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# Nutritional Status in Relation to Depressive Symptoms among Chinese Elderly in Malaysia

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## ABSTRACT

**Introduction:** The objective of the study was to determine the factors associated with depressive symptoms (DS) among Malaysian Chinese elderly. **Methods:** This was a cross-sectional study using interviewer-administered questionnaire conducted in a peri-urban area in Kajang, Selangor, Malaysia among 112 free-living residents aged 60 years and above, mean age 71.4±7.01 (60 to 89) years. Dietary food intakes and DS were assessed by 24-hour dietary recall and 15-items Chinese Geriatric Depression Scale (C-GDS-15), respectively. Anthropometric parameters were obtained using standard procedures. **Results:** The prevalence of DS among the respondents was 36.6%. Most respondents reported physically inactive (96.5%), abdominal obesity (61.6%) and on average high selenium (81.9 ± 54.44) and low calcium intake (309 ± 173.36). According to MLR model, folate (β=-0.206, p=0.007), magnesium (β=-0.209, p=0.007) and iron (β=-0.202, p=0.009) intake were significant predictors of GDS score only if they were analyzed separately in the MLR model. However, after adjustment for gender, and other dietary nutrient intake, there were only good money satisfaction (OR=2.48, p=0.001) and dietary intake of iron (OR=1.385, p=0.050) showed significant associations with lower risk reporting DS. **Conclusions:** Prevalence of DS could be restricted by achieving a good economic satisfaction for the living and adequate intake of dietary iron, which with good overall nutrient will reflect a good nutritional status and health being.

**Keywords:** Depressive symptoms, Elderly, Dietary intake, Nutritional status, Depression

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## INTRODUCTION

Depression is a highly prevalent mental disorder and serves as a major public health concern; known as one of the leading contributors to the global burden of disease. The database from National Health and Morbidity Survey (2015) estimated that over 29% of the adult population of Malaysia suffers from mental distress, with a nearly 3-fold increase from the 10.7% estimated by the NHMS in 1996 posing to the beginnings of a public health issue. Depression is highlighted as the major cause of disability among people, declined individual's ability to function well in daily psychosocial and cognitive functioning tasks (1). The severity implications of late-life depression increases with age by decreasing illness remission, whereas increasing disease relapse risk and mortality risk.

The etiology of depression is yet to be completely established. Aside from psychosocial factors, different biological and environmental factors are deemed to play a potential role in its pathophysiology. Poor dietary habits as well as low nutritional status may also position older adults at greater vulnerability for developing depressive symptoms. The geriatric depression may negatively impact nutritional status amongst aging population; with strong evident as a leading cause of loss of appetite, refusal to eat, and weight loss.

Dietary intake is known to be partake in biological processes associated with vascular and Alzheimer's pathology and should be called for further attention. Wide variations exist in the prevalence of depression across countries, suggesting that disparities in the distribution of several risk factors may determine this heterogeneity which differences of food habit could account for. Older adults with inadequate intake for ≥4 nutrients showed a significantly higher risk of developing depression (2). Micronutrients such as folate and omega-3 fatty acids in relation to depression are the major interests of most researchers. Increasingly, vitamin D has been suggested as a contributor to depression. Besides, calcium, iron, magnesium, zinc, selenium, fibre, vitamin B1, B6, B12, D and E have been linked to mood disorders, including depression, but were less studied (7). These nutrients were shown to have beneficial effect against depression; however, the evidences were inconsistent and remain inconclusive across many studies.

With evident from a local study, ethnic Chinese Malaysians were reported to experienced less depressive symptoms (5), and the relation between nutritional status with depressive symptom was relatively inadequate to address the issue particularly among Chinese elderly. Till date, number of local studies on the dietary factors associated with DS is still limited. Therefore, it is questionable whether the relationships between nutritional status with DS remain consistent among Chinese. Ultimately, this study aims to determine the associations between factors with DS, particularly dietary intakes, in Chinese elderly after adjustments of potential confounding factors, in particular, dietary variable.

