeth (Saunders & Meyerowitz, 2005). The etiology of caries is through a complex interaction over time between acid-producing bacteria and fermentable carbohydrate, and the host factors including teeth and saliva. Risk factors for caries include physical, biological, environmental, behavioural, and lifestyle-related factors such as high numbers of cariogenic bacteria, inadequate salivary flow, insufficient fluoride exposure, poor oral hygiene, chronic medical conditions, cognitive deficits due to mental illness, depression, Alzheimer's disease or dementia, Sjögren's syndrome (an autoimmune disease), multiple medication use, diminished manual dexterity due to stroke, arthritis, or Parkinson's disease, diabetes, Radiation treatment for head and neck cancer and poverty (B Gupta, 2006) (Selwitz, Ismail, & Pitts, 2007). Dental caries experience is measured by the mean number of Decayed, Missing and Filled Teeth index (DMFT) (P.

Petersen et al., 2010). The incidence of primary coronal caries in the older adults is not high but secondary coronal caries and root surface caries do have a high prevalence (Banting, Ellen, & Fillery, 1980).

For developed nations like United States of America, England, Denmark, New Zealand, Norway and Sweden a decline in the caries prevalence has been reported in the last part of the 20th century. According to the WHO databank for developing countries an increase in caries severity has been reported with DMFT ranging from 1.6 to 10.4 over periods of 9-50 years (Krishna Madhusudan, 2010). For the Malaysian Adults according to NOHSA 2010, there has been a declining trend in caries prevalence with 95%, 94.6% and 90.3% of adults experiencing caries in first, second and third adult epidemiological surveys respectively. For the 65-74 year age group, mean D index was 1.55 (95%CI:1.29-1.81); mean M index was 22.14 (95% CI:21.09-23.18), mean F index was 0.66 (95% CI:0.42-0.91 and mean DMFT was 24.35 (95% CI: 23.49-25.21) (Oral Health Division, 2010). Figure 2.4 depicts the microscopic progression of dentinal caries.

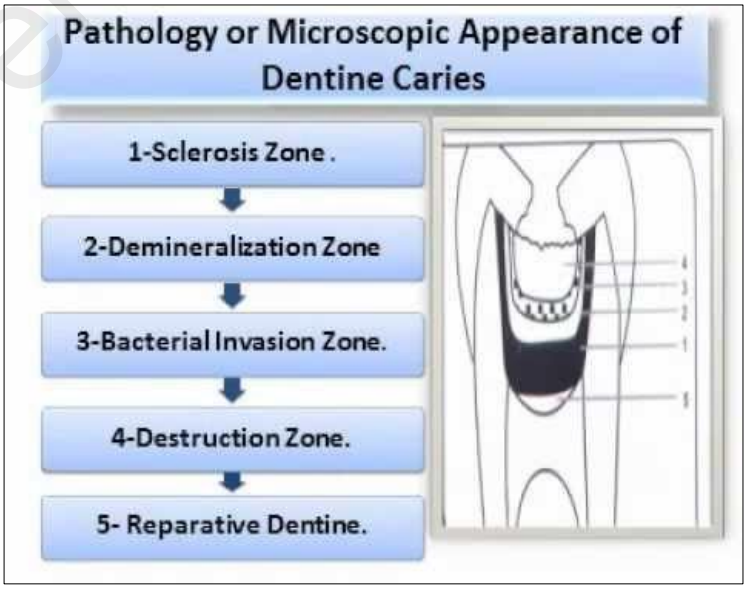


Figure 2.4: Microscopic Appearance of Dentine Caries

(https://www.google.com/dentinalcaries)

2.5.6.2 Tooth Loss and Edentulism

With increasing age, relatively more teeth are lost. Complete edentulism as shown in Figure 2.5 is a state of complete tooth loss described as the final marker of the burden of diseases for the health of the oral cavity (Cunha-Cruz, Hujoel, & Nadanovsky, 2007). Edentulism could be partial or complete. Edentulism was commonly reported in the older adults; however, in the present scenario growing number of people manage to retain their natural dentition into old age. The status of edentulism in Malaysia is greatly influenced by the historical pattern of oral health care practiced during the 19th century especially in the United Kingdom, when tooth extraction was perceived as an acceptable, and a preferred approach having left a legacy of edentulism among the Malaysian elderly (Ramli et al., 2002). Dental caries and periodontal disease are considered the major risk factors for tooth loss and in turn significant component of the global burden of oral disease (WHO, 2006). The risk factors for edentulism are influenced by the interaction between dental diseases, attitude towards dental health, socioeconomic status, lifestyle and habits (Amarasena et al., 2003).

It has been reported that the prevalence rate of edentulism is high (35%) in upper-middle income countries, but currently low (10%) in low income countries (Bank., 2010). Data from NOHSA 2010 shows a trend of decline in the incidence of edentulism with increasing age from 11.8% in 1974/75, 10.4% in 1990, and 8.8% in 2000. Tooth mortality is a major problem among older people in Malaysia with 32.2% of individuals in the 65-74 years old age group reported as edentulous (Oral Health Division, 2010). Compared to the change observed in adult surveys, there is not much marked improvement. The proportion of edentulous adults decreased from 28% in 1978 to 6% in 2009 for England (The NHS Informartion Centre, 2009) whereas, for Australia, the

decrease in edentulous adults was from 14.4% to 6.4% in 2006 over a period of 17 years (GD, AJ, & KF, 2004) (Marino, Calache, & Whelan, 2014).

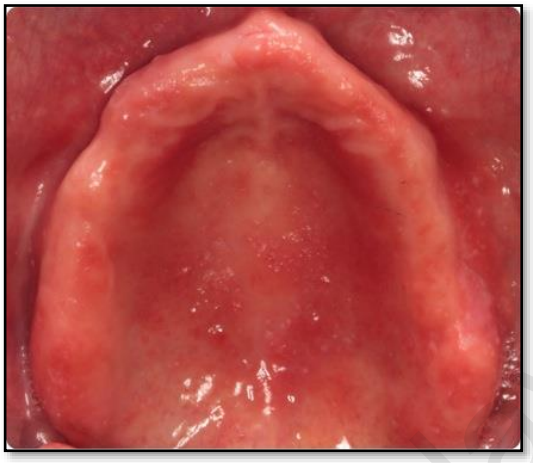


Figure 2.5: Complete Edentulism
(http://www.dentalnews.com)

2.5.6.3 Periodontal Diseases

Chronic periodontitis is a worldwide oral health problem, affecting people of all ages with high prevalence reported among the older population (WHO, 2007). The global prevalence of chronic periodontitis is 30-35% among the general adult population with 10-15% of the adult population having a Community Periodontal Index score of 4 (the most severe score or sign of periodontal disease) (Petersen, Bourgeois, Ogawa, Estupinan-Day, & Ndiaye, 2005).

According to epidemiological surveys conducted in the United States, United Kingdom, Japan, Korea, India and Australia, around 50-70% of the older population suffer from chronic periodontitis (Petersen & Ogawa, 2012) whereas, according to the National Oral Health Survey in Adults (NOHSA) conducted among Malaysian adults in 2010, the prevalence of chronic periodontitis at 48.5% among the general adult population (Oral Health Division, 2010). Among these adults, 4.1% reported gingivitis,

41.4% had calculus, 30.3% had shallow periodontal pockets, and 18.2% had deep periodontal pockets. The mean number of sextants with periodontal disease was 4.48. It was also reported that 94% of dentate adults needed oral hygiene instructions (TN1), 90% required oral hygiene scaling and prophylaxis and 18.2% required complex treatment (Oral Health Division, 2010).

2.5.6.4 Oral Mucosal Lesions and Oral Cancer

Oral cancer, which includes lip, oral cavity, and pharynx cancer, is of prime concern for individuals aged 65 years and older as they are reported to be 7 times more likely to be diagnosed with oral cancer than persons under 65 years of age (Ries et al., 2000). The prevalence of oral cancer is estimated to increase at an alarming rate according to World Health Organisation estimates, from 10 million new cases globally in 2000, to 15 million in 2020 (Mignogna, Fedele, & Russo, 2004). Tobacco use and other risk habits like betel quid chewing and excessive alcohol consumption are all risk factors for development of oral cancer. Amongst the Malaysian population prevalence of smoking is high (21.5%) with 46.4% of males being smokers (Oral Health Division, 2010).

Literature has time and again demonstrated the negative impact on oral health of HIV infection (Poul Erik Petersen et al., 2005) (Cueto et al., 2013). It is estimated that 40–50% of people who are HIV-positive have oral disease caused by fungal, bacterial, or viral infections that mostly occur early during the disease. Pseudo-membranous oral candidiasis, oral hairy leukoplakia, HIV gingivitis and periodontitis, Kaposi's sarcoma and non-Hodgkin lymphoma and dry mouth as a result of decreased salivary flow rate are some of the oral lesions strongly associated with HIV infection (Jainkittivong, Aneksuk, & Langlais, 2002) (Jin, Lamster, Greenspan, Pitts, Scully, & Warnakulasuriya, 2016) (Zakaria et al., 2017)

2.5.6.5 Prosthetic Considerations

The most important determinants while deciding the treatment and determining the prognosis are:

- Debilitating diseases: People suffering from chronic illness totally neglect oral and prosthetic care. Under such circumstances, prosthetic treatment should be postponed until the person's general health is restored and dentists should reinforce on maintenance of oral hygiene as a way to control caries and periodontal disease (Papas et al., 1991).
- Neurophysiological changes: With advancing age, functional elements in the central nervous system degenerate. They act as a limitation in the person's capacity for acquiring new muscle activity patterns. Older people, therefore, take time to adapt to any prosthetic treatment and learn the new muscle activity patterns (Razak et al., 2014).
- Mental changes: Neurocognitive decline and delirium coupled with contributing factors for poor oral health such as rapid dental decay, acute and chronic periodontal infections and compromised systemic health on a background of a dry mouth, coupled with xerostomia-inducing medications, reduced fine motor function, declining cognition and motivation will not only lead to an increase in both morbidity and mortality but also impact on quality of life (Foltyn, 2015).
- Oral physiological changes: Progressive atrophy of the masticatory, buccal and labial musculature is considered a sign of aging. This process is often accelerated in the people wearing dentures. Atrophy of the masticatory muscles severely affects chewing efficiency, which can be sufficiently improved through prosthetic treatment in conjugation with professional advice to attain an adequate diet that is easy to chew (Razak et al., 2014).

