UNIVERSITI SAINS MALAYSIA

PEJABAT PENGURUSAN & KREATIVITI PENYELIDIKAN
RESEARCH CREATIVITY AND MANAGEMENT OFFICE [RCMO]

LAPORAN AKHIR PROJEK

PENYELIDIKAN JANGKA *PENDEK*

(FINAL REPORT OF SHORT TERM RESEARCH PROJECTS)

KETUA PENYELIDIK:
PROF. MADYA ABDUL MANAF HJ HAMID

PTJ:
JABATAN PERUBATAN MASYARAKAT

PENYATA PERBELANJAAN

UNIVERSITI SAINS MALAYSIA
JABATAN BENDAHARI
KUMPULAN WANG PENYELIDIKAN GERAN USM(304)
PENYATA PERBELANJAAN SEHINGGA 28 FEBRUARI 2007

Jumlah Geran:	RM	16,718.00	Ketua Projek:	PROF(M) A.MANAF HAMID
Peruntukan 2005 (Tahun 1)	RM	8,359.00	Tajuk Projek:	Relationship between Oral Health status, Inadequate Nutrition Intake,Underweight and Anaemia Among Elderly Living in Pondok' in Kelantan
Peruntukan 2006 (Tahun 2)	RM	8,359.00		
Peruntukan 2007 (Tahun 3)	RM	0.00	Tempoh:	01 Okt 05-30 Sept 07
			No.Akaun:	304/PPSP/6131402

Kwg	Akaun	PTJ	Projek	Donor	Peruntukan Projek	Perbelanjaan T'kumpul Hingga Tahun Lalu	Peruntukan Semasa	Tanggungan Semasa	Bayaran Tahun Semasa	Belanja Tahun Semasa	Baki Projek
304	11000	PPSP	6131402		-	-	-	-	-	-	-
304	14000	PPSP	6131402		-	-	-	-	-	-	-
304	15000	PPSP	6131402		-	-	-	-	-	-	-
304	21000	PPSP	6131402		6,800.00	5,445.25	1,354.75	-	-	-	1,354.75
304	22000	PPSP	6131402		-	-	-	-	-	-	-
304	23000	PPSP	6131402		-	-	-	-	-	-	-
304	24000	PPSP	6131402		-	-	-	-	-	-	-
304	25000	PPSP	6131402		-	-	-	-	-	-	-
304	26000	PPSP	6131402		-	-	-	-	-	-	-
304	27000	PPSP	6131402		3,359.00	754.80	2,604.20	-	-	-	2,604.20
304	28000	PPSP	6131402		-	-	-	-	-	-	-
304	29000	PPSP	6131402		6,559.00	7,065.60	(506.60)	-	-	3,550.00	(506.60)
304	32000	PPSP	6131402		-	-	-	-	-	-	-
304	35000	PPSP	6131402		-	-	-	-	-	-	-
					16,718.00	13,265.65	3,452.35	-	-	3,550.00	3,452.35

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PEJABAT PENGURUSAN & KREATIVITI PENYELIDIKAN
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LAPORAN AKHIR PROJEK PENYELIDIKAN JANGKA *PENDEK*
FINAL REPORT OF SHORT TERM RESEARCH PROJECTS

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1) **Nama Ketua Penyelidik** :
Name of Research Leader :

Ketua Penyelidik *Research Leader*	PTJ *School/Centre*
Prof. Madya Abdul Manaf Hj Hamid	Jabatan Perubatan Masyarakat

Nama Penyelidik Bersama
(Jika berkaitan) :
Name/s of Co-Researcher/s
(if applicable)

Penyelidik Bersama *Co-Researcher*	PTJ *School/Centre*
Dr Hj Abdul Rashid bin Ismail	Pusat Pengajian Sains Pergigian

TAJUK PROJEK

(Title of Project)

Relationship between oral health status, inadequate nutrition intake and underweight among elderly living in Pondok in Kelantan.

ABSTRAK

3) **Abstrak untuk penyelidikan anda**
(Perlu disediakan di antara 100 – 200 perkataan di dalam **Bahasa Malaysia dan Bahasa Inggeris**. Ini kemudiannya akan dimuatkan ke dalam Laporan Tahunan Bahagian Penyelidikan & Inovasi sebagai satu cara untuk menyampaikan dapatan projek tuan/puan kepada pihak Universiti & luar).

Abstract of Research
(Must be prepared in 100 – 200 words in Bahasa Malaysia as well as in English. This abstract will later be included in the Annual Report of the Research and Innovation Section as a means of presenting the project findings of the researcher/s to the university and the outside community)

Abstrak dalam Bahasa Malaysia

KAJIAN PERKAITAN ANTARA STATUS FUNGSI ORAL DENGAN STATUS PEMAKANAN DALAM KALANGAN WARGATUA YANG TINGGAL DI "PONDOK" DI NEGERI KELANTAN

Pengenalan: Perkaitan antara status kesihatan oral dan status pemakanan dalam kalangan wargatua telah dikaji oleh beberapa penyelidik. Namun begitu kewajaran perkaitan tersebut tidak dijelaskan dengan terperinci. **Objektif:** Kajian hirisan lintang ini bertujuan menyiasat tentang status kegigian, keperluan dentur dan status fungsi oral dalam kalangan wargatua, menilai pengambilan nutrient, menentukan taburan indeks jisim tubuh (IJT), menentukan hubung kait antara pengambilan kalori harian dengan indeks jisim tubuh (IJT), mengenalpasti perkaitan antara status fungsi oral dengan pengambilan kalori yang tidak mencukupi dan kekurangan berat badan dalam kalangan wargatua yang tinggal di "Pondok" di negeri Kelantan. **Methodologi:** Kajian secara kaedah hirisan lintang ini dijalankan dari bulan Jun 2004 hingga Januari 2005 dan pemilihan sampel seramai 386 orang adalah secara rawak. Semua subjek ditemuduga untuk mendapatkan informasi tentang ciri-ciri sosio-demografi dan status kesihatan dengan menggunakan borang yang telah dirangka. Untuk pengukuran antropometri; berat badan dan ketinggian telah diukur, kemudian, Indeks Jisim Tubuh (IJT) dikira. Teknik ingatan diet 24-jam telah digunakan untuk mendapat anggaran pengambilan makanan harian yang telah diambil oleh subjek dalam tempoh 24 jam yang lepas. Akhir sekali, ia diikuti dengan pemeriksaan oral dimana penilaian keadaan gigi asli dan status dentur dijalankan. Pengambilan jumlah nutrient dikira dengan menggunakan Perisian Nutrical, kemudian semua data dianalisa dengan menggunakan "SPSS 11.5". **Keputusan:** Kadar sambutan daripada subjek sungguh menggalakkan (95.6%) dan majoriti adalah wanita (92.4%). Peratus wargatua yang kehilangan kesemua gigi asli adalah 81.0 % (95% CI: 77.0, 85.0) dan terdapat keperluan dentur yang tinggi, 47.2 % (95% CI: 42.1, 52.3). Status fungsi oral yang terjejas dialami oleh 48.2 % subjek (95% CI: 43.1, 53.3). Majority disumbang oleh wargatua yang kehilangan semua gigi asli samada tiada dentur (23.6 %) atau mempunyai denture yang bermasalah (56.2 %). Berkaitan dengan status pemakanan, 70.7 % wargatua (95% CI: 66.1, 75.3) mengambil jumlah kalori yang tidak mencukupi iaitu kurang daripada 66.7% atau 2/3 berbanding dengan Saranan Pengambilan Nutrien (RNI), sementara 25.7 % (95% CI: 21.1, 30.2) mengalami masalah kekurangan berat badan. "Odds" atau kebarangkalian untuk mempunyai pengambilan kalori yang tidak mencukupi dan mengalami kekurangan berat badan, masing-masing adalah 3.7

kali dan 42.0 kali lebih tinggi dalam kalangan wargatua yang mempunyai status fungsi oral yang terjejas. **Kesimpulan:** Kajian ini telah menunjukkan bahawa status kegigian wargatua yang tinggal di "Pondok" di negeri Kelantan adalah tidak memuaskan dimana terdapat peratusan wargatua yang kehilangan kesemua gigi asli, keperluan dentur dan status fungsi oral yang terjejas adalah tinggi. Purata pengambilan kalori dan kesemua nutrien adalah di bawah paras Saranan Pengambilan Nutrien (RNI), sementara prevalens kekurangan berat badan adalah 25.7%. Terdapat hubung kait yang positif antara pengambilan kalori dan Indeks Jisim Tubuh (IJT). Perkaitan yang bererti telah dikenalpasti antara status fungsi oral dengan pengambilan kalori yang tidak mencukupi dan kekurangan berat badan dalam kalangan wargatua yang tinggal di "Pondok" di negeri Kelantan.

