Artikel Asli/*Original Articles*

Association between Nutritional Status, Food Insecurity and Frailty among Elderly with Low Income
(Perkaitan Antara Status Pemakanan, Ketidakjaminan Makanan dan Keuzuran dalam Kalangan Warga Emas Berpendapatan Rendah)

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ABSTRACT

Aging is associated with increased risk of frailty and malnutrition. However, food insecurity has rarely been highlighted in the elderly population, especially among the low income group. Thus, a cross-sectional study was conducted to determine the association between nutritional status, food insecurity and frailty among elderly in low income residences in Klang Valley. A total of 72 elderly individuals aged 60 years and above was selected (mean age 66 ± 6 years) through convenient sampling. Participants were interviewed to obtain information on socio-demographic, health status, food insecurity and cognitive status. Anthropometrics parameters and frailty assessments was measured using standard criteria. Results showed that 75.0% of the participants had abdominal obesity. Nearly half of the participants were overweight (41.7%), followed by normal (43.0%) and underweight (15.3%). With respect to food insecurity, most of them reported that they had enough food (93.1%). There were significant correlation ($p < 0.05$) between food insecurity with height ($r = -0.263$, $p = 0.026$). Most of the participants were pre-frail (58.3%), frail (27.8%) and followed by non-frail (13.9%). Calcium intake is inversely associated with frailty ($t = -2.62$, $p = 0.011$). In conclusion, food insecurity was not a problem, however, half of the subjects were overweight and pre-frail. Three out four subjects had abdominal obesity. There is a need to investigate further the pathogenesis of fat frail in this low income elderly population and formulate effective intervention strategies.

Keywords: Elderly; frailty; food insecurity; low income; calcium intake

ABSTRAK

Penuaan meningkatkan risiko keuzuran dan malnutrisi. Walau bagaimanapun, ketidakjaminan makanan jarang diteliti dalam kalangan warga emas, terutamanya bagi golongan berpendapatan rendah. Oleh itu, satu kajian hirisan lintang dijalankan untuk menentukan perkaitan antara status pemakanan dengan ketidakjaminan makanan dan keuzuran dalam kalangan warga emas dari kawasan berpendapatan rendah di Lembah Klang. Seramai 72 orang warga emas berumur 60 tahun dan ke atas (min umur 66 ± 6 tahun) dipilih melalui kaedah persampelan mudah. Subjek ditemu ramah untuk mendapatkan maklumat mengenai sosio-demografi, status kesihatan, ketidakjaminan makanan, dan status kognitif. Pengukuran antropometri dan status keuzuran juga diukur. Hasil kajian menunjukkan bahawa 75.0% daripada subjek mempunyai obesiti abdomen. Hampir separuh daripada subjek mengalami berlebihan berat badan (41.7%), separuh lagi adalah normal (43.0%), diikuti dengan kurang berat badan (15.3%). Berkaitan dengan ketidakjaminan makanan, kebanyakan subjek melaporkan yang mereka mempunyai makanan yang mencukupi (93.1%). Terdapat hubungan yang signifikan ($p < 0.05$) di antara ketidakjaminan makanan dengan ketinggian ($r = -0,263$, $p = 0.026$) subjek. Kebanyakan subjek adalah pra-uzur (58.3%), uzur (27.8%) diikuti dengan tidak uzur (13.9%). Pengambilan kalsium yang kurang meningkatkan risiko keuzuran ($t = -2.62$, $p = 0.011$). Kesimpulannya, ketidakjaminan bukan menjadi masalah bagi subjek, walau bagaimanapun, separuh daripada subjek mempunyai berat badan berlebihan dan pra uzur. Tiga daripada empat subjek mengalami obesiti abdomen. Terdapat keperluan bagi mengkaji patogenesis fenomena gemuk uzur secara lebih lanjut dalam kalangan populasi warga emas berpendapatan rendah ini bagi menghasilkan formulasi dan strategi pencegahan yang berkesan.