CHAPTER 3: METHODOLOGY

3.1 Study Design

The study design was an observational, comparative cross-sectional study. It was carried on consecutive older patients being admitted to the geriatric ward located on the 11th and the 13th floor of the University of Malaya Medical Centre (UMMC) as well as on those being simultaneously recruited by Malaysian Elders Longitudinal Research (MELoR), in short, a national research study was conducted by University of Malaya to gain in-depth understanding about the present issues that our country's community dwelling older population are facing so that the Government and relevant agencies can plan for a better and holistic future for the older community. The study is supported by two grants under University of Malaya High Impact Research (Grant number UM.C/625/HIR/MOHE/DENT/07 and UMC/625/HIR/MOHE/ASH02).

3.2 Sample and Sampling Method

3.2.1 Hospitalised Participants

One part of the study was conducted on a total of 78 participants who were admitted to the geriatric wards located on the 13th and 11th floor of the University of Malaya Medical Centre (UMMC) because of sudden worsening of their general health, selected through convenience sampling. Three participants were reported to have died during the period of the study and were therefore, were excluded from the study. Thus, the final number of hospitalised participants in the study was 75 participants. Five of the participants were resided all alone whereas; others lived with their immediate family, caretakers or relatives before admission to the hospital. Detailed medical histories and the drugs that they used daily were verified by the hospital staff from medical records obtained upon admission. In-depth hospital records for each patient were maintained following admission determined by a team of physicians, including specialists in

geriatric medicine, internal medicine, neurology, nutritionist, occupational therapists, physiotherapists and psychologists. Average length of stay in the acute geriatric ward was approximately two weeks, and during this stay the patients were interviewed and examined (H.P.) (Sousa, Silva Filho, Mendes, Moita Neto, & Prado Junior, 2014). A convenience sampling method was used, and participants were recruited over a period of one and a half years from June 2014 till December 2015.

3.2.2 Non- Hospitalised Participants

For comparison, matched samples (1:1) of older non-hospitalised participants were selected from an ageing cross-sectional study from MELoR. The MELoR participants were recruited over a period one year from February 2014 till February 2015 as a representative sample selected through simple random sampling stratified by ethnicity and age from three local Parliamentary constituencies. The general and clinical health assessment for non-hospitalised participants was carried out once a week at a hospital based setting. Matching was conducted based on five-year age-groups and gender.

The Malaysian Elders Longitudinal Research (MELoR) recruited community-dwelling individuals aged 55 years and above residing within greater Kuala Lumpur (Goh, Ng, & Tan, 2016). Random sampling of individuals from the electoral rolls of three parliamentary constituencies in the Klang Valley, namely; Lembah Pantai, Petaling Jaya Utara and Petaling Jaya Selatan, stratified by three-major ethnic groups in Malaysia namely the Malay, Chinese and Indian ethnicities and age was done for the purpose of participant selection as shown in Figure 3.1. MELoR was the first research group of its kind in Malaysia; involving the collaborative efforts of multiple faculties and the Faculty of Medicine of the University of Malaya. Various faculties included Medicine, Economics, Law, Public Health Education, Sports Medicine, Computer Science, Built Environment, Engineering (Biomedical & Manufacturing), Institute of

Management Research & Consultancy and Dentistry. The multi-dimensional focus of the study was to allow for retired people to continue contributing to society; while also living in an environment where they are able to be actively involved in the formulation and implementation of policies related to their well-being and life (https://melor-um.weebly.com).

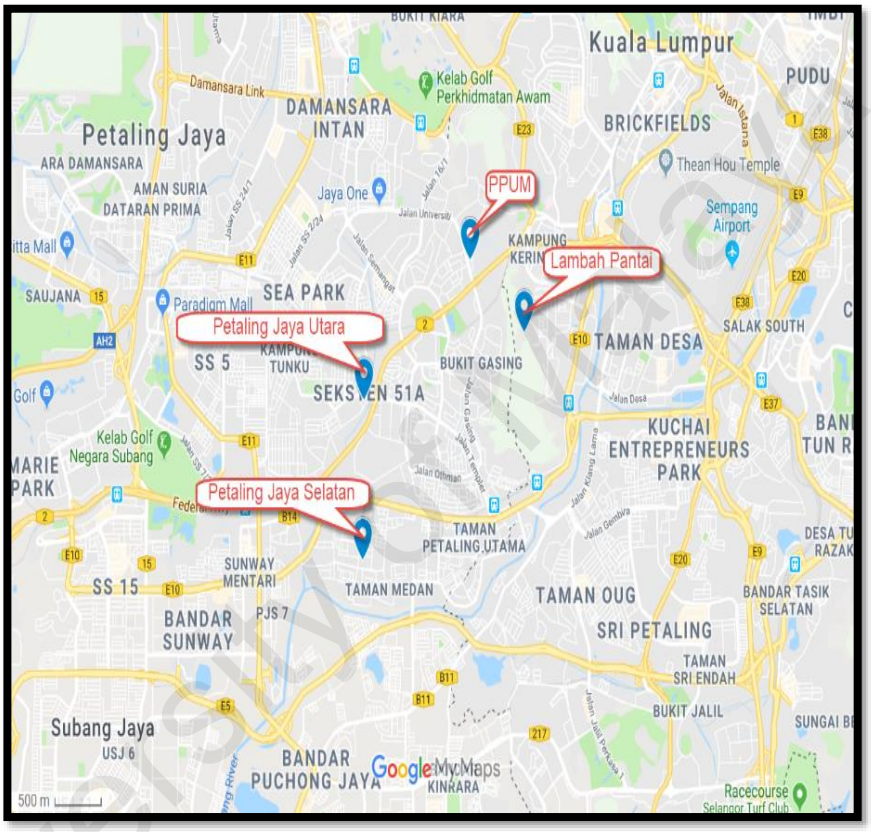


Figure 3.1: MELoR Map

3.3 Sample Size

Using G*Power 3.1.9, assuming if one-third of the population has any loss of sound teeth, a sample size of 150 will provide 80% power to detect an effect size ([mean of cases- mean control]/standard deviation of sample) of 0.30 (which constitutes a small to medium effect size). This will translate to a 30% difference in the primary outcome measure (Carrilho Neto, De Paula Ramos, Sant'ana, & Passanezi, 2011).

3.4 Inclusion and Exclusion Criteria

The inclusion and exclusion criteria for the hospitalised participants are presented in the table below:

Table 3.1: Inclusion and exclusion criteria for the hospitalised participants

Inclusion Criteria	Exclusion Criteria
1. Age ≥ 65 years.	1. Refusing informed consent.
	2. Critically unwell.
	3. Unable to tolerate dental assessments.
	4. Those who were non-conscious.

The inclusion and exclusion criteria for the non-hospitalised participants are presented in the table below:

Table 3.2 Inclusion and exclusion criteria for the non-hospitalised participants

Inclusion Criteria	Exclusion Criteria
1. Age ≥ 55 years.	1. Refusing informed consent.
	2. Under the age of 55 years
	3. Unable to tolerate dental assessments.
	4. Those who are bedbound and unable to be transported to the research center for assessments.
	5. Unable to answer questions verbally or unable to communicate for example sufferers of severe dementia or those who have a severe speech disability.

3.5 Ethical Consideration

Ethical approval was obtained from University of Malaya Medical Centre (MECID.NO: 20144-89) for the hospitalised participants and non-hospitalised participants (MEC reference number: 943.6) prior to the initiation of the study. This study was conducted in full accordance with the World Medical Association Declaration of Helsinki.

- Obtained for non-hospitalized participants (Medical Ethics Committee on 03/04/2014).
- Obtained for MELoR participants (Medical Ethics Committee on 19/09/2012).

3.6 Measurements

Interview and clinical assessments were used to collect data for both the hospitalised and the non-hospitalised participants.

*A pilot study was conducted in the Geriatric Ward at UMMC on five hospitalised participants who were later included in the final sample of the study. The pilot was conducted to obtain an estimate of the problems that would be encountered on the ward during the recruitment procedure and to assess the willingness and capacity of the patients on the ward to tolerate the interview and examination. It was observed during the pilot study that a language barrier existed between hospitalised participants and the assessors. In addition, the patients were prone to exhaustion, limiting the ability to respond to lengthy questioning. As much as possible information on socio-demographic data, general health status and medication history and calf circumference data (as a part of MNA questionnaire) were obtained from hospital records. Interviews and assessments were conducted in the morning to hasten the recruitment procedure. The

hospitalised and the non-hospitalised groups of participants were most responsive during the morning hours. The assistance of nursing staff was sought for translation purposes.

3.6.1 Interview Based Assessments

The questionnaire was designed and structured to gather the following information for both sets of participants.