Abstrak dalam Bahasa Inggeris

A STUDY OF ASSOCIATION BETWEEN FUNCTIONAL ORAL STATUS AND NUTRITIONAL STATUS AMONG ELDERLY LIVING IN "PONDOK" IN KELANTAN

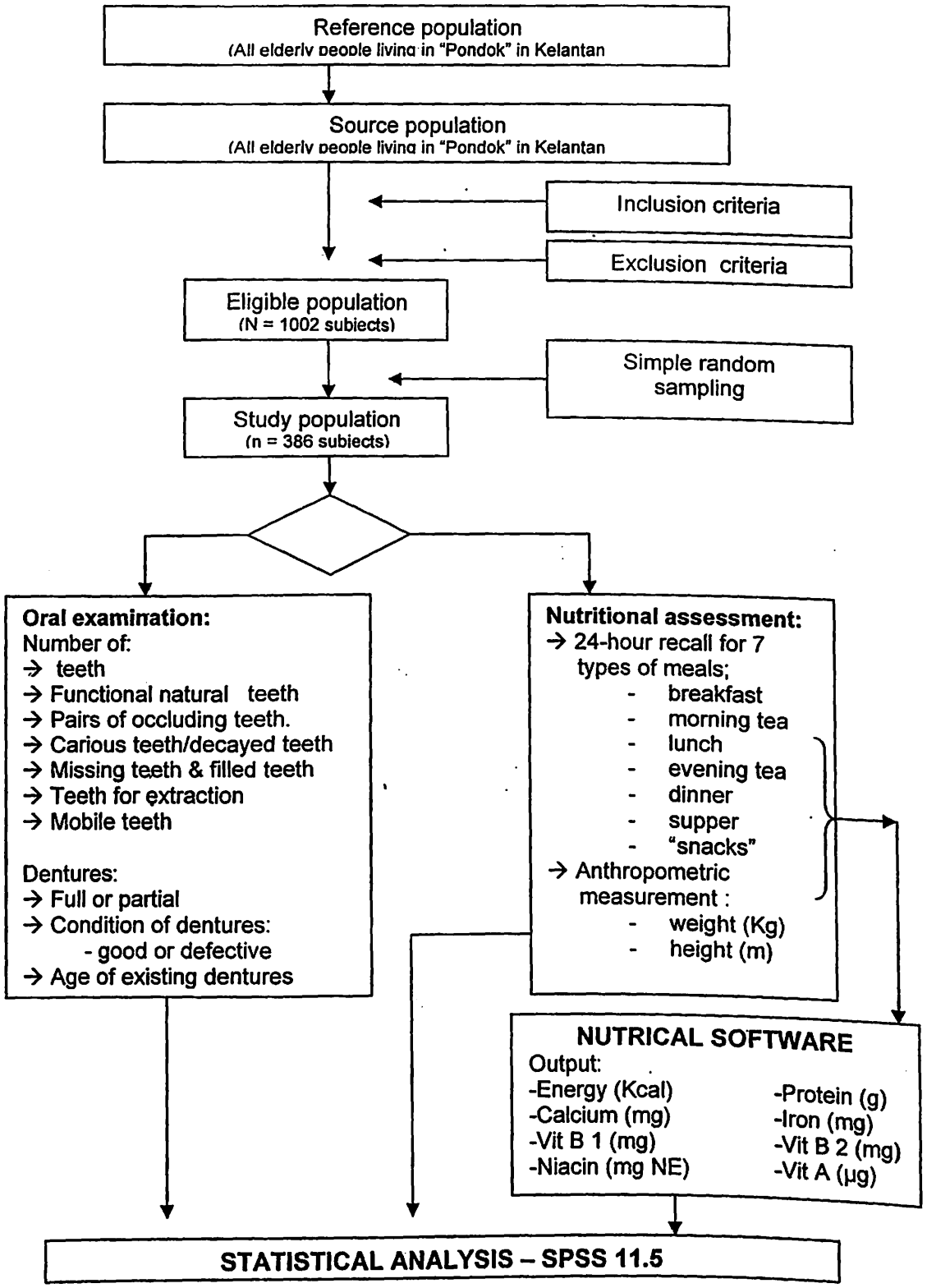
Introduction: The relationship between oral health status and nutritional status among elderly people have been explored by various researchers. However the exact nature and strength of the relationship has not been fully described. **Objectives:** This cross-sectional study were to investigate the dentition status, prosthetic needs and functional oral status of elderly people, to assess the nutrient intake, to determine the distribution of body mass index, to determine correlation between daily calorie intake and body mass index and to investigate the association between functional oral status with inadequate calorie intake and underweight in elderly people living in "Pondok" in Kelantan. **Methodology:** A cross-sectional study was conducted from Jun 2004 to January 2005, and a simple random sampling was utilized for selection of 386 subjects. Subjects were interviewed using a structured form to collect information about the subjects' demographic background and self-reported health status. For the anthropometric measurement; the subjects' weight and height were measured, then, body mass index was calculated. The 24-hour recall method was used to provide information on the subject's exact food intake during the previous 24 hours. Finally, it was followed by oral examination whereby the assessment of natural teeth and prosthetic status were done. The "Nutrical Software" was used for nutrient calculation, followed by SPSS version 11.5 for data analysis. **Results:** The response rate was 95.6% and majority of the respondents were female (92.4 %). The percentage of edentulism was 81.0% (95% CI: 77.0, 85.0) with high prosthetic need, 47.2% (95% CI: 42.1, 52.3). Compromised functional oral status was experienced by 48.2% (95% CI: 43.1, 53.3) of the subjects. Majority was contributed by edentate elderly without (23.6%) or with defective dentures (56.2%). Regarding nutritional status, 70.7 % (95% CI: 66.1, 75.3) of the subjects had inadequate calorie intake, that is less than 66.7% or 2/3 of the Recommended Nutrient Intake (RNI) and 25.7 % (95% CI: 21.2, 30.2) were underweight. The odds of having inadequate calorie intake and getting underweight among elderly with a compromised functional oral status was 3.7 times and 42.0 times respectively, compared to non-compromised functional oral status. **Conclusion:** This study has shown that dentition status of elderly living in "Pondok" in Kelantan was not satisfactory with high percentage of edentulism, compromised functional oral status, and prosthetic needs. Mean intake of calorie and all nutrients were below the Recommended Nutrient Intake (RNI), while the prevalence of underweight was 25.7%. There was a positive correlation between calorie intake and body mass index. Significant associations were noted between functional oral status with inadequate calorie intake and underweight among elderly living in "Pondok" in Kelantan.

Laporan teknikal

4) Sila sediakan Laporan teknikal lengkap yang menerangkan keseluruhan projek ini. [Sila gunakan kertas berasingan]
Kindly prepare a comprehensive technical report explaining the project (Prepare report separately as attachment)

The study was a cross-sectional study whereby the oral health and nutritional status were assessed. The study was conducted from Jun 2004 to January 2005. The reference population and the source population were all the elderly people living in "Pondok" in Kelantan and the sampling frame was determined based on the following inclusion and exclusion criteria. The inclusion criteria were all elderly aged 60 years old and above, while the exclusion criteria were those elderly with mental illness, having contagious diseases, were bed-ridden, deaf and mute and those with scoliosis as these might affect the measurement of height and weight and also the 24-hour recall nutrition intake.

The sample size was 386 people with 15 % non-response rate. The flow chart of the study is as shown below.



Flow-chart of the study

Tools used in this study were a blank name list form (which was distributed to all 23 "Pondok" in Kelantan to obtain the sampling frame and those who met the inclusion and exclusion criteria were included), a structured form (to obtain the socio-demographic characteristics and self-reported health status), dental Charting form (to record information on dentition status), the 24-hour recall form (to get information on the respondent's exact food intake during the previous twenty-four-hour period), a portable SECA weighing scale (Vogel and Halke, Germany) and a microtoise (for the measurement of weight in kilogram and standing body height in metres), NUTRICAL Software (for the calculation of nutrients intake) and SPSS version 11.5 (for the statistical analysis). The data collection was conducted in the mosque or in the hall within the vicinity, where all the identified subjects were gathered.

Findings from this study concluded that

1. Dentition status of elderly living in "Pondok" in Kelantan was not satisfactory with high percentage of edentulism (81.0 %), prosthetic needs (47.2 %) and elderly subjects with compromised functional oral status (48.2 %).

2. Mean intakes of calorie and all nutrients were below RNI and the proportion of elderly with inadequate intake was found to be higher for calcium (94.3%), Niacin (92.7%), vitamin A (90.5%), vitamin B2 (88.6%), vitamin B1 (86.7%) and total calorie intake (70.7%). Apart from that, significant differences for both calorie and protein intake were observed between age-groups of 60-64 years and those 75 years and above.