Kata kunci: Warga emas; keuzuran; ketidakjaminan makanan; berpendapatan rendah; pengambilan kalsium

INTRODUCTION

Assessing nutritional status with respect to nutrient intake and dietary habits is essential in order to determine the health risk among elderly of which malnutrition is a major problem and it is usually associated with several diseases (Shahar et al. 2002). Early screening and diagnosis of malnutrition in old age is important to help the elderly understand their nutritional needs, health status and to prevent them from disease co-morbidities (Shahar et al. 2002). Deterioration in nutritional status is closely linked to the lack of food intake, weight loss, illness, stress, self-sufficiency and the ability of the body function (Oliveira et al. 2009). Changes in dietary behaviour and physical activity patterns among the elderly may lead to increased risk of malnutrition (Siti et al. 2010).

The elderly are also prone to have food insecurity due to low income and low educational status generally (Lino 1996). In a study among low income community in Sabak Bernam, percentage of households experiencing food insecurity is above 50% (Shariff & Khor 2008). The percentage of low income households in the city that have food insecurity was higher (66.6%) compared with those in rural areas of 58% (Sharif & Ang 2001). A study in an oil palm plantation by Mohamadpour et al. (2012) stated that food insecurity is indirectly related to nutritional status and poor health. Prevalence of food insecurity among elderly individuals in Turkey was 21.7%, of which malnutrition and malnutrition risk was 2.7% and 28.0% respectively (Simsek et al. 2013) . However, little is known about food insecurity among Malaysian elderly.

Frail is described as a state of the elderly aged over 60 years old who are unable to perform physical activity, has limited mobility with disabilities and other characteristics that maybe due to its biological and clinical syndromes (Fried et al. 2001). It was reported that 5.7% of Malaysian elderly were classified as frail and 67.7% were pre-frail (Sathasizam et al. 2015). Malnutrition among frail elderly further weakens the status of individual functions (Chevalier et al. 2008). Decline in functional status of the body can increase vulnerability and affect food intake (Schroll 2003). Nutritional deficiencies, frequently observed among the frail elderly, have been associated with increased morbidity and dependency. The coexistence of aging and poverty might lead to an increase in nutritional deficiencies and health-related problems among the elderly (Sandhi et al. 2003). However, the association between nutritional status with food insecurity and frailty among elderly individuals, especially those with low income was not clear. Therefore, a cross-sectional study was conducted to investigate the association between nutritional status with food insecurity and frailty among the elderly in low income residences of Klang Valley, i.e. Kampung Medan, Petaling Jaya.

MATERIALS AND METHODS

STUDY DESIGN AND SAMPLING

A total of 72 elderly individuals (47 Malays and 25 Indians; 40 men and 32 women), with mean age 66 ± 6 years participated in this cross-sectional study through convenient sampling. The convenient sampling method was used because there were not enough subjects who are willing to participate in the area. The sample size was calculated as follows;

$$n = \frac{(z_{a/2})^2 p(1-p)}{\Delta^2}, \qquad (1)$$

In which $z_{a/2}$ = 1.96, p = 0.449 (prevalence of frailty in Taiwan (Chen et al. 2010), Δ = 0.1. Eqn. (1) gives n = 95. For this study with 10% dropout is 106 (Cochran 1977).

However, as mentioned earlier, only 72 subjects participated in this interview due to low participation. The study was conducted at community centres of an urban poor residential area in Klang Valley of Malaysia (i.e. Kampung Medan, Petaling Jaya). The inclusion criteria were aged 60 years and above, able to communicate or with carer that can communicate well and have total household income lower than or equal to RM3000 per month according to Economic Planning Unit, Prime Minister's Department. The exclusion criteria were bedridden, elderly who suffer from terminal illness, dementia and mental illness. Informed consent was obtained from all subjects. Ethics approval was obtained from the Universiti Kebangsaan Malaysia Medical Research and Ethics Committee.

DATA COLLECTION

Subjects were interviewed at respective community centres to obtain information on socio-demographic, physical activity using Physical Activity Scale for Elderly (PASE) questionnaire, cognitive status using Mini Mental State Examination (MMSE) questionnaire (Ibrahim et al. 2009), food security questionnaire by the Third Health and Nutrition Examination Survey (NHANES III 1988-1994) and Nutrition Survey of the Elderly in New York State (NSENY 1994) and dietary intake using 7 days dietary history questionnaire (DHQ) (Suzana et al. 2000). Anthropometric measurements including height, weight, waist circumference and body composition. Gait speed and hand grip strength tests were also performed.