## MATERIALS AND METHODS

### Designs and settings

This cross-sectional study was conducted in Kampung Baru Sungai Chua, a low-density peri-urban residential community area. It is the largest Chinese peri-urban community area in the Hulu Langat district, Selangor. According to District Office of Hulu Langat, 659 households were established in the area since 2012. Households were selected using a random sampling method based on household map of the study location. Individuals living in the selected households were enrolled based on inclusion and exclusion criteria. Chinese individuals, who were Malaysian, aged 60 years and above, freely living in the area for at least one year, and had no cognitive impairment, were included in the survey. If there were more than one eligible resident in a household, they were invited to take part in the survey. The response rate was 89.8%.

Approval and permission to conduct this study were granted by Medical Research Ethics Committee, UPM and village chief of the study location. Prior to data collection by structured face-to-face interview, briefing was given to participants based on the information sheet about this study before consent to participate. Once informed consent was obtained, each participant was screened for cognitive impairment using Elderly Cognitive Assessment Questionnaire (ECAQ) and will be excluded from this study if scoring less than five. The questionnaire was forward and backward translated between English and Chinese, and was assessed for language equivalence by a bilingual language expert. To ensure interview consistency and respondent anonymity, each questionnaire was assigned an identifying code and administered by the researcher. The questionnaire was pretested by the researcher. The questionnaire consisted of sections on demographics, lifestyles, medical history and other health status.

### Anthropometry assessment

Circumference at mid-arm (MUAC), waist (WC), and calf (CC) and arm span were measured using non-stretchable circumference measuring tape (SECA, Germany) with standard procedure (16). Body weight was measured using calibrated digital beam scale (TANITA, Japan) while body height was estimated using a predictive equation which was used among Malaysian elderly (6).

### Dietary assessment

24-hour dietary recall was used to estimate average dietary food and nutrient intakes in the sample population. The validity and reliability of 24-hour dietary recall among elderly has been established and produced an adequate test-retest reliability. It is widely used for collecting data on eating behaviours and measuring energy intake, including in homebound older adults (7). Since responses are recorded by interviewer, high levels of physical functioning and literacy of participants are not required and reduces the potential for both non-response bias and respondent burden. Besides, since the recall period is immediate, participants are able to recall most of the foods and beverages consumed during the preceding day. Every respondent was asked to describe all information about what they ate in the past 24-hour as detail as possible. Cooking methods were recorded for every food if applicable. Cross-checking technique was used to reduce respondent's misreporting. When necessary, the eaten separable edible ingredients of each complex food were recorded. A recipe of a customizable food was obtained from respondents who prepared it. However, standard recipes were used if respondents failed to describe the ingredients of the served foods. Dietary data were analysed using Nutritionist Pro food database software (version 2.2, 2005, Axxya Systems-Nutritionist Pro, Stafford, TX). The Nutritionist Pro database was expanded by manually adding analyses of local food which were not available in the database.

After a quick food list was obtained, each person was then asked to provide the food intake amount. The food intake amounts were estimated based on serving size and using U.K. metric standard household measurement tools and Atlas of Food Exchanges and Portion Sizes (25). If the respondent failed to estimate the amount eaten, however, the intake amount was estimated based on the standard recipe. The U.K. household measurement units were converted to U.S. units. Based on specific conversion factors, weight of edible food portion was determined using software called U.S. Department of Agriculture (USDA) National Nutrient Database for Standard Reference, Release and Nutrient Composition of Malaysian Foods, Fourth Edition. Subsequently, using the software, the nutrient composition was calculated for each food and ingredient consumed by the subject. Microsoft Office Excel software was used to calculate the total intake of every nutrient for 1-day diet among respondents.