3. The prevalence of underweight among elderly living in "Pondok" in Kelantan was 25.7 per cent. There were significant differences in the mean body mass index between groups in the duration of stay in "Pondok", level of education, and in the self-reported health status. With regards to age-group, significant differences were observed between age-group of 60-64 and 70-74 years, 60-64 and those 75 years and above and also between age-groups of 65-69 and 75 years and above. However, monthly income, previous employment status and living status, no significant difference between groups.

4. Calorie intake was moderately but significantly correlated with body mass index, with Pearson correlation coefficient (r) of 0.416.

5. Functional oral status, monthly income and duration of stay in Pondok" were significantly associated with mean daily calorie intake.

6. Functional oral status, inadequate energy intake, age of the subjects and self-reported health status were significantly associated with underweight. In general, functional oral status is intimately linked to food selection which in turn influences dietary adequacy and ultimately nutritional status.

Kata Kunci

Senaraikan Kata Kunci yang boleh menggambarkan penyelidikan anda :

List a glosssary that explains or reflects your research:

	Bahasa Malaysia	Bahasa Inggeris
1.	Status Fungsi Oral	Functional Oral Status
2.	Status Pemakanan	Nutritional status
3.	Status Fungsi Oral Yang Terjejas	Compromised Functional Oral Status
4.	Status Fungsi Oral Yang Tidak Terjejas	Non-Compromised Functional Oral Status
5.	Bilangan Gigi Asli	Number of Natural Teeth
6.	Bilangan Gigi Asli yang Berfungsi	Number functional natural teeth
7.	Ada Gigi Asli	Dentate
8.	Tiada Gigi Asli	Edentate
9.	Status Gigi Palsu	Denture Status
10.	Keperluan Gigi Palsu	Prosthetic needs
11.	Kekurangan Berat Badan	Underweight
12.	Pengambilan Nutrient Tidak Mencukupi	Inadequate nutrient intake
13.	Indeks Jisim Tubuh	Body Mass Index
14.	Pengambilan Kalori Harian	Daily Calorie Intake
15.	Kaedah Hirisan Lintang	Cross-sectional Study
16.	Wargatua	Elderly
17.	Saranan Pengambilan Nutrien	Recommended Nutrient Intake

Output Dan Faedah Projek

(Output and Benefits of Project)

5) **Output Dan Faedah Projek**
Output and Benefits of Project

(a) * Penerbitan *(termasuk laporan/kertas seminar)*
Publications (including reports/seminar papers)
(Sila nyatakan jenis, tajuk, pengarang, tahun terbitan dan di mana telah diterbit/dibentangkan).
(Kindly state each type, title, author/editor, publication year and journal/s containing publication)

Oral Presentation:

Title	Venue	Date
1. Influence of oral status on macronutrients intake in elderly population living in "Pondok" in Kelantan	12 th National Public Health Colloquium in the Legend Hotel, Kuala Lumpur.	20 th – 21 st Sept. 2005

Poster Presentation

Title	Venue	Date
1. Oral health status and prosthetic needs of an elderly population living in "Pondok" in Kelantan	10 th National Conference on Medical Sciences in USM Kubang Kerian, Kelantan	21 st – 22 nd May 2005
2. Relationship between oral health and nutrient intake in elderly population living in"Pondok" in Kelantan	12 th National Public Health Colloquium in the Legend Hotel, Kuala Lumpur.	20 th – 21 st Sept 2005
3. Relationship between oral health and Body mass index in elderly population living in"Pondok" in Kelantan.	12 th National Public Health Colloquium in the Legend Hotel, Kuala Lumpur	20 th – 21 st Sept 2005
4. The impact of functional oral status on Body mass index among elderly people living in "Pondok" in Kelantan.	2nd Asia Pacific Conference on Risk Management for Preventive Medicine 2005 in the Renaissance Hotel Kota Bharu, Kelantan	1 st – 3rd Oct. 2005
5. Oral health status of elderly people people living in"Pondok" in Kelantan.	-Same as above -	-Same as above-
6. Nutrient intake among elderly people living in"Pondok" in Kelantan.	-Same as above -	-Same as above-
7. The impact of functional oral status on mean energy intake among elderly people living in "Pondok" in Kelantan.	-Same as above -	-Same as above -
8. Body-mass index of elderly people living in"Pondok" in Kelantan.	-Same as above	-Same as above

DENTAL CARIES EXPERIENCE OF ELDERLY PEOPLE LIVING IN "PONDOK" IN KELANTAN

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ABSTRACT

Limited information is available about the oral health of elderly people living in "Pondok" in Kelantan. This study aimed to assess the dentition status of elderly population staying in Islamic Religious Community Setup, "Pondok" in Kelantan. A cross sectional study involving 369 elderly people was carried out. A simple random sampling method was utilized for the selection of the subjects. Oral examination was done to assess the dentition status and data was analyzed using SPSS 11.5 version. The response rate was 95.6%. Majority of the subjects were edentulous (81.0%). The mean number of natural teeth, functional natural teeth, decayed teeth (D), missing teeth (M) and teeth indicated for extraction (X) were 3.22 (SD 7.54), 2.75 (SD 6.70), 0.06 (SD 0.48), 28.80 (SD 7.51) and 0.41 (SD 1.60) respectively. Among 70 dentate subjects, the mean number of natural teeth, functional natural teeth, occluding pair of functional natural teeth, decayed teeth (D), missing teeth (M), teeth indicated for extraction (X) and DMFX (T) index were 17.1 (SD 8.00), 14.5 (SD 8.11), 6.3 (SD 4.22), 0.3 (SD 1.06), 15.1 (SD 8.20), 2.2 (SD 3.14) and 17.6 (SD 8.08) respectively. There was no teeth had been filled (F). The proportion of subjects having minimum 20 functional natural teeth was 7.3%. The above results indicate that dental caries status of elderly people living in "Pondok" in Kelantan was unsatisfactory with high percentage of edentulism, contributing to the high value of the mean DMFX(T) index, 29.3 (SD 6.63).

Key words: elderly, Malay, dental caries,DMFX(T) index, functional dentition

INTRODUCTION

With maturity, there are changes in the alveolar bone, anatomy of the teeth and soft tissues surround it (Martin, 1999). Among older adults, the salivary flow is reduced causing xerostomia commonly associated with pathologic condition or effects of medication in treating chronic diseases (Vargas *et al.*, 2001; Ettinger, 1981). Hypo-salivation causes rapid progression of root caries and its treatment is often technologically challenging (Lamster, 2004).

The increasing trend of elderly people and increase longevity has drawn attention to the dental health needs of elderly since they are retaining more of their natural teeth into old age (Fure, 2003; Curzon and Preston, 2003; Fiske, 2000). However, these seniors are at increased risk for caries (Thomson, 2004; Lamster, 2004; Fure, 2003) and periodontal diseases (Lamster, 2004). The National Oral Health Survey of Adults 2000 in Malaysia has shown that caries prevalence among elderly aged 65-74 and 75 years and above was 95.2% and 94.1% respectively, while caries experience or decayed teeth (D), missing teeth (M), filled teeth (F) and teeth indicated for extraction (X), DMFX(T) index for age-group of 65-74 years was 23.20 (Oral Health Division, 2004). An oral health survey done in Japan, from October 1988 to February 1989 among elderly population living in public and private institutions found that, in dentate persons, the mean number of remaining teeth present and the number of decayed (D) and filled teeth (F) were 13.4 and 8.6, 9.5 and 6.8, and 8.4 and 6.5 in the age-group of 65-74 years, 75-84 years, and 85 years and above, respectively (Miyazaki *et al.*, 1992).

It is well known that the overall prevalence and the incidence of dental caries in the Western societies is declining. This fact was proven by Jokstad *et al.* (1996) in a study among institutionalised elderly people in Norway, that in 1980, mean decayed, missing, and filled teeth

(DMFT), missing teeth (MT), filled teeth (FT), decayed teeth (DT) and retained roots (RR) were 25.7, 20.0, 3.6, 2.1, and 1.6 respectively, while observations in 1993, mean decayed, missing and filled teeth (DMFT), missing teeth (MT), filled teeth (FT), decayed teeth (DT) and retained roots (RR) were 22.9, 16.3, 5.1, 1.8, and 0.8 respectively. However there appears to be an increase in the prevalence of dental caries especially within disadvantaged communities such as inner cities dwellers, those with low socio-economic status, immigrant population and also in the very young and elderly (Curzon and Preston, 2003). Lin *et al.* (2001b) showed that socioeconomic factors have an effect on dental caries and periodontal diseases in the adults in Southern China, in which rural residence, people with lower education, women and those who were less wealthy were found to have higher decayed, missing, and filled teeth (DMFT) score.