Frailty is defined by having 3 or more symptoms based on Fried criteria (Fried et al. 2001) which are low physical activity, slowness, poor endurance and energy, shrinking and weakness. Physical activity is attained by PASE questionnaire includes self-reports of job, household and leisure activities within one week. The questionnaire is divided into 4 parts; part I is a recreational activity that includes 6 items, part II is activity at home that includes 3 items, part III is work activity that includes 6 items and

part IV is about activity of daily living (ADL) (Washburn et al. 1993). The calculation is made by multiplying the item weight of a particular activity with time period of carrying out the activity before summing up scores from each activity to get the final score. Score <91 indicated low physical activity which shows symptom of frailty.

Meanwhile, Centres for Epidemiological Scale-Depression Scale (CES-D Scale) was used to identify fatigue. Questions related to fatigue were asked to determine whether participants experienced fatigue. In the study by Fried et al. (2001), fatigue is stated to be a sign of frailty in elderly. Gait speed test was assessed by dividing the individual's normal walking time over a distance of 15 feet. Hand grip strength was measured using Hand Dynamometer (Jamar, Hydraulic Hand Dynamometer, USA) with subject's dominant hand because it has been found that dominant hands gives greater grip and pinch strength. Mean of three hand grip strength was taken as the measurement. Hand grip weakness was classified based on body mass index (BMI) of the subject. Data was further compared with the reference data (Fried et al. 2001).

MMSE questionnaire is validated for elderly population in Malaysia by Ibrahim et al. (2009) and it is a reliable instrument which was widely used in the detection of cognitive impairment in the elderly. MMSE assesses memory and cognitive level of the various domains of cognitive functions including orientation to time and place; introduction of new words; concentration; short term memory; naming common items; repeating a regular expression and the ability to read and follow written instructions, write a sentence, draw diagrams and follow a three-step oral directions. Subjects obtained score more than or equal to 21, the optimal cut-off point for M-MMSE-7 were classified as normal whereas those who score less than 21 were classified as having cognitive impairment. This cut-off point is for both men and women (Ibrahim et al. 2009).

Radimer/Cornell Hunger and Food Insecurity Instrument were used to assess hunger status and food insecurity for the whole household. However, Lee & Frongillo (2001) reported that one instrument to assess food insecurity for elderly is not enough because each elderly is influenced by physical status, socio-economic status, perception and attitude with different experience. Hence, food insecurity questionnaire for elderly which include above factors was designed with four questions related to food insecurity of Third Health and Nutrition Examination Survey (NHANES III 1988-1994) and three questions from Nutrition Survey of the Elderly in New York State (NSENY 1994) which measure the presence of food in the last six months. The subjects will be classified as "food insecure" if he/she gave a decisive answer of frequent or sometimes not enough food to eat at least to three out of seven questions.

Body weight was measured using a digital weighing scale (SECA, Seca 803, USA) to the nearest 0.1 kg. Height was measured using stadiometer (SECA, Seca 213 Portable, USA) to the nearest 0.5 cm. Body mass index (BMI) was calculated using the formula of [weight in kg/(height in m)^2] and cut-off normal BMI for elderly is 22 to 27 kg/m^2 as suggested by Nutrition Screening Initiative (NSI) (Barrocas et al. 1996). The higher BMI cut-off point for older adults were used as a number of longitudinal studies indicated that a greater BMI associated with more fat and muscle reduced will increase the risk of mortality among older adults (Comasia, 2005). Waist circumference was measured using a lufkin tape with the accuracy to ± 0.1 cm. Body composition was measured using Bioelectrical Impedance Analysis (Biospace, InBody S10 Body Composition analyser, Korea). DHQ was used to obtain information on food, beverages and other nutrients consumption that are normally taken by an individual in a period of one week by means of an interview. Portion sizes consumed by an individual were taken as an indication based on household measurement and the use of pictures from the Atlas of Food Exchanges and Portion Sizes in order to calculate the total intake (Suzana et al. 2002). In addition, the method of cooking was also taken into account in this assessment (Shahar et al. 2000).