- Socio demographic information: age, gender, ethnicity, level of education, marital status, living status (residing alone or not).
- Self-perception of health and oral health. Likert scale questionnaire was used to assess the self- rated oral and general health and was scored using the four response options; Poor (1), Fair (2), Good (3) or Excellent (4).
- General health assessment to assess the presence of co-morbidities like hypertension, cholesterol, respiratory illness, history of any stroke/ transient ischemic attack (TIA). The medical records were cross-checked to confirm the presence of ailment (for participants admitted in the geriatric ward, their respective records were used to obtain this information and lessen the burden of an interview on the patient).
- Structured questionnaires were administered by dentists to provide information on the oral health related knowledge, attitude and practices. Questions and responses were adapted and modified according to our local cultural context from two different studies carried out to determine the oral health related knowledge, attitudes, practices and behaviour of adults in China (H. C. Lin, M. C. Wong, Z. J. Wang, & E. C. Lo, 2001) (Zhu, Petersen, Wang, Bian, & Zhang, 2005). The knowledge component was assessed based on three questions to test the participant's understanding of oral health: are teeth important for eating; is it

important to brush teeth daily; do you think fluoridated tooth paste is good for you or not. The attitude component was assessed based on two questions: last visit to the dentist; how do you feel about visiting a dentist (fear of dentist). The last component of practice was assessed based on four questions to judge the acquisition of habits of preservation and maintenance of oral health: type of tooth brush used; brushing frequency; reason for visiting a dentist; difficulty in chewing food. Binomial responses were recorded for the knowledge domain; they were coded as No/Yes. Multinomial responses were recorded for the other two domains; as presented in Table 4.3.

- Nutritional assessment was carried out using the Mini-Nutritional Assessment Form. The Mini Nutritional Assessment (MNA) is a part of the Comprehensive Geriatric Assessment (CGA) to assist in clinical practice by measuring the nutritional status in older people in outpatient clinics, hospitals, and nursing homes. It is a validated nutrition screening and assessment tool that can identify geriatric patients age 65 years and above who are malnourished or at risk of malnutrition. The MNA was developed nearly 20 years ago and is the most well validated nutrition screening tool for the elderly. Originally comprised of 18 questions, the current MNA now consists of 6 questions and streamlines the screening process. The current MNA retains the validity and accuracy of the original MNA in identifying older adults who are malnourished or at risk of malnutrition. It provides a single, rapid assessment of nutritional status and is composed of simple measurements and brief questions that can be completed in about 10 minutes. It is a well-validated tool, with translations in more than 20 languages. The questions are simple and brief. It has a 96% sensitivity and 98% specificity, and a predictive value of 97% which distinguishes patients by their adequate nutritional status (score $\geq$ 24), risk of malnutrition (score 12‑23), and malnourishment (score < 17) (Guigoz, Vellas, & Garry, 1996).

Individuals who are at risk of malnutrition have not yet started to lose weight and do not show low plasma albumin levels but have lower protein-calorie intakes than recommended. For them, a multidisciplinary geriatric intervention is recommended, considering all aspects and if necessary, therapeutic interventions for diet or supplementation to be advised. An MNA score of less than 17 is indicative that the patient has protein-calorie malnutrition. It is recommended at this stage to quantify the severity of the malnutrition (by measuring biochemical parameters like plasma albumin or prealbumin levels, establishing a 3- day record of food intake, and measuring anthropometric features like weight, BMI, arm circumference and skin folds). With the scoring method, the tool was reported to have high sensitivity, high specificity and high reliability (Vellas et al., 2006).

3.6.2 Clinical Assessment

Clinical assessments were carried out for non-hospitalised participants once a week on Saturday mornings in the Diabetic Rehabilitation Clinic of UMMC. Bedside assessments were carried out in the ward for hospitalised patients, considering their overall health status.

3.6.3 Oral Health Status (Dentition Status, Periodontal Heath Status and Levels of Dryness)

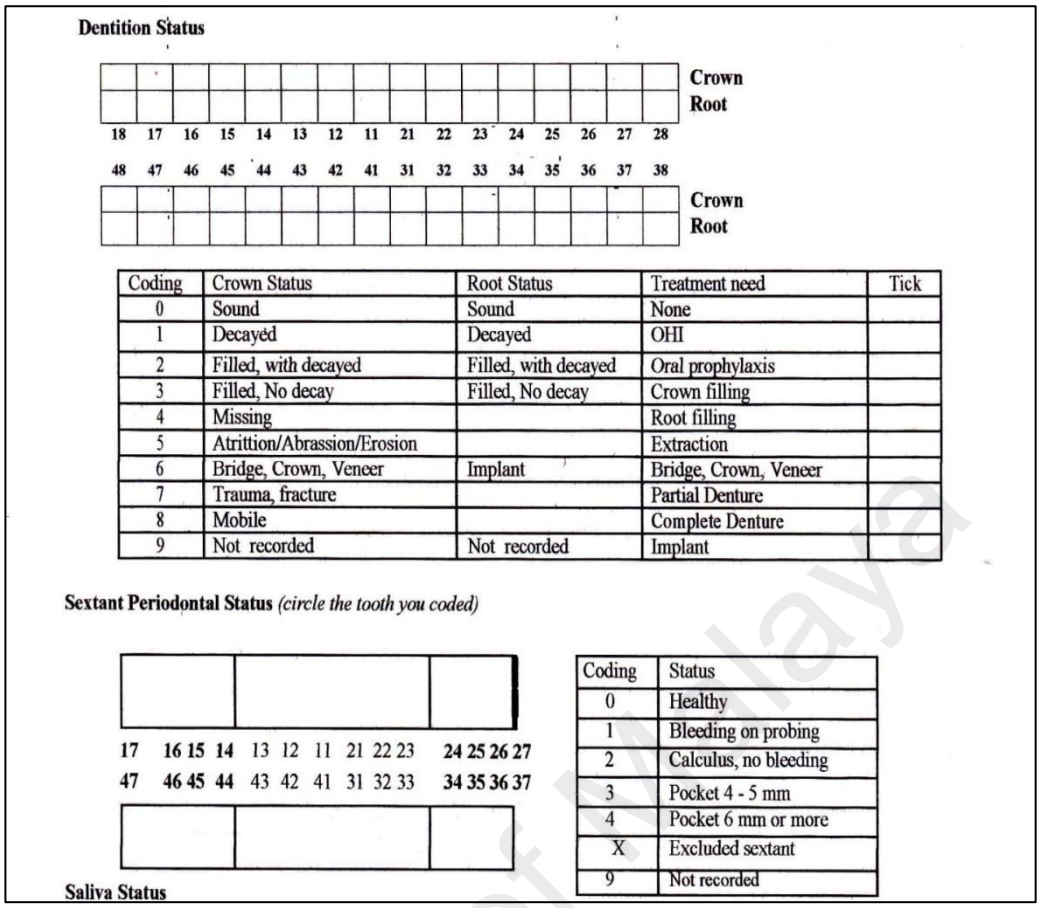
3.6.3.1 Dentition Status

- The clinical examination for dentition status, periodontal status and prosthesis status followed an oral health examination format adapted and modified to our local cultural context from the WHO Oral Health Assessment form (WHO, 2013) as shown in Figure 3.2. The dental examination was carried out using a portable dental unit with a headlight. Basic dental instruments and amenities such as mouth mirror, disposable dental examination kits and WHO periodontal probe were used during the

clinical examination. Examination of all permanent, fully erupted teeth (including the third molars) was carried out. The examination was carried out by trained and calibrated dentists. Subsequently, each tooth was classified as Decayed (D), Missing (M), Filled with no decay (F), Sound (S) or Mobile (M) to determine the dentition status of each individual. Participants were assessed on their needs for restorative, periodontal, prosthetic treatment and if any pathology is found; appropriate arrangements for care were made.

3.6.3.2 Periodontal Health Status

- Periodontal examination was carried out using a WHO probe with calibrated markings (Hu-Friedy Mfg. Co. Inc., Chicago, IL, US). Basic periodontal examination (BPE) was used for assessment of periodontal status of participants, with the mouth divided into six sextants. BPE is an important tool in periodontal screening of participants in epidemiological surveys with score 0 “healthy”; score “1” bleeding upon probing; score 2 “calculus”; score 3 “shallow pocket”; and score “4” as deep pocket (BSP, 2011). The presence of BPE scores of “3” or “4” indicates the presence of chronic periodontitis.