The purpose of this study was to explore the dental caries experience in elderly people living in "Pondok" in Kelantan. Elderly people is defined as those aged 60 years and above (Rusli *et al.*, 1992). "Pondok" was chosen because no study has been done in that community group of elderly and apart from that, relatively limited information on dentition status of elderly people is available. "Pondok" refers to a group of cottage which is built around a mosque, and it is for the muslim people who would like to improve their religious knowledge. It is not only for the elderly, but many elderly people live there because they would like to spend their remaining years in a pious manner (Abdul Manaf *et al.*, 1999). Hence, "pondok" is considered as semi-institutions for the elderly who are physically and mentally healthy. Should they be physically and mentally disabled, their children or relatives must bring them back home, or if they have nobody and no where to go, they will be placed in the government-owned institution such as "Rumah Sri Kenangan" at Pengkalan Chepa, Kelantan. In addition, all elderly people staying in "pondok" are Malays.

MATERIALS AND METHODS

This was a cross-sectional study where the reference population and the source population were all the elderly people living in "Pondok" in Kelantan. The sampling frame was determined based on the following inclusion and exclusion criteria. The inclusion criteria were all elderly aged 60 years old and above, while the exclusion criteria were those elderly with mental illness, infectious diseases, bed-ridden, deaf and mute as these might affect the history taking and oral examination.

The names of elderly people were obtained by going from one "pondok" to another and the assessment of their medical conditions were done by looking at physical conditions and was self-reported. Twenty-three "Pondok" in Kelantan were identified and 1,002 elderly people fulfilled the criteria. The names were arranged according to "Pondok" and were numbered from 1 to 1,002. A simple random sampling method was utilized for the selection of 386 elderly people. The sample size of 386 was determined by using Power and Sample Size Calculation software (Dupont and Plummer, 1998) with requirement for significance level (α) of 0.05, 80% power and 15% non-response rate.

A structured form was used to obtain the socio-demographic characteristics, which includes age, monthly income, duration of stay in "pondok", level of formal education, past employment status, and marital status. Dental Charting form was used to record information on dentition status. The data collection was conducted in the mosque or in the hall within the vicinity, where all the identified subjects gathered. A short briefing on the aims and procedure of the study was given. After getting the consent, the subjects were interviewed individually using a structured form to collect information about the subjects' demographic background.

Oral examination was done by one examiner throughout the study, using a portable dental chair, portable operating light, disposable mouth mirror and dental probe. A portable dental chair was used so that oral examination could be done in a supine position. For the dentate subjects, the oral examination included the assessment of the number of natural teeth (including retained roots), number of functional natural teeth, occluding pairs of functional natural teeth, decayed, missing, filled crown or root surfaces and teeth mobility. Functional natural teeth refer to all natural teeth, either sound or filled which are functioning very well, while occluding pairs of functional natural teeth refer to the pairs of maxillary and mandibular functional natural teeth that come into contact when the subjects close their mouth in the centric occlusion.

Tooth status (both crown and root) was primarily assessed by visual inspection and then confirmed by tactile inspection by means of blunt dental probe, no. 9. Coronal caries was recorded as present when there was a cavity, undermined enamel or a detectable softened floor or wall. Root caries was recorded as present when a lesion located on a root surface was felt to be soft on probing. However, both coronal and root caries were considered under the term "decayed tooth" (DT). In general, oral examination was based on the diagnostic criteria recommended by the World Health Organization (1997). Caries severity is measured by DMFX(T) index which records the number of decayed teeth (D), missing teeth (M), filled teeth (F) and teeth indicated for extraction (X).

All statistical analyses were performed using SPSS version 11.5. Descriptive statistics such as means and standard deviation (SD) for continuous variables, and frequency and percentages for categorical variables were determined. Normality in distributions of continuous variables was also checked.

RESULTS

Socio-demographic profile of elderly subjects

Three hundred and sixty nine (369) out of 386 selected elderly subjects participated in the study, in which the response rate was 95.6%. It represented 36.9% of the total eligible residents identified at all 23 "Pondok". The remaining 17 subjects were not available at the time of study. Majority of the respondents were female (92.4%). The mean age of male and female subjects was 77.1 years (SD 7.04) and 73.1 years (SD 7.20) respectively, while the mean age of all subjects was 73.4 years (SD 7.24). The mean income per-month per-person was RM 137.4 (SD 67.12), while the mean duration of stay in "Pondok" was 81.9 months (SD 68.10) at which male elderly were found to have longer mean duration of stay in "Pondok" as compared to female elderly.

Regarding the level of formal education, none of them obtained secondary school or high education. Majority of the participants were previously self-employed (99.2%) and all of the female subjects were widows and living alone (Table 1).

Dentition status of elderly subjects

Majority of the subjects were found to be edentulous (81.0%). The percentage of edentate subjects in age-group of 60-64 years was 52.2%, 65-69 years was 73.0%, 70-74 years was 87.0% and in the age-group of 75 years and above, was 89.5%. The percentage of dentate subjects in age-group of 60-64 years, 65-69 years, 70-74 years and 75 years and above was 47.8%, 27.0%, 13.0% and 10.5% respectively.

Among dentate subjects, 47.1% (33 subjects) were with natural teeth 20 or more and

38.6% (27 subjects) with functional natural teeth 20 or more. Regarding number of pairs of occluding teeth, 32.9% (23 subjects) of the dentate subjects had no occluding tooth pairs, 17.1% (12 subjects) had 1-5 pairs while 50.0% (35 subjects) had 6 or more occluding tooth pairs. Both coronal and root caries was experienced by 10 % of dentate subjects, none of them had tooth that had been filled and 7.1 % had teeth which required extractions.

Table 2 shows the dentition status of all study subjects by age-groups, while Table 3 shows the dentition status of dentate elderly subjects by age-group.

DISCUSSION

The response rate of this study was satisfactory and females contributed to the larger proportion of the elderly population studied. All of them lived alone and widowed, whereas majority of male elders were still married and living with their wives. This high proportion of widowed female elderly agrees to the findings by Avlund *et al.* (2003) which indicates that more elderly men than women were still married. Nevertheless, women tend to live longer than men and the disproportion between males and females increases with age (Mafauzy, 2000).

Apart from that, females were found more in the younger age-group of 60-74 years as compared to males and the mean age of males was older than females. Possible reason could be because men in their 60s and 70s are more susceptible to acute diseases such as strokes and heart attacks than women in the same age-group and delayed onset of acute diseases in women allows them to survive longer (Perls, 2004). However, the healthy men who have escaped from these acute diseases will have a survival advantage at later ages compared to their female peers and this phenomenon is called gender crossover (Perls, 2004).

This study also identified high proportion of elderly was without formal education. This could be due to growing-up in the pre-independence years where education was not readily accessible, and majority of the people lived in rural areas and in poverty. Being without formal education, majority of them were self-employed during their younger ages, and this study also found that some of them received monthly income from Welfare Department at the rate of RM 100 to RM 135. On the whole, the percentage of elderly subjects with monthly income of RM 50 or less was 55.3%. Basically, this amount is not enough for healthy living particularly for good food. However, they always get free supply of basic necessities such as rice, flour and sugar from the community. Hence, low monthly income was not a problem for them.

The prevalence of edentulism was found to be very high when compared to other studies (Petersen *et al.*, 2005; Loke et al., 2003; Srisilapan *et al.*, 2002; Oral Health Division, 2004; Saub and Evans, 2001; Lin, et al,. 2001a; Xie and Ainamo, 1999; Lamy, *et al.*, 1999; Bourgeois et al., 1998; Ismail, 1996; Miyazaki, *et al.*,1992; Soh, et al., 1992). Nevertheless, it agrees with other studies in terms of the trends of edentulism where the prevalence of edentulism increased with age while for the dentate, the proportion decreased with increasing age (Oral Health Division, 2004; Henriksen et al., 2003; Xie and Ainamo, 1999; Miyazaki *et al.*, 1992). However, comparison between studies is difficult because of difference in social and economic backgrounds, oral health care delivery system and treatment philosophies. For instance, in some developed countries, elderly people received better dental treatment, rather than extraction of teeth which was the most generally accepted treatment for dental caries in poor and some developing countries.

Owing to the high prevalence of edentulism, the mean number of teeth present, pairs of occluding teeth, carious teeth (coronal and root caries) and number of teeth indicated for

extraction was very low, whereas the missing component was high. The percentage of dentate elderly people with minimum 20 functional natural teeth was lower than what was found by other researchers (Fure, 2003; Srisilapanan *et al.*, 2002; Lin *et al.*, 2001a). However, it was better as compared to findings by Jokstad *et al.* (1996) in their study among institutionalised senior citizens in Skedsmo, Norway in 1993.