STATISTICAL ANALYSIS

Statistical Package for Social Science (SPSS) program version 21.0 was used to analyse the data. Dietary intake was analysed using Nutritionist Pro and compared with Recommended Nutrient Intake (RNI) for Malaysian by National Coordinating Committee on Food and Nutrition (NCCFN 2005). The relation between frailty and food security among elderly with demographic, socioeconomic, health status, anthropometric parameters and dietary intake were explored using one-way Anova, Pearson Chi-square, Fisher exact test and Spearman Correlation test. Multiple linear regression was used to identify predictors of frailty and food insecurity.

RESULTS

As shown in Table 1, the mean age of the subjects is 66 ± 6 years old. Out of 72 subjects, 40 were men (55.6%) and 32 were women (44.4%). There were 47 Malays (65.3%) and 25 Indians (34.6%). More than half of the subjects were married (65.3%) and 93.1% of the subjects lived with others. Most of the women did not go to work (84.4%), whilst 55.0% of men were retirees. A total of 76.4% of the subjects went to school, especially men. With respect to health profiles, 52.8% of the subjects had hypertension and 93.0% had prescribed medicines. A total of 34.7% of the subjects had cognitive impairment. A total of 75.0% of the subjects had a larger waist and hip circumference. Figure 1 shows that nearly half of the subjects were overweight (41.7%) and other half were normal (43.8%).

TABLE 1. Demographic characteristics and health profiles (presented as *n* (%))

| Characteristics	Men (*n* = 40)		Women (*n* = 32)		Total (*n* = 72)	
Age (years)						
60-74	37	92.5	29	90.6	66	91.7
≥ 75	3	7.5	3	9.4	6	8.3
Ethnicity						
Malay	33	82.5	14	43.8	47	65.3
Indian	7	17.5	18	56.3	25	34.7
Marital Status						
Unmarried	2	5.0	23	71.9	25	34.7
Married	38	95.0	9	28.1	47	65.3
Education Level						
No schooling	1	97.5	16	50.0	17	23.6
Schooling	39	2.5	16	50.0	55	76.4
Living with						
Alone	1	2.5	4	12.5	5	6.9
With others	39	97.5	28	87.5	67	93.1
Occupational Status						
Not working/housewife	5	12.5	27	84.4	32	44.4
Retirees	22	55.0	2	6.3	24	33.3
Retirees but still working	6	15.0	0	0.0	6	8.3
Health Profiles						
Hypertension						
Yes	23	57.5	15	46.9	38	52.8
No	17	42.5	17	53.1	34	47.2
Diabetes						
Yes	10	25.0	14	43.8	24	33.3
No	30	75.0	18	56.2	48	66.7
Medication						
Herbal Medicines						
Yes	6	15.0	8	25.0	14	19.4
No	34	85.0	24	75.0	58	80.6
Prescribed Medicines						
Yes	40	100	27	84.4	67	93.0
No	0	0	5	15.6	5	7.0
Hospital admission						
Yes	7	17.5	7	17.1	14	19.4
No	33	82.5	34	82.9	58	80.6
Cognitive status						
Normal (Score ≥ 21)	36	90.0	11	34.4	47	65.3
Cognitive impairment (Score < 21)	4	10.0	21	65.6	25	34.7
Waist hip ratio (cm)						
<90 (men), <80 (women)	16	40.0	2	6.2	18	25.0
>90 (men), >80 (women)	24	60.0	30	93.8	54	75.0
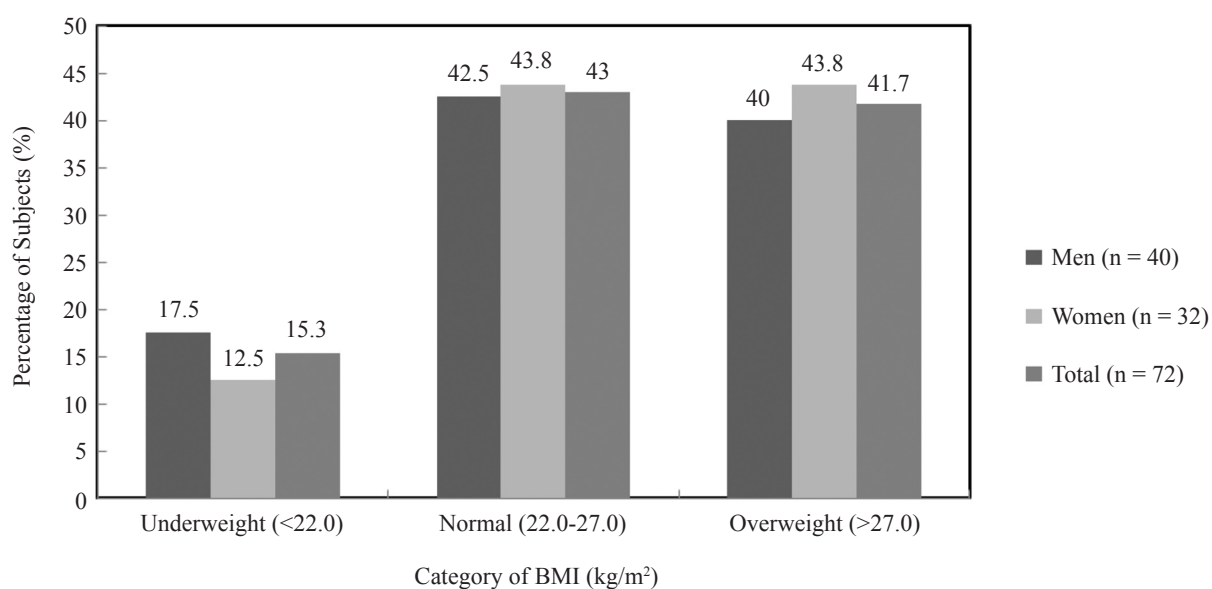
FIGURE 1. Percentage of subjects according to BMI categories