Dentition Status

Crown
Root

18 17 16 15 14 13 12 11 21 22 23 24 25 26 27 28

48 47 46 45 44 43 42 41 31 32 33 34 35 36 37 38

Crown
Root

Coding	Crown Status	Root Status	Treatment need	Tick
0	Sound	Sound	None	
1	Decayed	Decayed	OHI	
2	Filled, with decayed	Filled, with decayed	Oral prophylaxis	
3	Filled, No decay	Filled, No decay	Crown filling	
4	Missing		Root filling	
5	Atrittion/Abrassion/Erosion		Extraction	
6	Bridge, Crown, Veneer	Implant	Bridge, Crown, Veneer	
7	Trauma, fracture		Partial Denture	
8	Mobile		Complete Denture	
9	Not recorded	Not recorded	Implant	

Sextant Periodontal Status *(circle the tooth you coded)*

17 16 15 14 13 12 11 21 22 23 24 25 26 27

47 46 45 44 43 42 41 31 32 33 34 35 36 37

Coding	Status
0	Healthy
1	Bleeding on probing
2	Calculus, no bleeding
3	Pocket 4 - 5 mm
4	Pocket 6 mm or more
X	Excluded sextant
9	Not recorded

Saliva Status

Figure 3.2: WHO Adapted Form for Oral Clinical Assessment

3.6.3.3 Level of Dryness of the Oral Cavity

- The Challacombe scale is used to assist in visually identifying and quantifying whether your patient has xerostomia (dry mouth) and if so, how it changes over time and the most appropriate therapy options. Under the supervision of Professor Stephen Challacombe through research conducted at King's College London Dental Institute; a scale to visually quantify and identify xerostomia was developed. It was known as the "Challacombe Scale". This scale was also chosen as tool for our study keeping in mind the time limitation when conducting community screening and to lessen the burden for lengthy assessments on the hospitalized participants. The Challacombe Scale works as an additive score of 0 to 10; 0 indicating absence of and 10 indicating severe xerostomia. Each symptom scores 1 and symptoms will not necessarily progress

in the order shown, but summative scores indicate likely patient needs. Changes in the score over time can be used to monitor symptom progression or regression of xerostomia (Frost et al., 2006). The examination was carried out by using a dental mirror and visual observance using the guide line as shown in Figure 3.3. The scoring method for this scale is as follows:

- Mild Dryness: an additive score of 1 - 3 indicates mild dryness. No treatment is required. Sugar-free chewing gum for 15 mins, twice daily and attention to hydration is advised. Routine checkup monitoring will be required.
- Moderate Dryness: an additive score of 4 - 6 indicates moderate dryness. Sugar-free chewing gum or simple sialagogues are advised. Further investigations may be required if reasons for dryness are not clear. Saliva substitutes and topical fluoride may be helpful. Monitoring at regular intervals is recommended especially for early decay and symptom change.
- Severe Dryness: an additive score of 7 - 10 indicates severe dryness. Salivary substitutes and topical fluoride are recommended. Causes for hypo salivation need to be ascertained and Sjögren's Syndrome needs to be excluded. Patients are referred for further investigations and establishment of a concrete diagnosis. Patients then need to be monitored for changing symptoms and signs, with possible further specialist input if worsening.

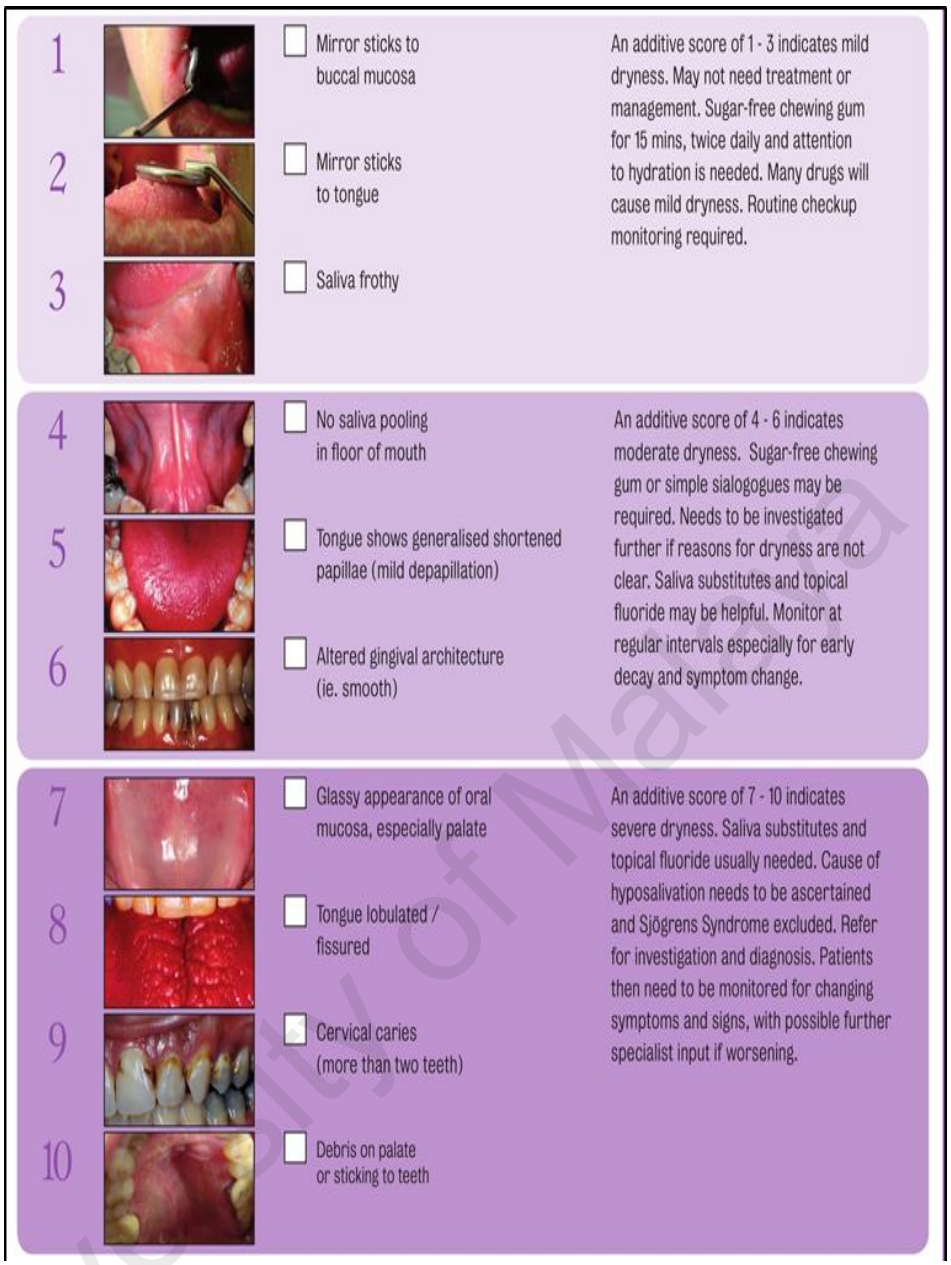


Figure 3.3: The Challacombe Scale

3.7 Standardization and Calibration

Since the non- hospitalised participants were recruited from a larger research group, two assessors were involved in the process of conducting face-to-face interviews and clinical assessments. The standardization and calibration exercises were carried out among these two assessors who were qualified dentists. Both assessors were trained and calibrated by a specialist in Restorative Dentistry (expert). The aim of the exercise was to minimize any examiners variability. For this exercise, the two assessors were asked

to score twenty clinical photographs provided by the expert. The standardization and calibration exercise were carried with a time interval of 3 hours in between the assessments. This time interval was performed to decrease the chance of memorization of previous recordings between the assessors. The Cohen's kappa coefficient was calculated by the expert. The kappa values for inter-examiner and intra-examiner reliability were reported as 0.79 and 0.81 respectively. The questionnaire was too pre-tested prior to the data collection stage. Two dentists were in charge of organizing the clinical examinations and administering the questionnaire in a comparable group of older adults in order to assess reliability and validity. Tests of reliability of answers were carried out from a sub-sample of participants who were given the same questionnaire 20 days after the completion of the initial questionnaire and consistency rates of 70% were achieved.

3.8 Data Collection

Participants from both the groups (hospitalised and non-hospitalised), who fulfilled the inclusion and exclusion criteria, were invited to participate in this study. Participants were provided with the Patient Information Sheet (PIS) before they agreed to participate in the study. The PIS document is the summarized version of the purpose, procedure, possible benefits and drawbacks of the study. The PIS was available in two languages; English and Bahasa Malaysia as shown in Appendix C and Appendix D respectively. Following which, an informed consent was obtained from all the participants or their legal representatives. The consent form was also available in two languages; English and Bahasa Malaysia as shown in Appendix B respectively.

After obtaining informed consent, data collection was carried out in two steps; a face-to-face interview session with respondents and clinical oral health assessment. For the non-hospitalised respondents, face-to-face interviews were performed at

participants' homes using home-based computer assisted interview where the responses were entered and coded in the software and were cross-checked that very day to minimize any errors. For hospitalised participants, bedside face-to-face interviews were carried out and to lessen the burden of lengthy interviews, their respective hospital records were assessed prior to obtaining information on their medical history, medication history and general health status. Basic socio-demographic data, information about co-morbidities, self-perceived general and oral health, and knowledge on oral health, attitudes and practices was determined. Also, data on nutritional assessment was collected. Weekly general and clinical health assessment for non-hospitalised participants was carried out at the hospital. Participants were scheduled for the clinical assessments by the MELoR team depending on their area of residence. Transport was provided to enhance participation. About 30 participants were screened meticulously from station to station, dental being one of them during the health screenings. Whereas, for all the recruited hospitalised participants, bed side general and clinical health assessment was carried out by the two examiners.

3.9 Data Management and Analysis

For the hospitalized participants, the interview and clinical examination data was recorded on the survey forms. Data was then entered into the computer and any missing data due to incomplete records was managed immediately by re-interviewing or re-examining the subject. For non-hospitalized controls, data was entered directly into the computer and cross-checked on the same day to minimize missing data. Missing data was further minimized by setting compulsory fields; further efforts were taken to reconcile missing data during the health check.

Data analysis was carried out using the statistical packages for social sciences software (SPSS Inc., version 20, USA). The cut-off level for statistical significance was

set at $p \leq 0.05$. Appropriate statistical tests were utilized according to the distribution of the main variables. Data cleaning was performed prior to the data analysis.

For demographic characteristics of study subjects, continuous data was presented as mean and standard deviation, whilst the categorical variables were presented as frequencies and percentages. Chi-squared test was applied to determine differences in the socio-demographic profile and the general health status of the hospitalised and non-hospitalised attendees as the data was categorical in nature. Age being a continuous variable in the socio-demographic profile; Paired T-test was used to determine the difference in the age profiles between the two groups of the study population.

The dentition status (decayed, missing, sound, filled and mobile teeth) for both the groups was compared using the Chi-squared test. For the dentition status, mean (SD), range and the p-values were reported.