The missing (M) component had contributed to the higher value of DMFX (T) index while none from the filled teeth (F) component. This could be due to either no restoration was done in the earlier days, or the restorations did not last. In the early post-independence years, people had little or no access to health care facilities. Thus, in the absence of qualified dental practitioners, the public had no alternative but to get treatment from other unqualified "tooth extractors". This situation continued until the 1960's and 1970's. Because of shortage of dental professionals particularly in rural areas, the main task of dental professionals was to provide basic first aid and outpatient curative services for instance, tooth extraction. In children and adults suffering from tooth decay, teeth were either left untreated or extracted to relief pain or discomfort. Hence, during that time it was considered as "Forcep era". These reasons might contribute to the higher missing component and no filled component among elderly living in "Pondok" in Kelantan, because majority of them were from rural areas and of low socio-economic status.

In Europe and North America, restorations, (F) component constitute a major part of the DMFX (T) index or "caries experience. This is due to the situations that favour treatment such as variety of preventive measures are used by the people, easy access to dental treatment and wide utilization of health insurance schemes (Luan et al., 2000). The high missing teeth component (MT) contributed to the DMFT score was also documented by other researchers (Lin, *et al.*,

2001b: Bourgeois, *et al.*, 1998). In the review by Bourgeois *et al.* (1998) it was observed that missing (M) component had contributed to the higher value DMFT, in some countries such as Hungary while in Georgia, filled (F) component had contributed only 0.1.

The mean DMFX (T) index among elderly people living in "Pondok" in Kelantan was higher for comparable age-groups in other studies (Henriksen, *et al.*, 2004; Oral Health Division, 2004; Jokstad, *et al.*, 1996). However, comparing to the study by Bourgeois *et al* (1998), the present findings was lower than findings from Hungary and Slovenia but higher than those in Austria, Belarus, Czechoslovakia Republic, France, Georgia, Germany, Iceland, Italy, Latvia, Netherlands, Poland, Russian Federation, Spain, Switzerland, United Kingdom and Former Yugoslavia. Generally, the mean number of missing teeth (M) or tooth loss and DMFX(T) was found to be increasing with advancing age and it is in agreement with earlier findings (Henriksen, et al., 2004; Oral Health Division, 2004; Jokstad, *et al.*, 1996).

Despite the encouraging results, limitations were also noted in this study. The measurement of loss of attachment which reveals the total history of periodontitis was not done and root caries were considered together with coronal caries under the general term "decayed teeth". Apart from that, the DMFX(T) index is less useful for elderly people as loss of teeth (M) from periodontal disease leads to overestimation of past caries. However, periodontal diseases account for only a minor proportion of tooth extraction in adults (Baelum, *et al.*, 1997). Hence, periodontal disease is not a major cause of tooth loss (Bailit, *et al.*, 1987).

From a public health perspective, the key goal is prevention. However, findings from this study have shown that elderly people in "Pondok" is suffering from oral health problem. Therefore steps should be taken to improve their oral health status. It has been reported that visits to physician among elderly has increased with age but not to dentists. The possible reason could

be due to the lack of financial ability to afford dental care (Arokiasamy, 1997). Therefore, the oral health care programme for elderly that has already been in place since late 1993, which is confined only to the government-owned institution should be extended to other set-ups such as "Pondok". This can be achieved by having a "mobile dental squad" which can deliver services, such as preventive measures and simple dental procedures at institutions using portable dental equipments. Only in this way the barriers to oral health care for elderly living in "Pondok" can be resolved.

The elderly are more likely to visit a physician than a dentist. Therefore, it is imperative that primary health care providers (medical professionals) be educated about the medical, functional (local effects), emotional and social consequences of oral diseases and dysfunction so that dental and medical professionals would work together in providing regular screening and preventive education for dental diseases. In addition, policies and strategies of a two-pronged system for oral health care should be strengthened: One is the provision of oral care services to the elderly, especially those in institutions, and the other one is the same programs for the younger generations. With such programmes, the National Oral Health Goals for dental caries among elderly aged 60-70 years, which is 30 % or less are edentulous and at least 50 % to have minimum of 20 functional natural teeth would be achieved (Oral Health Division, 2002).

As for the conclusion, it appears that oral health status of elderly people living in "Pondok" in Kelantan was unsatisfactory with high percentage of edentulism and low proportion of subjects with minimum 20 functional natural teeth. The tooth loss as measured by the number of missing teeth (M component) was very high in which it had contributed to the high value of the mean DMFX (T) index.

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TABLES

Table 1: Socio-demographic characteristics of elderly subjects by sex

Characteristics	Male n (%) 28 (7.6)	Female n (%) 341 (92.4)	All subjects n (%) 369 (100.0)
Age group (years):			
60 - 64	2 (7.1)	44 (12.9)	46 (12.5)
65 - 69	3 (10.7)	71 (20.8)	74 (20.1)
70 - 74	3 (10.7)	74 (21.7)	77 (20.8)
≥ 75	20 (71.4)	152 (44.6)	172 (46.6)
Monthly Income (RM)			
≤ 50	14 (50.0)	190 (55.7)	204 (55.3)
> 50	14 (50.0)	151 (44.3)	165 (44.7)
Duration of stay in "Pondok" (months):			
< 60	5 (17.9)	179 (52.5)	184 (49.9)
≥ 60	23 (82.1)	162 (47.5)	185 (50.1)
Level of formal education:			
No schooling	23 (82.1)	242 (71.0)	265 (71.8)
Primary	5 (17.9)	99 (29.0)	104 (28.2)
Secondary	-	-	-
Past- employment status:			
Self- employed	26 (92.9)	340 (99.7)	366 (99.2)
Government / private	2 (7.1)	1 (0.3)	3 (0.8)
Marital status:			
Widowed	1 (3.6)	341 (100.0)	342 (92.7)
Married	27 (96.4)	0	27 (7.3

Table 2: Dentition status of elderly subjects by age-groups

Characteristic	60 – 64 (years) n=46	65 – 69 (years) n=74	70-74 (years) n=77	≥ 75 (years) n=172	All ages n=369
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Mean number of teeth present	8.1 (10.10)	4.1 (7.89)	2.1 (5.76)	2.1 (6.76)	3.2 (7.54)
Mean number of functional natural teeth	7.1 (9.03)	3.5 (7.21)	1.9 (5.50)	1.6 (5.70)	2.8 (6.70)
Mean number of carious teeth (coronal & root caries) (D)	0.1 (0.89)	0.1 (0.38)	0.1 (0.41)	0.1 (0.38)	0.1 (0.48)
Mean number of missing teeth (M)	23.9 (10.10)	28.0 (7.94)	30.0 (5.48)	29.9 (6.76)	28.8 (7.51)
Mean number of filled teeth (F)	0	0	0	0	0
Mean number of teeth for extraction (X)	0.9 (1.88)	0.4 (1.42)	0.2 (1.26)	0.4 (1.72)	0.4 (1.60)
Mean DMFX (T) (Caries experience)	24.9 (9.03)	28.4 (7.21)	30.2 (5.25)	30.4 (5.63)	29.3 (6.63)

Table 3: Dentition status of dentate elderly subjects by age-groups

Variable	Age-group (years)				All age-group (n=70)
	60-64 (n=22) Mean (SD)	65-69 (n=20) Mean (SD)	70-74 (n=10) Mean (SD)	≥ 75 (n=18) Mean (SD)	Mean (SD)
Natural teeth present	16.9 (7.90)	15.0 (8.15)	16.3 (4.81)	19.9 (9.06)	17.1 (8.00)
Functional natural teeth	14.8 (7.40)	13.1 (8.23)	14.6 (7.01)	15.7 (9.68)	14.5 (8.11)
Occluding functional natural teeth	7.0 (3.87)	6.0 (4.26)	6.3 (4.57)	5.9 (4.66)	6.3 (4.22)
Carious teeth (both coronal and root) (D)	0.3 (1.28)	0.3 (0.72)	0.5 (1.08)	0.4 (1.14)	0.3 (1.06)
Missing (M)	15.1 (7.90)	17.2 (8.60)	16.7 5.21)	12.1 (9.07)	15.1 (8.20)
Filled teeth (F)	0	0	0	0	0
Number of teeth for extraction (X)	1.8 (2.4)	1.4 (2.52)	1.2 (3.46)	4.1 (3.75)	2.2 (3.14)
DMFX(T) (Decayed, Missing, Filled, Extraction)	17.2 (7.40)	18.8 (8.07)	18.4 (7.34)	16.6 (9.62)	17.6 (8.08)

Association between functional dentition with inadequate calorie intake and underweight in elderly people staying in Islamic Religious Community Set-up, "Pondok" in Kelantan

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ABSTRACT

This study was to investigate the association between functional dentition with inadequate calorie intake and underweight in elderly people living in "Pondok" in Kelantan. A cross-sectional study participated by 369 elderly people was carried out. A simple random sampling method was utilized for the selection of the subjects. Subjects were interviewed using a structured form to collect information about subjects' demographic background and self-reported health status. The 24-hour recall method was used to provide information on the subject's exact food intake during the previous 24 hours. Body mass index was calculated from subjects' weight and height, followed by oral assessment. The "Nutrical Software" was used for nutrient calculation, followed by SPSS version 11.5 for data analysis. The response rate was 95.6 %. Majority of the respondents were female (92.4 %). The percentage of subjects who had inadequate calorie intake and underweight was 71.0 % and 25.7 % respectively. The percentage of edentulism was 81.0%. The proportion of elderly with compromised functional dentition was 48.2% and majority was edentate elderly without wearing any complete dentures or wearing defective dentures, 23.6% and 56.2% respectively, while 20.2% was dentate elderly. The odds of having inadequate calorie intake and getting underweight among elderly with a compromised functional dentition was 3.7 times and 42.0 times respectively, compared to elderly with a non-compromised functional dentition. There was a significant association between inadequate calorie intake and underweight with functional dentition among elderly living in "Pondok" in Kelantan.