With respect to food insecurity, most of the subjects were having enough food (93.1%) (refer Table 2). However, Table 3 shows that there were significant correlation ($p < 0.05$) between food insecurity with height ($r = -0.263$, $p = 0.026$) and fat intake ($r = -0.280$, $p = 0.017$) of the subjects.

Analysis of the multiple linear regression indicated that fat intake was associated with food insecurity by 4.8%. However, the association diminished when controlled for age and gender.

TABLE 2. Household food insecurity

Household Food Insecurity	Men ($n = 40$)		Women ($n = 32$)		Total ($n = 72$)	
	N	%	n	%	n	%
Enough Food	39	97.5	28	87.5	67	93.1
Sometimes Not Enough Food	1	2.5	4	12.5	5	6.9

TABLE 3. Correlation between anthropometry, dietary intake and food insecurity ($n = 72$)

	Food Insecurity	
	Coefficient value (r)	p value
Anthropometry		
Weight	-0.158	0.186
Height	-0.263	0.026*
Body Mass Index (BMI)	-0.045	0.709
Waist Hip Ratio (WHR)	-0.086	0.484
Muscle Mass Percentage	-0.160	0.183
Body Fat Percentage	0.147	0.217
Dietary Intake		
Energy	-0.220	0.064
Carbohydrate	-0.075	0.532
Protein	-0.230	0.052
Fat	-0.280	0.017*
Cholesterol	0.099	0.410
Sodium	-0.220	0.064