For questions under the following categories; oral health related knowledge, attitude and practices, periodontal status; nutritional assessment; to measure the level of dryness of the oral cavity for both the groups of participants and to assess the denture wearing status, data was categorical and was analyzed using the Chi- squared test. The Chi-squared tests were employed whenever the number of categories exceeded two. Data was presented with frequency and percentages.

To determine the potential predictors for dentition status for the study population, considering that the dental is count data and the predictors were a mix of qualitative / quantitative data, test applied was Poisson Log linear Regression analysis.

CHAPTER 4: RESULTS

4.1 Results of Interview Based Assessments

4.1.1 Demographic Profile and General Health Status

A total of one hundred and fifty participants, 75 hospitalised and 75 non-hospitalised participants received dental screening and completed the assessment questionnaire. The data from the stage of design of study was age and gender matched and because of which the total number of participants were then reduced to one hundred and forty-eight, 74 hospitalized and 74 non- hospitalized. Table 4.1 summarizes the socio-demographic characteristics of the two groups of the urban older Malaysians and their living status. Females were predominant within the study population (54.1%). As the participants were age and gender matched no significant differences existed in age or gender. A higher proportion hospitalized individuals (80.6%) were married compared to non-hospitalized individuals (55.4%). From the perspective of ethnicity, it was observed that a higher proportion of Chinese (56.8%) were hospitalised compared to the non-hospitalised participants (44.6%), however, there was a higher percentage of Indians (36.5%) and Malays (18.9%) in the non- hospitalized group (p=0.399). In both the groups of participants, 71.4% hospitalised and 73.0% non- hospitalised had attained secondary or higher level of education (p=1.000). Likewise, 74.3% hospitalised and 89.2% non- hospitalized lived either with their spouses, children, family or caretakers in their respective homes (p=0.963). Out of the 19 hospitalized participants who were living alone, 13 were nursing home residents.

Table 4.2 gives an overview of the general health status of the hospitalised and non-hospitalised groups of our study population. Non-hospitalized individuals (54.8%) were significantly more likely to have high cholesterol compared to hospitalised individuals (19.2%) (p=0.028). Non-hospitalised patients (31.1%) were more likely to have had an

episode of ischaemic heart disease compared to the hospitalised individuals (16.2%). Both the groups of urban older Malaysians 51.3% hospitalised and 52.7% of non-hospitalized were suffering from three or more co-morbidities during the course of the study (p=0.345).

Table 4.1: Socio-demographic profile of the non-hospitalised and the hospitalised urban older adults

Characteristics	Level	Non-Hospitalised (n=74)	Hospitalised (n=74)	χ^2/t	P Value
Age (years) mean (SD)		79.8 (6.8)	80.76 (7.4)	0.647*	0.519
Gender, n (%)	Male	34 (45.9)	34 (45.9)	0.031#	0.859
	Female	40 (54.1)	40 (54.1)		
Ethnicity, n (%)	Malays	14 (18.9)	13 (17.6)	4.05#	0.399
	Chinese	33 (44.6)	42 (56.8)		
	Indians	27 (36.5)	18 (24.3)		
Marital status, n (%)	Single/Widowed/ Divorced	33 (44.6)	14 (19.4)	0.536#	0.464
	Married	41 (55.4)	58 (80.6)		
Levels of education, n (%)	Primary Education	20 (27.0)	18 (28.6)	0.000#	1.000
	Secondary or Higher	54 (73.0)	45 (71.4)		
Living Status (do you live alone), n (%)	Yes	8 (10.8)	19 (25.7)	0.002#	0.963
	No	66 (89.2)	55 (74.3)		

***t= Paired T- Test, #χ^2= Chi-squared Test**

Table 4.2: General health status of the non-hospitalized and the hospitalized urban older adults

Characteristics	Level	Non-Hospitalised (n=74)	Hospitalised (n=74)	χ2*	P Value
Comorbidities, n (%)	Stroke/TIA	4 (5.4)	6 (21.6)	1.167	0.280
	Hypertension	46 (62.2)	59 (79.7)	1.921	0.166
	Cholesterol	40 (54.8)	14 (19.2)	4.809	0.028
	Diabetes	32 (43.2)	30 (40.5)	2.019	0.155
	Respiratory Illness	5 (6.8)	13 (17.6)	1.143	0.285
	Cancer	5 (6.9)	4 (5.5)	0.311	0.577
	Ischaemic Heart Disease	23 (31.1)	12 (16.2)	0.034	0.854
Presence of at least 3 comorbidities, n (%)		39 (52.7)	38 (51.3)	0.892	0.345

***Test applied: Chi-squared Test**

4.1.2 Comparison of the Oral Health Related Knowledge, Attitude and Practices between the Hospitalised and the Non-Hospitalised Groups

Table 4.3 summarizes the oral health related knowledge, attitude and practices between the hospitalised and the non-hospitalised groups of our study population. Hospitalised patients were less likely to indicate that teeth were important for eating ($p=0.050$), and were less likely to brush one's teeth every single day ($p=0.002$) compared to non-hospitalised group. There was a significant difference in frequency of dental visits between groups ($p<0.001$), with only 20.3% of hospitalised individuals having seen a dentist in the previous two years compared to 59.5% of non-hospitalised controls. Hospitalised participants self-reported their oral health as poor when compared the non-hospitalised controls ($p<0.001$).

Table 4.3: Oral health related knowledge, attitude and practices between the non-hospitalised and hospitalised older adults

	Characteristics	Level	Non-Hospitalised (n=74)	Hospitalised (n=74)	P Value
Knowledge	**Importance of teeth for eating, n (%)**	No	2 (2.7)	4 (6.1)	0.050
		Yes	72 (97.3)	62 (93.9)	
	Important to brush daily, n (%)	No	1 (1.4)	11 (16.9)	0.003
		Yes	73 (98.6)	54 (83.1)	
	Important to use fluoridated toothpaste, n (%)	No	5 (12.2)	5 (41.7)	0.078
		Yes	36 (87.8)	7 (58.3)	
Attitude	**Last dental visit, n (%)**	Less than 1 year ago	29 (39.2)	6 (8.1)	0.903
		Between 1-2 years ago	15 (20.3)	9 (12.2)	
		More than 2 years ago	29 (39.2)	58 (78.4)	
		Never	1 (1.4)	1 (1.4)	
	Fear of Dentist, n (%)	Very frightened	3 (4.1)	7 (9.5)	0.574
		Frightened to some extent	15 (20.3)	24 (32.4)	
		Not at all	56 (75.7)	42 (56.8)	
Practices	**Type of toothbrush used, n (%)**	Manual	71 (95.9)	61 (82.4)	0.257
		Electric	1 (1.4)	5 (6.8)	
		Don't have a toothbrush	2 (2.7)	7 (9.5)	
	Brushing Frequency, n (%)	More than once	61 (88.4)	20 (29.0)	0.002
		Once or less	8 (11.6)	49 (71.0)	
	Reason for dental visit, n (%)	Regular check-ups	10 (13.7)	5 (6.8)	0.167
		Relieve dental pain	63 (86.3)	69 (93.2)	
	Difficulty in chewing food, n (%)	No	27 (36.5)	22 (35.3)	0.252
		Yes	47 (63.5)	44 (64.7)	
SRDH	**Self-rated dental health, n (%)**	Poor	8 (11.8)	32 (47.1)	<0.001
		Fair	33 (48.5)	24 (35.3)	
		Good	24 (35.3)	9 (13.2)	

		Excellent	3 (4.4)	3 (4.4)	

*Test applied: Chi-squared Test

4.1.3 Nutritional Status Assessment between the Hospitalised and the Non-Hospitalised Groups

The Mini Nutritional Assessment (MNA) was used to identify patients who are malnourished or at risk of malnutrition. 82.4% of the hospitalized participants were malnourished (p=0.110) compared to 71.6% of the non-hospitalized participants who were at no risk as reflected in Table 4.4.

Table 4.4: Nutritional status assessment of the non-hospitalised and the hospitalised

Characteristics	Level	Non-Hospitalised (n=74)	Hospitalised (n=74)	χ2*	P Value
Mini Nutritional Assessment, n (%)	Not at risk	53 (71.6)	1 (1.4)	7.540	0.110
	Risk for malnourishment	20 (27.0)	12 (16.2)		
	Malnourished	1 (1.4)	61 (82.4)		

*Test applied: Chi-squared Test

4.2 Results for Clinical Assessments

4.2.1 Comparison of the Dentition Status, Periodontal Health Status and Salivation Status between the Hospitalised and Non-Hospitalised Group

4.2.1.1 Dentition Status

With respect to the dentition status, the mean number of filled teeth were higher for non-hospitalised participants compared to hospitalized controls (p<0.001). Hospitalised participants had a higher number of missing teeth (p=0.091) when compared to the non-hospitalised group. There was no difference in number of sound, decayed or mobile teeth between groups as reflected in Table 4.5.

Table 4.5: Dentition status of the non-hospitalised and the hospitalised urban older adults

Characteristics	Level	Non-Hospitalised (n=74)		Hospitalised (n=74)		$\chi 2^*$	P Value
		Mean (SD)	Range	Mean (SD)	Range		
Dentition status, Mean (SD)	Sound	8.26 (6.7)	0-23	4.5 (6.33)	0-26	391.657	0.255
	Filled	4.26 (5.5)	0-20	1.72(3.46)	0-15	291.523	<0.001
	Decayed	1.43 (2.47)	0-15	1.55(2.3)	0-10	77.889	0.242
	Missing	17.34 (5.5)	0-32	23.12(10.1)	2-32	721.542	0.091
	Mobile	1.09 (2.42)	0-14	1.07 (2.4)	0-14	86.437	0.587

***Test applied: Chi-squared Test**

4.2.1.2 Periodontal Status

Table 4.6 compares the periodontal sextant status for the two groups of the population. Chi- squared test was applied to compare the two groups. Individuals coded with a score of 3 or above were labeled as having periodontitis whereas; individuals having a score of 0-2 were labeled as having no periodontitis. In our study sample 67.6% of the hospitalized participants were fully edentulous and so their periodontal sextant examination was excluded. 66.2% of the non-hospitalized controls were recorded having periodontitis. None of the hospitalized participants were recorded with either healthy sextants or having bleeding on probing or calculus with no bleeding ($p<0.001$).