Key words: Functional dentition, inadequate calorie intake, underweight, elderly, Malays

INTRODUCTION

The number of functional natural teeth, pairs of occluding teeth, tooth loss, denture status, dental caries and periodontal diseases are among the oral factors that are associated with nutrition intake (Wynne, 1999; Marshal *et al.*, 2002; Mojon *et al.*, 1999; Shimazaki *et al.*, 2001). Decreasing numbers of occlusal units would increase the numbers of chewing strokes needed for swallowing and those with less than 4 occlusal units in symmetrically shortened tooth arches and less than 6 in asymmetrically shortened arches started complaining about their masticatory function (Kayser, 1981). Hence, the position of the remaining teeth seems to be more accurate indicator of chewing ability than merely the total number of teeth presents (Hildebrandt *et al.*, 1997).

Loss of teeth resulted in impaired chewing ability (Idowu *et al.*, 1986) and avoidance of foods that are difficult to chew such as fruits, vegetables (Brodeur *et al.*, 1993; Hildebrandt *et al.*, 1997; Chauncey *et al.*, 1984) and protein-rich foods such as meat (Zulkowski and Albrecht, 2003) resulting in poor diet quality and poor nutritional status. Changes in eating habits and food selection appear to be reflected in the findings by few researchers in which edentulous individuals consumed more the softer foods such as processed foods and refined carbohydrates which tends to have high content of saturated fats and cholesterol than dentate individuals (Joshipura *et al.*, 1996; Greksa *et al.*, 1995; Hartsook, 1974).

This study aims to identify associations between functional dentition with inadequate calorie intake and underweight in elderly population staying in Islamic Religious Community Setup, "Pondok" in Kelantan. "Pondok" refers to a group of cottage built around a mosque, and it is for the people who would like to improve their

religious knowledge. It is not only for the elderly but many of them live there because they would like to spend their last bit of life in a more pious manner (Abdul Manaf *et al.*, 1999). They should be physically and mentally fit, otherwise they are not allowed to stay there. Should they be physically and mentally disabled, their children or relatives must bring them back home, or if they have nobody and no where to go, they will be placed in the government-owned institution such as "Rumah Sri Kenangan" at Pengkalan Chepa, Kelantan. Thus, "pondok" is considered as semi-institutions for elderly who are independent and apparently looked healthy. In addition, all elderly people staying in "pondok" are Malays.

The rationale of this study is because the relationship between nutritional status and oral health among elderly people has not been explored in Kelantan and previous research on association between dentition status and nutritional status has yielded mixed results. Therefore, this study is important to generate data for the elderly population living in "Pondok" in Kelantan. The one-day 24 hour recall method was used because it is certainly simpler, less demanding, more practical in survey work, and impose little burden to the illiterate respondents compared to the seven-day dietary record (Garn *et al.*, 1976). Apart from that, it has been shown by Madden, Goodman and Guthrie this method was valid on a group basis given a sufficient sample size (Garn *et al.*, 1976).

MATERIALS AND METHODS

This was a cross-sectional study which was conducted from Jun 2004 to January 2005. The reference and the source population were all the elderly people living in "Pondok" in Kelantan. The sampling frame was determined based on the following

inclusion and exclusion criteria. The inclusion criteria were all elderly aged 60 years old and above, while the exclusion criteria were those elderly with mental illness, infectious diseases, bed-ridden, deaf and mute, and those with scoliosis as these might affect the history taking, oral examination, the 24-hour recall nutrition intake and the anthropometric measurement.

The names of elderly people were obtained by moving from one "pondok" to another and the assessment of their medical conditions were done by looking at physical conditions and was self-reported. Twenty-three "Pondok" in Kelantan were identified and 1,002 elderly people fulfilled the criteria. The names were arranged according to "Pondok" and were numbered from 1 to 1,002. A simple random sampling method was utilized for the selection of 386 elderly people. The sample size of 386 was determined by using Power and Sample Size Calculation software (Dupont and Plummer, 1998) with requirement for significance level (α) of 0.05, 80% power and 15% non-response rate. It was based on the prevalence of inadequate calorie intake, 72.0% (Chee *et al.*, 1997).

The data collection was conducted in the mosque or in the hall within the vicinity. One examiner was involved throughout the study to reduce inter-variability and no duplicate measurements were made for checking the reliability of measurements. The participants were given briefing about the aims and procedure of the study in detail. After getting the consent, the subjects were interviewed individually using a structured form to collect information about the subjects' demographic background which includes sex, household monthly income, duration of stay in "pondok", level of formal education, past employment status, marital status and self-reported health status. Self-reported health status is a subjective integration of individual health or it is a perceived health. It was

assessed with the question: "How would you judge your present health in general?" using a two-point scale: healthy or unhealthy. If it is unhealthy, then the subjects need to state any chronic diseases they might have.

We utilized the 24-hour recall form to get information on the respondent's exact food intake during the previous twenty-four-hour period. It was conducted in four stages, based on the format of the forms. First, a complete list of all foods and beverages consumed during the previous 24 hour were recorded. Second, detailed descriptions of all foods and beverages consumed were recorded (e.g. cooking method). Third, estimates of the amounts of all food and beverages consumed were obtained and finally, the recall was reviewed to ensure all items have been recorded correctly. The household measurements such as bowls, cups, plates, glass and spoons were used to estimate the amount of food consumed and the same household measurements were used for all subjects.

For the body weight measurement, the subjects wore light garments and bare-footed. it was measured using calibrated portable SECA weighing scale with precision of 0.5 kg. For the standing height, the subjects stood bare-footed on a flat horizontal floor with their heels together, against a microtoise fixed to the wall. Then, it was measured with a flat ruler placed on the person's head with the precision of 0.1 cm. Body mass index was then calculated by dividing an individual's weight in kilograms by the square of his or her stature in metres. The unit for BMI is kg/m^2.

Dental Charting form was used to record information on dentition status. Oral examination was done using standard portable dental chair, portable operating light, disposable mouth mirror and dental probe. Oral examination included the assessment of the number of natural teeth including retained roots, number of functional natural teeth,

occluding pairs of functional natural teeth, decayed teeth (D), missing teeth (M), filled crown or root surfaces of the teeth (F) and teeth indicated for extraction (X) when caries has destroyed the tooth that it can not be restored or the tooth is so loose that it can not be restored to a functional state.

Functional natural teeth refer to all natural teeth, either sound or filled which are unctioning very well, while occluding pairs of functional natural teeth refer to the pairs of maxillary and mandibular functional natural teeth that come into contact when the subjects close their mouth in the centric occlusion. Coronal caries was recorded as present when there was a cavity, undermined enamel or a detectable softened floor or wall. Root caries was recorded as present when a lesion located on a root surface was felt to be soft with the probe. However, both coronal and root caries were considered under the term "decayed tooth" (DT). In general, oral examination was based on the diagnostic criteria recommended by the World Health Organization (1997).

In denture wearers, prosthetic status was recorded as either being completely or partially edentulous, and as either wearing denture or not. Denture status was assessed by its stability, retentiveness (McCord and Grant, 2000; Soh *et al.*, 1992; Vigild, 1987) and comfort. Dentures which have fulfilled all the criteria that are stable, retentive and did not cause any pain or discomfort on functioning were classified as satisfactory, otherwise unsatisfactory. Subjects were classified into two groups, having a compromised functional dentition or not. Those with at least one of the following criteria were classified as having a compromised functional dentition: dentate elderly with less than 20 functional natural teeth and not wearing any partial denture or with poor dentures (Marshal *et al.*, 2002; Mojon *et al.*, 1999; Wynne, 1999)) or any subject regardless of the

number of functional natural teeth present but with decayed teeth or retained roots more than three or with mobile teeth indicated for extraction (Mojon *et al.*, 1999) or edentate elderly without full dentures or presenting with defective dentures (Marshal *et al.*, 2002; Shimazaki *et al.*, 2001; Mojon *et al.*, 1999).