* Significant correlation ($p < 0.05$) by using Spearman correlation

Meanwhile for frailty status, most of the subjects fell into the category of pre-frail (58.3%), followed by frail (27.8%) and women were more likely to be frail (46.9%) compared to men (12.5%) as shown in Figure 2. Based on Fried criteria, handgrip strength gave the highest score for frailty as compared to others as shown in Table 4. There were no significant differences between frailty and nutrient intake, as shown in Table 5 ($p > 0.05$ for all parameters). As shown in Table 6, calcium intake was found to be associated negatively with frailty score, with a variability of 22.6% ($p < 0.05$).
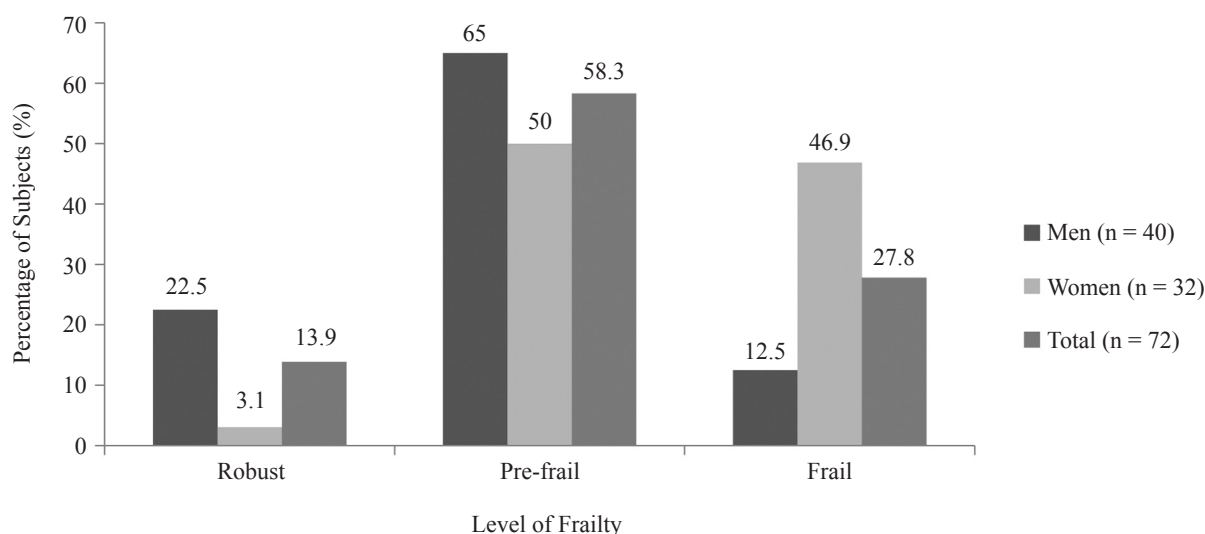

FIGURE 2. Percentage of subjects according to level of frailty

TABLE 4. Comparison of frailty score based on criteria

	Men ($n = 40$)		Women ($n = 32$)		Total ($n = 72$)	
	n	%	n	%	n	%
Physical Activity (PASE)						
Low PA	6	15.0	9	28.1	15	20.8
Normal	34	85.0	23	71.9	57	79.2
Weakness						
Weak	6	15.0	23	71.9	15	20.8
Normal	34	85.0	9	28.1	57	79.2
Body Shrinking						
Weight loss	5	12.5	7	21.9	12	16.7
Normal	35	87.5	25	78.1	60	83.3
Slowness						
Slow	12	30.0	24	75.0	36	50
Normal	28	70.0	8	25.0	36	50
Handgrip Strength						
Poor Endurance	5	12.5	7	21.9	12	16.7
Normal	34	87.5	25	78.1	59	81.9

TABLE 5. Comparison of mean energy and nutrients intake for non-frail, pre-frail and frail

Nutrients	Robust ($n = 10$)	Pre-frail ($n = 42$)	Frail ($n = 20$)	p Value
Energy (kcal/d)	1313.69 ± 454.29	1312.13 ± 373.94	1269.13 ± 393.34	0.314
Carbohydrate (g/d)	167.89 ± 50.20	175.19 ± 66.44	165.53 ± 67.94	0.844
Protein (g/d)	58.50 ± 34.72	55.69 ± 18.06	47.62 ± 20.09	0.301
Fat (g/d)	45.68 ± 20.07	43.37 ± 16.06	33.41 ± 15.62	0.058
Calcium (mg/d)	395.18 ± 252.96	382.79 ± 194.74	292.23 ±168.84	0.232

TABLE 6. Multiple linear regression for factors associated with frailty score

Variables	R	R^2	Adjusted R^2	p-value
Body Mass Index				0.73
Waist Hip Ratio				0.22
Calorie Intake	0.553	0.306	0.226	0.81
Protein Intake				0.31
Calcium Intake*				0.11*