### Depressive symptoms assessment

The Mandarin version 15-item GDS (GDS-15) developed by Lee et al. (8) was used to evaluate depressive symptoms in this study. Each respondent was asked to respond yes or no for each question regarding how they have felt over the past week. According to Sheikh and Yesavage (28), scoring more than 5 indicates "probable" depression and further assessment is recommended, whereas scoring more than 10 indicates almost always depression. In addition, higher GDS score indicates more symptoms and higher severity. Almeida and Almeida (29) showed that GDS-15 is a reliable screening instrument for major depression according to DSM-IV criteria. On the other hand, GDS score in between 6 to 8 was categorised as mild depressive symptoms, 9 to 12 as moderate, and 13 to 15 as severe while less than 6 as normal in this study. Lee et al. (8) demonstrated that the GDS-15 had high sensitivity (96.3%) and specificity (87.5%) at cut-off point of 8, and was a highly reliable and valid tool among Chinese elderly in Hong Kong.

### Statistical analysis

Collected data were analysed using Statistical Package for Social Sciences (SPSS) Statistics 20. Exploratory data analysis (EDA) was used to check the data normality for all variables. Logarithm transformation was made for variables in attempt to achieve normal distribution. Log transformation was performed to transform skewed data to approximately normal data to augment the reliability of the related statistical analysis. In descriptive analysis, continuous variables were expressed in mean, standard deviation (SD) and median while categorical variables were expressed as frequency (n) and percentage (%) in cross tabulation. Subsequently, independent samples T-test was used to compare the difference in GDS score between 2 subgroups of a categorical variable. Chi-square ($\chi^2$) test for goodness of fit was used to compare frequency differences between categories of an observed variable. Mann-Whitney U test was used to compare median of a continuous variable between the subgroup of a categorical variable. Simple linear regression (SLR) was used to provide adjusted $R^2$ as additional information to Pearson correlation's results. Multiple regression analysis was used to determine whether the association between the dependent and independent variables of interest remained significant after adjusting for other potentially confounding independent variables. For this analysis, the dependent variables were natural log ($\log_e$) transformed if they were not normally distributed to satisfy the necessary statistical assumptions of linear regression. Stepwise model building was used to estimate the relative contribution of the independent variables and the variability of the dependent variable. Assumption tests have been done to ensure all the results from every statistical analysis test were valid. Non parametric tests were used if any of the assumption was not met. Data with a p value less than or equal to 0.05 were considered statistically significant.

## RESULTS

### Characteristics of the subjects

A total of 112 subjects with mean age 71.4±7.01, range from 60 to 89 year-old were recruited in this study (Table I). Majority of the subjects in the sample population were married (56.3%), attended primary school (58.0%), retired (65.2), living with their children (75.0%), receiving monetary allowance from children (75.0%) and satisfied with their income (71.4%). Significant association were found between educational level ($p<0.001$), living arrangement (living with spouses) ($p<0.05$) with gender. No significant associations were found between marital status, working status and money satisfaction with age groups and genders.

Almost half of the subjects were reported to have normal BMI (41.5%) with mean of 24.73 ± 4.44 kg/m$^2$. Abdominal obesity among females was more prevalent compared to male subjects ($\chi^2$ =5.23; $p<0.05$), corroborated with prior national data which documented that the prevalence of obesity was almost twice higher in women than men (9). The mean WC, CC and MUAC of subjects were reported to be 88.75 ± 11.84 cm, 32.97 ± 3.69 cm and 26.82 ± 3.48 cm, respectively. When CC and WC cut off point were implied, there were significant associations between risk of malnutrition ($\chi^2$=5.22; $p<0.05$) and abdominal obesity ($\chi^2$ =13.63; $p<0.05$) with gender. However, the association between gender was no longer significant when MUAC cut-off points was used. Primarily, 12.5% and 9.8% of subjects were at risk of malnutrition based on CC and MUAC cut-off parameters. Further investigation on CC cut off point demonstrated that the risk of malnutrition was more prevalent among male compared to female subjects ($\chi^2$ =4.57; $p<0.05$).