Food consumption data of each subject (from the 24-hour recall nutrition intake) was converted into daily calorie intake or energy (Kcal) using a computer programme, "Nutrical Software". The "Nutrical Software" is a nutrient calculation system, version 1.01, and it is based on the data contained in "Nutrient Composition of Malaysian Foods" which was compiled by Tee *et al* (1997). Then, the data of daily calorie intake or energy (Kcal) was transferred manually to SPSS version 11.5 statistical software for the calculation of dietary adequacy, based on the "Recommended Nutrient Intakes for Malaysia 2005" (NCCFN, 2005). The percentage dietary intake was computed for daily calorie (Kcal) intake and two-thirds of the RNI was used as the lower limit for considering sufficient energy intake based on Suriah *et al.* (1996). For the underweight, the value of body mass index of 18.5 kg/m^2 and below was considered (Abdul Manaf *et al.*, 1996).

All statistical analyses were performed using SPSS version 11.5. Descriptive statistics such as means and standard deviation (SD) for continuous variables, and frequency and percentages for categorical variables were determined. Normality in distributions of continuous variables was also checked. To determine the association between functional dentition and socio-demographic factors with inadequate calorie (energy) intake and underweight, a simple logistic regression was used followed by multiple logistic regression analysis. The level of significance was set at 0.05. For the

independent variables of a categorical in nature, dummy variables were created with a reference category which was set to 0 and for the interpretation of the resulting coefficients for two-category variables, such as gender, is straight forward because it tells the difference between the log odds of a case and a reference category, but for the variables that have more than two categories, the only statement that could be made was by comparing a particular category with the corresponding reference category.

In this analysis, there were two dependent variables (outcome): Inadequate daily calorie or energy (Kcal) intake (Yes or No), and underweight (Yes or No). They were assessed separately. For the outcome of inadequate daily calorie or energy (Kcal) intake, the independent variables were functional dentition and socio-demographic factors while for the outcome of underweight, daily calorie or energy (Kcal) intake was considered as an additional independent variable other than functional dentition and socio-demographic factors. The main independent variable was functional dentition, which was classified into a dichotomous variable: compromised and non-compromised functional dentition. For socio-economic independent variables: sex was categorized as male and female, age of subjects (in years) was categorised into four groups, 60-64, 65-69, 70-74 and 75 years old and above (Oral Health Division, 2004), the level of formal education was categorized as no formal education (0 year), primary and secondary (Oral Health Division, 1998), past employment status as self-employed or being-employed and marital status as married or widowed.

Initially household monthly income and duration of stay in "Pondok" were treated as continuous variables but were found later, they were not linear to the logit, hence were categorized into groups based on their beta coefficient values. Monthly income was

categorized as RM 50 or less and more than RM 50 while duration of stay in "Pondok" (months) was categorized as less than 60 months and 60 months or more.

For the multiple logistic regression analysis, to arrive at the final models, the backward stepwise logistic regression technique based on the likelihood-ratio and Wald chi-square statistics were employed. Backward elimination starts with all chosen variables in the model, then, at each step, variables were evaluated for entry and removal (variables were entered in the model when p-value < 0.05). The final model should contain all variables remaining under the p-value less than 0.05. Crude and adjusted odds ratios (adjusted for confounders) were obtained from simple and multiple logistic regression respectively. Confidence Interval (CI) at 95 % of the odds ratios (OR), likelihood-ratio (LR) chi-square and p-value of the association were obtained in order to make inferences to the study population.

In multiple logistic regression analysis, the two-way interactions between the factor of interest and other significant independent variables were also checked by LR test. The model was tested for the fitness by using Hosmer-Lemeshow goodness-of-fit test. If the p-value approached one, the model was perfectly fit. The Receiver Operating Characteristic (ROC) curve for area under the curve and classification table for sensitivity, specificity and correctly classified were also obtained in order to evaluate the fitness of the model.

RESULTS

The response rate was 95.6% with 369 out of 386 selected elderly people participated and the remaining 17 people were not available at the time of study. Majority

of the respondents were female (92.4%) and only 7.6% were male. The mean age of male and female subjects was 77.1 years (SD 7.04) and 73.1 years (SD 7.20) respectively, while the mean age of all subjects was 73.4 years (SD 7.34). The subjects were categorized into four age-groups (Oral Health Division, 2000) and it was found that 12.5% was in the age group of 60-64 years, 20.1% was in the age-group of 65-69 years, 20.8% was in the age-group of 70-74 years, while 46.6% was in the age-group of 75 years and above. About 71.4% of the male subjects were in the oldest age-group (≥ 75 years old) while for the female subjects, it was 44.6%.

The mean household monthly income and mean duration of stay in "Pondok" was RM 137.4 (SD 67.12) and 81.9 months (SD 68.10) respectively. Regarding the level of formal education, 71.8 % were with no formal education, 28.2% were with primary level of formal education and none of them obtained secondary school or high education. Majority of the participants were previously self-employed (99.2%) and all of the female subjects were widows and living alone while majority of male subjects (96.4 %) were still married. Looking at self-reported health status, more male subjects (78.6%) claimed they were healthy as compared to female subjects (58.4%). Overall, there were about 60% of the subjects considered their general health to be good.

The proportion of elderly with a compromised functional dentition was 48.2% and majority was edentate elderly without wearing any complete dentures or wearing defective dentures, 23.6% and 56.2% respectively as shown in Table 1. Table 2 shows the prevalence of inadequate calorie (energy) intake while Table 3 shows the prevalence of underweight in elderly people. The correlation between calorie intake and body mass index (BMI) is shown in Figure 1. The results of simple logistic regression and multiple

logistic regression analysis of the factors associated with inadequate calorie intake were summarized in Table 4 and Table 5 respectively. At multivariable level, functional dentition, duration of stay in "Pondok" and monthly income were significantly associated with inadequate calorie intake. Table 6 and Table 7 summarize factors associated with underweight at univariable and multivariable level respectively. At multivariable level significant associations were noted between functional dentition, self-reported health status, age of the subjects and energy intake with underweight. For age-group, there was a significant association between older age-group cohorts (70-74 years old and 75 years old and above) with the outcome.

DISCUSSION

The response rate of this study was 95.6% and it represented 36.9% of the total eligible residents identified at all 23 "Pondok". The females contributed to the largest proportion of the elderly subjects studied and all of them lived alone and widowed, whereas majority of male elders were still married. This high proportion of widowed female elderly agrees to the findings by Avlund *et al.* (2003) which indicates that more elderly men than women were still married. Nevertheless, women tend to live longer than men and the disproportion between males and females increases with age (Mafauzy, 2000).

Good oral health is important for all people because it provides the individual with a nice smile, improves the functionalities of speech, mastication and also helps them to enjoy food. Teeth serves as the primary means of mastication and it is a very important function of the oral cavity. Thereby, the loss of teeth reduces an older adult's ability to

chew food (Wayler and Chauncey, 1983) which may lead to poor diet quality and poor nutritional status (Sahyoun *et al.* 2003). This study has indicated higher proportion of elderly subjects with a compromised functional dentition compared to Mojon *et al.* (1999). Better findings by Mojon *et al.* (1999) could be due to the fact that most residents (69 %) had their dental treatment covered by a government plan unlike the residents in "Pondok".

There was 71.0% of elderly people with inadequate calorie intake and 25.7% were underweight. The higher proportion of elderly in the age-group of 75 years and above had inadequate calorie compared to the younger age-group is consistent with a local study among free living elderly in southern Peninsular Malaysia (Suriah *et al.*, 1996). Regarding the prevalence of underweight, it was found to be similar with the observation by Juguan *et al.* (1999). However, it was better than findings among elderly in the rural, agro-based communities in Kelantan and in institution, Rumah Sri Kenangan, Kemumim, Kelantan, respectively (Abdul Manaf *et al.*, 1997; Abdul Manaf *et al.*, 1996).