*$p < 0.05$; Dependent Variable- Frailty Score; adjusted for age & gender

DISCUSSION

This study found that food insecurity was not a problem among sample group of elderly individuals from low income household in Petaling Jaya, Selangor. On the other hand, most of them had abdominal obesity (75.0%) and were overweight (41.7%). The prevalence of abdominal obesity among Malaysia elderly in this study was similar to those reported by Suzana et al. (2013). Aging will increase adiposity, especially the intra-abdominal fat and the loss of fat-free mass. However there were studies in India reported that respondents from underprivileged community were underweight (Bigitendriya 2013; Maiti et al. 2013). In this study, it was found that fat intake was correlated to food insecurity that can lead to fat-frail. The resulting difference might be due to the respondents in this study were mostly have food security with consumption of poor quality diet, i.e. high in fat.

Despite of the obesity problems, most of them were pre-frail (58.3%) compared to frail (27.8%) and robust (13.9%). Curcio et al. (2014) suggested multiple factors identified to be associated with frailty, including increasing in age, lower education, presence of chronic diseases, poor self-reported health status, low dependence in basic and instrumental activities of daily living, depression and cognitive impairment. Further, a study done in Canada comparing the prevalence of frailty in urban and rural areas reported differences, with the rural had a higher prevalence than urban area (Song et al. 2007). It seems that this sample from sub-urban of Malaysian was more likely to be pre-frail probably due to diseases and unhealthy lifestyle.

It was found that there were 48.6% of total subjects being identified as under-reporters, especially those who overweight (63.3%). Underreporting was determined by computing ratio of energy intake (EI) to basal metabolic rate (BMR) (Briefel et al. 1997). Underreporting of total calorie intake by self-reported dietary assessment was a very common problem (Rennie et al. 2007), especially among obese and the low income. Overweight and obese subjects tended to underreport their total energy intake (Johnson et al. 2005). In order to obtain accurate diet record, biomarkers or underwater weighing should be used (Bingham 2003; Trabulsi & Schoeller 2001).

It was found that there was weak association ($r = -0.280$, $p = 0.017$) between height and food insecurity. Reducing in height is an important marker for chronic malnutrition. The height of the elderly might also reduced due to spinal shortening as consequence of degenerative bone disease (Han et al. 2011). Gulliford et al. (2003) found that subjects with food insecurity were shorter in height. Occasionally, food inadequacy in the elderly would lower nutrient intake that will impact the nutritional status (Lee & Frongillo 2001).

Most of the food insecure subjects in the study (6.9%) were women. This may due to their responsibilities of buying, preparing and serving food for the household. Thus, women would be more likely to feel food insecurity compare to men (Norhasmah et al. 2011). Subjects who were facing food insecurity were more likely to consume less food and change their ways in food preparation (Cohen & Garret 2010). Hence, fat intake might be reduced together with other nutrients.

Most of the subjects in the study were fat frail probably due to poor physical function and endurance as handgrip strength shows the highest number of score for frailty. Jeoung & Lee (2015) also reported that handgrip strength has the highest correlation with frailty compared to other variables such as gait speed test, chair stand test and BMI. A systemic review concluded that dietary calcium intake was not associated with risk of fracture and there was no clinical trial evidence that prove increasing calcium intake from dietary sources prevents fractures (Bolland et al. 2015). However in this study, low calcium intake was found to be predictors to increase risk of frailty. Thus, there is a need to investigate this matter further, as inadequate calcium intake associated with osteoporosis; and women with frailty have a higher risk of osteoporosis (Liu et al. 2015).

As a whole, this study found no association between frailty, food insecurity and nutritional status. This might due to fewer subjects had food insecurity. Besides that, higher number of underreporters for the dietary assessment making it unable to assess dietary intake accurately. It is acknowledged that those with low income tend to underreport, thus, future studies should consider objective markers of nutrients (Johnson et al. 1998).

CONCLUSION

Three out of four subjects in this study had an abdominal obesity and half of the subjects were overweight. Half of the subjects were pre-frail in both men and women, with

low calcium intake was associated with frailty. There is a need on intervention programme to overcome fat frail in low income community.

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