Table 4.6: Periodontal sextant status of the non-hospitalised and the hospitalised urban older adult

Characteristics	Level	Non-Hospitalised (n=61)	Hospitalised (n=20)	P Value
Periodontal status, n (%)	No periodontitis	12 (16.2)	0(0.0)	<0.001
	Periodontitis	49 (66.2)	20 (27.0)	

***Test applied: Chi-squared Test**

4.2.1.3 Level of Dryness of the Oral Cavity

The salivation status for the study participants as depicted in Table 4.7 was assessed using the Challacombe Scale, whereby, 83.8% of the hospitalised participants were found to be suffering from moderate levels of dryness and 97.3% of the non-hospitalized controls were only found to be suffering from mild levels of dryness ($p<0.001$).

Table 4.7: Challacombe scale status of the non-hospitalised and the hospitalised urban older adults

Characteristics	Level	Non-Hospitalised (n=74)	Hospitalised (n=74)	P Value
Challacombe scale, n (%)	Mild dryness	72 (97.3)	12 (16.2)	<0.001
	Moderate dryness	2 (2.7)	62 (83.8)	
	Severe dryness	0 (0.0)	0 (0.0)	

***Test applied: Chi-squared Test**

4.2.1.4 Factors Associated with Denture Wearing Status

Table 4.8 gives an overview of the factors related to denture wearing status. It was observed that 67.6% of the hospitalized participants were edentulous ($p<0.001$). While the use of dentures was not different between groups, denture hygiene was significantly

worse among hospitalized patients compared to non-hospitalized individuals (p=0.047).

Factors related to denture wearing status.

Table 4.8: Factors related to denture wearing status

Characteristics	Level	Non-Hospitalized (n=74)	Hospitalized (n=74)	P Value
Edentulousness, n (%)	No	61 (82.4)	24 (32.4)	<0.001
	Yes	13 (17.6)	50 (67.6)	
Dentures present, n (%)	No	36 (48.6)	39 (52.7)	0.639
	Yes	38 (51.4)	35 (47.3)	
Denture hygiene, n (%)	Poor	1 (3.4)	5 (13.5)	0.047
	Fair	12 (41.4)	28 (75.7)	
	Good	16 (55.2)	4 (10.8)	

***Test applied: Chi-squared Test**

4.3 Multivariate predictor models

Sequentially predictors for the dentition status were added to Poisson log-linear models and the best fit model is depicted in Table 4.9.

Table 4.9: Predictors for decayed teeth of the study population

Predictor	Decayed Teeth		Missing Teeth		Filled Teeth	
	IRR	**95% CI**	**IRR**	**95% CI**	**IRR**	**95% CI**
Intercept	0.99	0.05-17.23	5.26	1.94-14.24	297.88	20.42-4343.91
Cohort • **Hospitalised** • **Non-Hospitalised (ref)**	0.84	0.50-1.41	0.75	0.63-0.90	2.68	1.49-4.83
Gender • **Male** • **Female (ref)**	1.28	0.75-1.98	1.05	0.88-1.25	0.84	0.47-1.48
Ethnicity • **Malay** • **Non-malay(ref)**	1.39	0.71-2.71	1.09	0.88-1.36	0.65	0.31-1.36
Marital Status • **Alone** • **Married (ref)**	0.99	2.05-4.04	0.97	0.78-1.21	0.88	0.48-1.59
Educational Level • **Primary** • **Secondary or higher (ref)**	1.82	0.95-3.48	1.11	0.93-1.32	0.53	0.25-1.13
Comorbodities • **No** • **Yes (Ref)**	1.02	0.59-1.76	0.99	0.84-1.17	1.11	0.68-1.81
Living Status • **Not Alone** • **Alone (Ref)**	1.38	0.69-2.75	1.01	0.84-1.21	0.55	0.29-1.05
Age	0.99	0.96-1.03	1.01	1.00-1.03	0.94	0.91-0.97

IRR=incident rate ratio. CI=confidence interval. *Test applied: Poisson log linear regression

CHAPTER 5: DISCUSSION

5.1 Study Design and Sample Population

The study was a cross-sectional, comparative, observational study with the main objective of comparing the oral health status between the hospitalised and non-hospitalised older individuals, where the disease and exposure variables were measured simultaneously at a given point of time in the study population (Pajukoski, Meurman, Snellman-Gröhn, & Sulkava, 1999).

Our study used a convenience sampling method to select hospital-based participants. Although, this method is convenient, designed to suit the community set-up keeping in consideration the chair-side time, it is cost effective, and easy; the samples recruited using this method are not representative of the entire population. Thus, one cannot generalize the results of these findings to the entire population of hospitalised older patients. Nevertheless, all the older adults hospitalised and non- hospitalised that were approached agreed to participate in the study. This is encouraging since some oral health surveys of the elderly achieved response rate as low as 25-37% (Locker & Slade, 1993) The high success rate could be attributable to the methods used to survey the samples, wherein, face to face interview was used instead of self-administered or mail questionnaires. Furthermore, it was advantageous for both the groups of population to have their respective oral cavities being examined without having to travel too far.

The findings of this study provide an insight about the prevalence of oral health issues and nutritional status of the two sub-sets of the population; their level of knowledge related to oral health; attitudes towards utilization of oral health services, and self-care practices especially by the hospitalised individuals. This spade work is an important social dental indicator for potential possibilities for the establishment of oral health services and creating awareness about disease prevention for the older people at

all the levels of society. They are all key factors relevant to various organizations for promotion of oral health programmes and in overcoming the existing set of barriers with meticulous future planning to aid in the provisions of oral health care for the older people (P. Petersen et al., 2010).

5.2 Interview Based Assessment

5.2.1 Demographic Findings and General Health Status

Malaysia, like any other developing country in the world, has experienced a refinement in the health care system and services in turn leading to low mortality rates, longer life expectancy and low fertility rates. The consequential effect of all these changes has brought about a transition in the existing demographic profile of its population. If we examine, the age structure for the past three census, 1970, 1980 and 1991, has shown that the proportion of younger population (15 years and below) is decreasing while the proportion of older people is on the rise. The median age has risen from 17.4 in 1970 to 21.9 in 1991 and is further projected to increase up to 27.1 in the year 2020. It has further been observed from the year 1991 till year 2020, the median age is increasing on an average of 1.7 years per decade (Sim, 2001) .

Likewise, our study findings reflect that demographic transition among the three major ethnic groups which varies not only in intensity but also changes with each consecutive year. This could be attributed to factors such as inter-group socio-economic differences; historical; institutional and economic differences (Pala, 2000). It was observed that amongst the three major ethnic groups, ageing is significantly a more pronounced amongst the Chinese group than the other two groups, 44.6% non-hospitalised and 56.8% hospitalised. This could be attributed to low mortality rates leading to increased life span amongst the Chinese whereas, the low fertility rates in them have reduced the proportion of the younger population substantially. This

phenomenon has been observed for our cultural set up from times immemorial now whereby, Chinese outlive the two other major ethnic groups. As per the statistics trend the proportion of older Chinese is projected to be around 14.4 per cent in the year 2020. Likewise, the Malays will form 7.9 per cent of older population group in 2020 whereas; the proportion of Indian senior citizens is projected to be 10.4 per cent in the same year (Sim, 2001)

This demographic shift, will increase be the risk of developing multiple chronic health issues. Transition in the morbidity and disease patterns will result in prevalence chronic degenerative and non-communicable diseases rather than the infectious diseases. This will further influence socioeconomic development of a nation by bringing about changes in behaviour, environment and life style of its population leading to changes in the patterns of risk to the population (World Population Ageing, 2009.).

From gender inequality point of view, the ageing phenomenon seems to exhibit an inclination towards the females, indicating that the problem of widowhood will be more serious; 54.1% females compared to 45.9% males in both the groups. More elderly males were reported in the year 1970 with gender ratio being 108.4, however, in the year 2000 the ratio has dropped to 88.3. It was observed that the male-female ratio was 216.6 in 1970 for the Indian community. However, this ratio drastically dropped to 89.1 in 2000 and is expected to go down further to 74.8 in 2020. These observations simply imply that there will be far more older females compared to males the gender inequalities can have serious social implications. (Department of Statistics Malaysia, Official Portal: Population Projections 2010-2040; 2012).

Results from the study conducted by AR Hosseinpoor., et al. in 2012 suggest that the main reason for differences in the social determinants of self-reported health in women

and men in the European region was ‘age’. The gender difference was explained owing to the longevity of lives of women in the European region. It was further highlighted that women are in worse-off health with advancing age and was supported by the differences in the health scores (61% inequality). Inequality in the health status was suggested as one of the possible reasons for gender inequality in different regions of Europe. The study reported a total of 20% males and 29% females in the age bracket of 60 years or. However, they further reported very few males and females were in this age bracket in the African region; 9% males and 10 males and females respectively (Hosseinpoor et al., 2012).