The mean calories intakes of male and female subjects met were 1386$\pm$433 kcal and 1025$\pm$498 kcal respectively. In accordance to RNI for Malaysia, subjects fulfil the protein requirement intake with mean consumption of 51.06$\pm$29.18 g. Shown in Table II, majority of nutrient intake by female subjects were significantly lower compared to male subjects. On average, 63.01% of total mean calories among subjects were derived from carbohydrate while 16.95% and 19.02% of total mean calories from protein and fats, respectively. Inadequacy intake of iron, calcium and folate which unmet the RNI recommendation; subsequently imposed them to disease-related deficiency. Despite of such inadequacy, subjects exceeded recommended selenium intake with 330.45% and 295.57% of RNI, respectively indicating risk of selenium toxicity. Overall, the female subjects on average significantly consumed less calories, vitamins and minerals ($p<0.05$) compared to males in reference of RNI.

The total mean score of GDS was 4.88 ± 2.90, 5.18 ±

**Table I:** Characteristics of subjects by gender (n=112)

| Characteristics | n (%) | | |
|---|---|---|---|
| | Men (n=56) | Women (n=56) | Total (n=112) |
| **Depressive Symptom** | | | |
| Normal | 39(69.6) | 32(57.1) | 71(63.4) |
| Mild | 7(12.5) | 17(30.4) | 24(21.4) |
| Moderate | 4(7.1) | 4(7.1) | 8(7.2) |
| Severe | 6(10.7) | 3(5.4) | 9(8.0) |
| **Marital status** | | | |
| Married | 39(69.6) | 24(42.9) | 63(56.3) |
| Widowed / Divorce | 9(16.1) | **31(55.4)**** | 40(35.7) |
| Single | 8(14.3) | 1(1.8) | 9(8.0) |
| **Education level** | | | |
| Never been school | 3(5.4) | **29(51.8)**** | 32(28.6) |
| Primary school | 42(75.0) | **23(41.1)*** | 65(58.0) |
| Secondary school | 11(19.6) | 4(7.1) | 15(13.4) |
| **Living arrangement** | | | |
| Children | 38(67.9) | 46(82.1) | 84(75.0) |
| Spouse | 36(64.3) | **23(41.1)*** | 59(52.7) |
| Alone | 4(7.1) | 2(3.6) | 6(5.4) |
| **Money satisfaction level** | | | |
| Satisfied | 38(67.9) | 42(75.0) | 80(71.4) |
| Not satisfied | 18(32.1) | 14(25.0) | 32(28.6) |
| **BMI** | | | |
| Underweight | 5(8.9) | 5(8.9) | 10(8.9) |
| Normal | 30(53.6) | 21(37.5) | 51(45.5) |
| Overweight | 18(32.1) | 21(37.5) | 39(34.8) |
| Obese | 3(5.4) | 9(16.1) | **12(10.8)*** |
| **Malnutrition/at risk** | | | |
| CC ≤30 (men); <27.3 (women) | 11(19.6) | **3(5.4)*** | 14(12.5) |
| **Abdominal obesity** | | | |
| WC >90 (men); >80 (women) | 25(44.6) | **44(78.6)*** | 69(61.6) |
| | | Mean + SD | |
| **GDS Score** | 4.88 + 2.90 | 5.18 +2.45 | 5.03 _ 2.68 |
| **Dietary Intake** | | | |
| Calories | 1386 + 433.00 | **1025 + 498***** | 1205 + 499 |
| Carbohydrate | 215.96 + 188.44 | **163.65 + 119.48**** | 189.81 + 70.35 |
| Protein | 60.06 + 30.67 | **42.05 + 24.74**** | 51.06 + 29.18 |
| Fat | 29.41 + 16.44 | **21.52 + 19.92**** | 25.46 + 18.61 |
| Calcium | 382.07 +188.44 | **235.93 + 119.48**** | 309 + 173.36 |
| Iron | 7.56 + 3.34 | **5.86 + 3.69*** | 6.71 + 3.61 |
| Zinc | 6.11+ 2.22 | **5.08 + 3.44**** | 5.6 + 2.93 |
| Selenium | 95.83 + 8.38 | **67.98 + 46.67*** | 81.9 + 54.44 |
| Vitamin B6 | 0.95 + 0.41 | **0.75 + 0.41*** | 0.85 + 0.42 |
| Thiamine | 0.88 + 0.39 | **0.7 + 0.46*** | 0.79 + 0.43 |
| Folate | 169.13 + 96.18 | **118/52 + 97.24*** | 143.82 + 99.57 |
| Vitamin E | 2.1 + 1.3 | **2.05 + 2.4*** | 2.22 + 1.93 |
| Vitamin D | 2.39 + 3.2 | **1.46 + 2.17*** | 1.93 + 2.76 |
| MUFA | 10.9 + 6.74 | **8.09 + 8.53**** | 9.5 + 7.78 |
| PUFA | 6.08 + 3.42 | **4.48 + 5.22**** | 5.28 + 4.47 |