Our results also demonstrated that elderly subjects with compromised functional dentition have inadequate calorie intake. As stated earlier, one of the criteria under compromised functional oral status was the presence of functional natural teeth less than 20 without good partial dentures or with poor partial dentures. This result seems to be consistent with Joshipura *et al.* (1996) that there is a linear decreasing trend of nutrient intakes as the total number of teeth decreases. It was documented that maintaining about 20 natural teeth may contribute to general health, and frequently, individuals with poor dentition consume soft, easily chewed food that are low in fibre, energy and nutrient density (Suzana *et al.*, 1999; Appollonio *et al.*, 1997). Hence, a minimum of 20 functional

natural teeth (for adults 35 years old and above) has been regarded as favourable for optimal nutritional status because with 6 aesthetic units and 4 premolars occlusal units is necessary for moderate functioning and better mastication (Wynne, 1999; Shimazaki *et al.*, 2001; Budtz-Jorgensen *et al.*, 2000).

The present study also showed that elderly subjects with good dentures (non-compromised functional dentition) seemed to have a better chance of having adequate calorie intake as compared to those without dentures or with defective dentures (compromised functional dentition). Therefore, our results support observations of other researchers that edentulousness or ill-fitting dentures reduce dietary quality and nutrient intake (Marshall *et al.*, 2002). In addition, Lamster (2004) and Walton (2001) supported the fact that defective and ill-fitting dentures adversely affect chewing efficiency. Hence adequacy of dental prostheses in edentulous person is important for an optimal nutritional status (Brodeur *et al.*, 1993). Nonetheless, findings by Appollonio *et al.* (1997) the association was only true for micronutrients (vitamins and minerals) but not for calorie intake.

Previous studies of the association between oral status and body weight have yielded mixed results. In our study it showed that elderly with a compromised functional oral status tend to be underweight because of a decrease in calorie intake. It is in agreement to the findings by other researchers (Srisilapanan *et al.*, 2002; Mojon *et al.*, 1999; Blaum *et al.*, 1995). However, the present finding is in contrast to Sahyoun *et al.* (2003) in which edentulous elderly subjects had elevated body mass index because edentulism reduce chewing ability so, they tend to eat foods high in caloric density which consequently lead to increase in weight. This fact is in accordance to the findings by

Johansson *et al.* (1994) that edentulous men and women were more obese and tended to have higher BMI because they ate more sweet snacks but less fruits, vegetables and fibres.

This study also noted that monthly income and duration of stay in "Pondok" were significantly associated with inadequate calorie intake, while self-reported health status, age and calorie intake were significantly associated with underweight. Low income or poverty plays the most important environmental determinant of inadequate nutrition among elderly because it affects person's ability to obtain adequate and more diverse diet (Clarke *et al.*, 1998). It has been documented that consumption of more diverse diet was associated with higher calorie intake, while a narrow range of food choices may lead to dietary inadequacies (Bernstein, 2002). Knapp (1989) cites a study by Guthrie *et al.* and United States Department of Health, Education and Welfare that there was a relationship between income and nutritional adequacy. The same fact was also reported by Suzana *et al.* (1999) in their local study among rural elderly Malays in Mersing District, on the East coast of Malaysia, that elderly people who did not have a pension or salary as their main source of income were more likely to be undernourished. Moreover, other factors that can affect nutritional intake are also influenced by income, such as transportation (inability to use public transport to go to towns to get good foods), housing and facilities for food storage and preparation (Knapp, 1989).

The duration of stay in "Pondok" was also significantly associated with inadequate calorie intake. As indicated earlier, majority of the elderly subjects in the present study were alone in their "Pondok". The longer the duration of stay in the "Pondok", means the longer they were alone. Living alone is a psychosocial issue and

reflects loneliness. Loneliness results in a lack of interest towards food and can undermine the desire to prepare and eat food which ultimately affects the nutrition intake (Walker and Beauchene, 1991). This fact was supported by Abdul Manaf *et al.* (1999) in their "Community Kitchen" study that there was an improvement in nutritional status of elderly after four months of the Community Kitchen programme. Possible reasons could be because in the Community Kitchen programme, the elderly ate the warm meal together which might improve their appetite thus increased food intake and consequently increase the mean intake of calorie.

Self-reported health status was found to be significantly associated with underweight. In this study, those elderly subjects who claimed that their health status is excellent (healthy and no known disease) was found to be significantly associated with underweight where the odds of getting underweight was 2.6 times more compared to those who claimed unhealthy. The reason is probably because chronic diseases are associated with obesity or over nutrition and it agrees to the results by Suzana *et al.* (1999) in their nutrition study among rural elderly in Malaysia, where elderly without such diseases were found to be undernourished.

Age was also associated with underweight, in which the odds of being underweight was increased by five and six times among elderly in age-groups of 70-74 years and 75 years and above respectively as compared to the younger age-groups. This finding is consistent with Srisilapanan *et al.* (2002) in their study among Thai people aged 70-74 years. With ageing there is a decrease in peristalsis and hydrochloric acid secretion, resulting in gastrointestinal disturbances which may interfere with nutrient absorption and utilization (Ferry, 2005). On the other hand, a decrease in the number of

taste buds on the tongue and nerve ending response to taste and smell may reduce dietary intake because taste is the strongest determinant of food choices, and the sense of smell is a major determinant of appetite (Krall and Henshaw, 2003). Hence, inability to perceive the aromas of food can diminish an external cue for eating. However, there are few researchers who did not support this fact. They suggested that ageing process per se is not a cause of malnutrition in a healthy elderly population but it is more likely to occur among elderly with poor socio-economic status, the homebound (particularly those living alone), the bereaved, those with physical disability and those with depression or mental disorders (Buchowski and Sun, 1996). In addition, Abdul Manaf *et al.*, (1997) have also suggested low BMI was not influenced by age. Calorie intake was also significantly associated with underweight while controlling other factors. This finding would be explained by a positive correlation between calorie intake and body mass index.

In general, we can conclude that inadequate calorie intake and underweight were highly significantly associated with functional dentition status. Hence, it is timely that oral health services to restore masticatory function are looked into. Improved masticatory function consequently will improve their feeling of well-being, self-image, ability to communicate and to socialize, improve nutrition and ultimately the quality of life. Health professionals, nutritionist and dietitions should play an important role in educating the elderly people to improve their dietary intake in order to have a better quality of life. Apart from that, it is in the hand of government to improve the economy of the poor elderly since poverty is known to play the most important environmental determinant.

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TABLES

Table 1: Dentition status of 369 elderly subjects by functional dentition

Dentition status	Compromised n (%)	Non-compromised n (%)	**Total**
Edentate:	**142 (47.5) [a]**	**157 (52.5) [a]**	**299 (81.0) [e]**
Good complete dentures	-	157 (82.2) [d]	157
No complete denture	42 (23.6) [c]	-	42
Defective complete dentures	100 (56.2) [c]	-	100
Dentate:	**36 (51.4) [b]**	**34 (48.6) [b]**	**70 (19.0) [e]**
≥ 20 functional teeth with decayed tooth or root ≤ 3	-	23 ((12.0) [d]	23
≥ 20 teeth with decayed tooth or root > 3	4 (2.2) [c]	-	4
< 20 teeth but with good partial denture	-	11 (5.8) [d]	11
< 20 teeth and with poor partial denture	1 (0.6) [c]	-	1
< 20 teeth and without partial denture	31 (17.4) [c]	-	31
Total	**178 (48.2) [e]**	**191 (51.8) [e]**	**369 (100.0)**

[a] denominator is all edentate subjects, n=299
[b] denominator is all dentate subjects, n=70
[c] denominator is all subjects with compromised functional dentition, n=178
[d] denominator is all subjects with non-compromised functional dentition, n=191
[e] denominator is all study subjects, n=369

Table 2: Proportion of elderly subjects who had adequate and inadequate calorie intake by sex and age-groups

Variables	Adequate n (%)	Inadequate n (%)	Total n
Sex:			
Male	3 (10.7)	35 (89.3)	28
Female	104 (30.5)	237 (69.5)	341
Total	**107 (29.0)**	**262 (71.0)**	**369**
Age-group (years):			
60 - 64	18 (39.1)	28 (60.9)	46
65 - 69	23 (31.1)	51 (68.9)	74
70 - 74	25 (32.5)	52 (67.5)	77
≥ 75	41 (23.8)	131 (76.2)	172
Total	**107 (29.0)**	**262 (71.0)**	**369**

Table 3: Proportion of elderly subjects who was underweight and not underweight by sex and age-groups

Variables	Underweight (BMI ≤ 18.5 kg/m^2) n (%)	Not Underweight (BMI > 18.5 kg/m^2) n (%)	Total n
Sex:			
Male	2 (7.1)	26 (92.9)	28
Female	93 (27.3)	248 (72.7)	341
Total	**95 (25.7)**	**274 (74.3)**	**369**
Age-group (years):			
60 - 64	4 (8.7)	42 (91.3)	46
65 - 69	15 (20.3)	59 (79.7)	74
70 - 74	24 (31.2)	53 (68.8)	77
≥ 75	52 (30.2)	120 (69.8)	172