The most common comorbidities reported in our study population were high blood pressure (62.2% non-hospitalised; 79.7% hospitalised); high cholesterol (54.8% non-hospitalised; 19.2% hospitalised); diabetes mellitus (43.2% non-hospitalised; 40.5% hospitalised) and ischemic heart disease (31.1% non-hospitalised; 16.2% hospitalised). Literature has established an absolute association between periodontal diseases and a variety of medical disorders. This is not surprising enough, as the oral cavity, is often a neglected part of the human body (Holmstrup et al., 2017). Although most people can now look forward to living longer, the risk of developing at least one chronic disease (such as hypertension or diabetes) increases with age; this is more of a cumulative effect of lifetime exposure to risk factors (like multimorbidity, polypharmacy, frailty, disability, poor oral health and care dependency) and is not linked to chronological age per se. More so, multimorbidity and polypharmacy, together with alterations in pharmacokinetics and pharmacodynamics, expose older people to the risk of adverse medication reactions. A very common side effect of several medications is xerostomia and hypo salivation which in turn adversely affects mastication, swallowing, speech and caries development. The comorbidities (diabetes, cardiovascular diseases, and

hypertension) act as risk indicators not only affecting the course, pathogenesis but also the severity of periodontitis. Likewise, periodontitis is considered as the risk factor for comorbid diseases. This interplay between oral health, general health and quality of life requires that healthcare providers must shift from a narrow disease focus to a broader psychosocial approach (J.H. Lee et al., 2015) (Khader et al., 2008).

Among developing countries, chronic diseases such as obesity, diabetes and caries are on the increase, with the consequence that oral health-related quality of life and general quality of life can deteriorate. Due to the common determinants of oral and other chronic diseases, more emphasis should be put on the common approach to the risk factor. The main idea behind the future plans being the focus on improving health conditions in general for the whole population and for groups at high risk, thereby reducing social inequities (Khader et al., 2008).

The nature and severity of illness in old age are known to have profound implications on the health care system. They include non-specific presentation of diseases, pathological conditions, need for rehabilitation rapid deterioration if no treatment is provided, and high incidence of complications of disease and treatment, (World Population Ageing, 2009). To deal holistically with the overall health care needs of the older people, multidisciplinary approach concerned with the clinical, rehabilitation, social and preventive aspects of illness and health for the elderly is required. This should aim at the preservation and restoration of function and simultaneously treating the underlying health issues. Most of the times, the degenerative diseases of old age may not respond well to therapeutic therapies and therefore, it is important is to enable the older people to function effectively in the environment of their choice as long as possible (Healthy People, 2010).

5.2.2 Oral Health Related Knowledge, Attitude and Practices

When assessed for the knowledge component; both the sub groups recognized the importance of brushing daily (98.6% non-hospitalised and 83.1% hospitalised) and agreed upon the importance of having teeth for eating well (97.3% non-hospitalized and 93.9% hospitalized). These findings are consistent with other study findings (H. Lin et al., 2001) (Zhu et al., 2005), in part, reinforcing the importance of effective oral health care prevention programmes and in creating awareness about the importance of oral health care practices and its subsequent consequences at the community level (Poul Erik Petersen & Yamamoto, 2005).

With regards to the attitude towards treatment seeking behavior; when dentist visiting habits of both groups were compared it was observed that the findings were higher for hospitalised group. 78.4% of hospitalised and 39.2% of the non-hospitalised participants not having visited a dentist in the previous 2 years (Zhu et al., 2005). These results could be partially attributed to difficulties in obtaining affordable dental care (Wall, Vujicic, & Nasseh, 2012). Low utilization of dental services is also reported in the older people in other countries like in rural China (Kiyak & Reichmuth, 2005). Health care utilization can be attributed to multifaceted human behavior. A lot of theories have been proposed to provide insight on this fact. The most suitable explanation for the determinants of oral health care for our respective population could be described as follows a) pre-disposing (socio-demographic factors like age, sex, occupation, and social network), b) motivation factors (transportation, income, and information), and most importantly c) the need/pain (perceived health or professionally assessed illness) (Pizarro et al., 2009). It could also be be a lack of knowledge about the benefits of good oral health from an early age that exacerbate oral health access disparities in the society (Kadaluru, Kempraj, & Muddaiah, 2012).

It was also observed for the Malaysian population under the practice component that the most habitual practice was to consult a dentist when in pain, 93.2% hospitalised and 86.3% non hospitalised participants. Similar findings have also been reported by a study conducted on the older Chinese population where 46% urban older citizens had last visited the dentists more than 3 years ago (McMillan, Wong, Lo, & Allen, 2003) and in Southern China where 24% urban older citizens had last visited the dentists 1-3 years ago and 24% had their last visit to the dentist over 5 years ago (Lo, Lin, Wang, Wong, & Schwarz, 2001). Reasons cited in support of this behaviour could be anticipation of painful dental treatment, costly treatments, long waiting hours, dependency on care takers and uninformed attitudes about seeking timely treatment from the dentist (Bamise, Bada, Bamise, & Ogunbodede, 2008).

Our study findings revealed that 85.1% of non- hospitalized participants brushed more than once daily. However, 69.4% hospitalized participants brushed either once or less. The self - care practices are significantly lower in the hospitalized group due to their increased dependency on the outside care, be it nursing staff or family or care takers to help them conduct basic day-to day physical activities; something as simple as brushing their own teeth (Yaffe, Barnes, Nevitt, Lui, & Covinsky, 2001). Physically inactive older individuals are at a higher risk of dementia and cognitive impairment (Bassuk, Glass, & Berkman, 1999; Heyn, Abreu, & Ottenbacher, 2004) yet these findings have not consistently been replicated in literature (Winblad et al., 2004). For the non- hospitalized group, the figure is similar to studies carried out in industrialized western countries (Baseer, Alenazy, AlAsqah, AlGabbani, & Mehkari, 2012) (H. Lin, M. Wong, Z. Wang, & E. Lo, 2001)

Majority of our study group 95.9% non-hospitalised and 82.4% hospitalised used a manual toothbrush. This could be attributed to the lack of knowledge about the use of

sonic brushes and subsequent increase in care dependency due to lack of manual dexterity is in accordance with the recommendations for oral care and maintenance of oral health by the dentists (Zhu et al., 2005) .

The hospitalized participants in comparison to the non-hospitalized group significantly rated their dental health as being poor ($p>0.001$). This is in compliance with the compounding factors as discussed above.

Based on personal oral health care awareness and behaviors, we can improve the information and provide a range of dental treatments from various areas of dentistry, including guidance on personal hygiene and oral health maintenance.

5.2.3 Nutritional Assessment

To assess the nutritional status of our study population, Mini Nutritional Assessment (MNA) was used. 82.4% of the hospitalised participants were at risk of being malnourished ($p<0.001$) compared to 71.6% of the non-hospitalized participants who were at no risk at all. The main reason of choosing this specific tool over the others is that; MNA extends to a wide range of elderly patients (i.e., community dwelling and the elderly hospitalized). The questions are concise and simple. It has a sensitivity of 96% and a specificity of 98%, and a predictive value of 97% that distinguishes patients by their adequate nutritional status (score < 24), risk of malnutrition (score 12–23), and malnutrition (score < 17) (Vellas et al., 2006).

Older adults commonly present with some form of nutritional deficiency, for example vitamin D is highly reported as being deficient in the older people (De Groot, Verheijden, De Henauw, Schroll, & Van Staveren, 2004). Studies have reported that up to 15% of ambulatory outpatients, 35% to 65% of elderly hospital patients, and 25% to 60% of institutionalized older adults have been found to be malnourished (Posner, Jette,

Smith, & Miller, 1993) (De Groot et al., 2004). Nutritional deficiencies in the hospitalised group could have resulted from greater burden of comorbid diseases combined with specific physiological changes due to aging (GH, 2000). Also, keeping in mind the wide ethnic variation of our country, dietary variations between individuals (Van Staveren, de Groot, & Haveman-Nies, 2002) differences in cultural, social, societal and diversity in lifestyle factors (De Groot et al., 2004) add up to the risk factors predisposing to being malnourished. Edentulousness and chewing problems could be associated with being underweight as they contribute to changes in food preferences and nutritional deficiencies (Sheiham et al., 2001; Suzuki et al., 2005)Nutritional problems in the older people can be detected by using the appropriate tools and is highly advised to be included as a recommended part of comprehensive geriatric assessments and in population based screening (Ahmed & Haboubi, 2010). According to a national survey on older people in Great Britain, older adults aged 65 years and over, retaining few or no natural teeth were at a higher risk of being underweight (Sheiham, Steele, Marcenes, Finch, & Walls, 2002).

Doctors must maintain strong perceptions of malnutrition in the senior population and be diligent in developing preventive measures and care plans for those at risk or with malnutrition. Due to the impact of coexisting diseases on the overall nutritional status, a systematic, multidisciplinary approach also helps to resolve all contributing factors.

5.3 Clinical Assessments

5.3.1 Oral Health Status

The study findings reflect that the oral health status in both groups, hospitalised and non-hospitalised was poor; however, the status was unacceptable among those who were hospitalised. As per our study results, poor oral health status became an

independent predictor for hospitalization. The findings of our study revealed older greater number of edentulous individuals in the hospitalised group 67.6% when compared to non-hospitalised group 17.6%. This was because missing teeth was a major constituent of the dentition status score. The figure was higher for the hospitalised group and lower for the non-hospitalised group when compared to that reported by NOHSA 2010 with 32.1% of individuals in the age group of 60-70 years being edentulous (Oral Health Division, 2010). A regional Malaysian study, however, reported a much higher prevalence of edentulism (57%) in a rural Muslim population in the north-east of Malaysia (Shamdol Z, Ismail NM et al., 2008). Reports from a study carried out in Kelantan to analyze dentition status of elderly population states that majority of subjects were found to be edentulous (81.0%). The mean number of natural teeth, functional natural teeth, decayed teeth (D), missing teeth (M) were 3.22 (SD 7.54), 2.75 (SD 6.70), 0.06 (SD 0.48), 28.80 (SD 7.51) respectively (Mafauzy, 2000).Variations in prevalence of edentulism between the two groups of our study population could be attributed to differences in social, economic, geographical backgrounds, general and dental health care systems, treatment philosophies and treatment seeking behaviour (Medina-Solis, Perez-Nunez, Maupome, & Casanova-Rosado, 2006). An association also exists between edentulism and educational status which may result from inadequate dental health awareness, under-utilization of oral health facilities, and less knowledge about proper oral hygiene habits (Emami et al., 2013).

Edentulism should not be treated as an inevitability of old age. Loss of teeth with age for the hospitalised group can further be attributed to various factors such as complex interactions between dental diseases and underlying co-morbidities, tendency to use dental care in response to specific dental attitudes, the ability to afford dental treatment

alternatives, increase in dependency for care, ambulation, lack of knowledge about oral health, education background, ethnic/cultural differences, lifestyle, psychosocial factors, regional disparities and habits (Holm-Pedersen et al., 2008). Research findings have further linked edentulism to lower nutritional levels, which would be of concern with increasing age as this may contribute to increased frailty with ageing (Felton, 2009).

Gender also was found to be associated with edentulousness in both groups; males being the strongest explanatory factor. Differences between genders has also been observed in other studies with females being more susceptible (Russell, Gordon, Lukacs, & Kaste, 2013). Dental caries and periodontal diseases are considered as the major risk factors for tooth loss and a major component of the global burden of oral diseases (P. Petersen et al., 2010).

However, with so many advances in the health delivery systems, and more people retaining more natural functional teeth into their old age, the goal laid down WHO/FDI of retaining at least 20 natural teeth at the age of 80 years is yet to be achieved by many nations (Atchison & Andersen, 2000) (Muller, Naharro, & Carlsson, 2007).

As for the periodontal health status, majority of the hospitalized participants had their sextants excluded from the periodontal examination owing to being edentulous. Remaining 23% had a score of 4 indicating pocket depths of 6mm or more. The findings of the non-hospitalised group was similar to that of the elderly cohort in the Hong Kong adult oral health survey conducted in 1991 where most subjects had codes 2 or 3 as their highest CPI score (Holmgren, Corbet, & Lim, 1994) and to more recent studies conducted on Nepalese population (David, Yee, & Lama, 2011). Periodontal assessment involved basic periodontal examination (BPE). The Ministry of Health has laid down a recommended protocol for referrals by government dentists to the

periodontist which in turn is based on the Basic Periodontal Examination (BPE) screening system. According to this protocol, dentists can refer patients with a BPE score of 4 (periodontal pocket depth of ≥ 6mm) in any one sextant. However, it is not a compulsory screening procedure (Vaithilingam, Raman, Siow, & Hassan, 2009). Keeping in mind, the time constraints, case definition employed by this study was based on BPE which gives an estimated rather than a true prevalence of chronic periodontitis. This greatly stresses the importance of diagnosing and treating periodontitis in the older adults. Likewise, periodontitis in the non-hospitalised group could also be the consequence of some underlying ill health, however, its timely and accurate treatment can help to diminish the systemic effects of oral bacteremia (Holmén, Strömberg, Hagman-Gustafsson, Wårdh, & Gabre, 2012).

The proportion of subjects who wore dentures was 47.3% among our hospitalized patients and 51.4 % among our non-hospitalized patients, a result in disagreement with earlier studies concerning hospitalized patients (Pajukoski et al., 1999). This possibly be because of poor tendency to use dental care in response to specific dental attitudes, the ability to afford dental treatment alternatives, increase in dependency for care, ambulation issues, lack of knowledge about oral health, education background (Holm-Pedersen et al., 2008).

Similarly, taking proper care of one's dentures is an aspect of oral hygiene worth exploring among geriatric patients, with both the groups of our population having fair denture hygiene.

For our respective population, poor oral health status was an independent predictor for hospitalisation. Our study findings are based on the facts that when a patient is admitted to a geriatric ward, his or her mouth is not screened by a dentist visiting the

wards. Only very acute oral health requirements of this population are highlighted to the medical and other health care personnel. Moreover, a dental geriatric curriculum is yet to be incorporated as a part of special care dentistry in dental schools. This will have profound implications in the future as the number of elderly and medically compromised dentate patients will increase (Ettinger & Mulligan, 1999).

In the near future, Malaysia will experience the ageing phenomenon. Presently, the Malaysian population is described as "youthful" though projections from the census data clearly indicate that 6.1% of the total population was 60 and above (Department of Statistics, 2005). Around the year 2020, Malaysia will be an ageing society with 9.5% of its population aged 60 and above. Although these figures of its older population may not be not as phenomenal as in countries such as China and Singapore, they are large numbers and escalating rapidly, the high numbers of older people would make it impossible for the government to ignore the impact of social and economic changes brought about by population ageing (Department of Statistics Malaysia, Official Portal: Population Projections 2010-2040; 2012).

Malaysia's transition to a developed country by 2020 is poised with a major health care challenge of population ageing. Our country's older population of 60 years and above has increased steadily from 5.7% in 1990 to 6.3% in 2000 and is expected to be 9.8% in 2020 (Mafauzy, 2000). Like other developed countries, population ageing in Malaysia can be attributed to factors of falling mortality rates, effective prevention of infectious diseases, declining fertility, improvements in the health care system. and better nutrition has resulted in more people surviving into old age (Arokiasamy, 1997) (Poi, Forsyth, & Chan, 2004). In comparison, Australia, a developed country with a population of 22 million, has 13.3% of its population aged 65 years and above (Australian Bureau of Statistics, 2009).

The chronological age for older people are different in both the countries, however, comparisons can still be made because chronological age is not a precise marker for the biological changes which accompany ageing.

As Malaysia progresses in its path to becoming a developed nation by 2020, population ageing is inevitable and this will generate new challenges in terms of health and social services (Organization, 2014).

According to the Third National Health and Morbidity Survey (NHMS III), chronic illnesses were reported to be most prevalent (48.8%) amongst the 60 and above age group (Malaysia, 2008). This will require other non-health factors like work retirement and income, housing and institutionalization, family and the community, leisure and personal characteristics which can influence the quality of life of this vulnerable group to be addressed (Arokiasamy, 1997).

Based on published literatures, aging health issues in Malaysia can be summarized into four main domains- physical healthcare, physiosocial health care, nutritional problems and oral health care problems (Tinker 1996).

The way forward includes restructuring of the health care system, setting up of a multidisciplinary approach with national health financing scheme. Manpower in terms of highly trained allied health care personal is crucial to support the organization of multi-disciplinary teams in primary care. Older persons should be fully entitled to have access to comprehensive health care services which includes chronic disease management, preventive care, rehabilitative care and oral health car. Establishment of crucial clinical information systems by using electronic medical records would ensure long term coordinated care of older people in the community. Apart from improving

health care services for older people there is a need to develop a collaborative network with community services.

CHAPTER 6: CONCLUSION

While it is widely accepted that dental disorders are common among older persons, this study has provided an insight into the magnitude of the problems to be encountered among urban-dwellers in Malaysia, particular in those who are hospitalised. Our results show that oral health in both hospitalised and non-hospitalised older patients was poor and that the situation was worse among those who were hospitalized, as we had expected. 67.6% of the hospitalized participants were edentulous. There was poor utilization of dental services by both the groups. The present survey also suggests that use of fluoridated toothpaste and dental attendance rates were low. Dental visits were mostly prompted for symptomatic relief and seldom for preventive reasons. The hospitalized participants were more likely to be malnourished and moderated dryness of the oral cavity. Our study findings lay the foundation for future research studies to on the effect of poor oral health on the general health and quality of life of older people. It remains to be established whether improved oral health could reduce hospitalisation.

CHAPTER 7: LIMITATIONS AND RECOMMENDATIONS

7.1 Study Limitations

The main problem encountered during the study was difficulty in recruiting hospitalised participants. Low participant's compliance was seen owing to their willingness to just participate in surveys without being provided with the consequential chair –side follow-ups which hindered the recruitment. These difficulties will explain the paucity of available data from this setting from published literature. In addition, it was not possible to ensure our hospitalised samples and non-hospitalised controls were adequately matched, even though they were well matched in terms of age, gender and number of comorbidities. Therefore, the relationship between poor oral health and hospital admission needs to be explored further within the existing dataset using an analysis which is out with the scope of this project.

7.2 Recommendations

The findings of the study emphasize the necessity to reorient the dental health services in the care of the elderly. Focus on middle age adults is important to ensure that they enter old age in a good state of general and oral health. This will ensure that they remain in a reasonable state of health in the remaining years. The focus on preventive measures rather than curative is also important.

There is also a need to change the philosophy of oral health care system. Primary health care authorities should also assist in the development of policies, measurable goals and targets for provision of oral health care in the older population. Public health programmes at national/ regional levels should be designed to integrate oral health promotion and disease prevention keeping in lieu of the common risk factors approach. Prevention of occurrence of oral diseases and illness in older adults can be intensified by establishing affordable oral health services, which meet their immediate needs. In

developing countries like Malaysia the challenge to establish provisions for primary oral health care are particularly high because of lack of specialized dental manpower and funds. Through educating and continuous training we can try to achieve the sensitization of the oral health care provider not only with skills, but can imbibe in them empathy, aptitude, professionalism and a profound understanding of the biomedical and psychosocial aspects of care for older people.

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