† Chi-square test for goodness of fit was used to compare frequency between genders of an observed variable
Frequency values were significantly different between genders:
*Significant at level 0.05; ** Significant at level 0.01 for Pearson Chi-Square

**Table II: Nutritional status with GDS status**

| Characteristic | $r/r_s$ | | | Adjusted $R^2$ (%) |
|---|---|---|---|---|
| | Male (n=56) | Female (n=56) | Total (n=112) | |
| **Anthropometric** | | | | |
| BMI (kg/m$^2$) | 0.058 | -0.096 | -0.003 | -0.9 |
| WC (cm) | 0.023 | -0.060 | -0.014 | -0.9 |
| CC (cm) | 0.029 | **-0.280*** | -0.112 | 0.4 |
| MUAC (cm) | -0.055 | -0.090 | -0.072 | -0.4 |
| **Dietary Intake** | | | | |
| Calories (Kcal) | **-0.294*** | -0.016 | -0.165 | 1.8 |
| Carbohydrate (g) | -0.222 | -0.002 | -0.128 | 0.7 |
| Protein (g) | **-0.292*** | -0.246 | **-0.277*** | - |
| Fats (g) | -0.196 | -0.043 | -0.154 | - |
| Fiber (g) | **-0.327*** | -0.078 | **-0.212*** | 3.6 |
| Calcium (mg) | **-0.263*** | -0.108 | **-0.212*** | 3.6 |
| Selenium (g) | **-0.290*** | -0.004 | -0.183 | 2.5 |
| Magnesium (mg) | **-0.391*** | -0.050 | **-0.214*** | 3.7 |
| Iron (mg) | **-0.373*** | -0.092 | **-0.242*** | 5.0 |
| Zinc (mg) | **-0.282*** | -0.197 | **-0.252*** | - |
| Thiamine (mg) | **-0.266*** | -0.106 | **-0.192*** | 2.8 |
| Vitamin B6 (mg) | **-0.324*** | -0.017 | **-0.191*** | 2.8 |
| Folate (mcg) | **-0.413*** | -0.073 | **-0.261*** | 5.9 |
| Vitamin B12 (mcg) | -0.176 | -0.082 | -0.144 | - |
| Vitamin D (mcg) | -0.101 | -0.003 | -0.048 | - |
| Vitamin E (mg) | -0.227 | -0.194 | **-0.264*** | - |
| MUFA (g) | -0.184 | -0.053 | -0.143 | - |
| PUFA (g) | **-0.292*** | 0.008 | **-0.196*** | - |
| EPA (g) | -0.214 | -0.067 | -0.176 | - |
| DHA (g) | **-0.287*** | -0.122 | **-0.245*** | - |

† Pearson correlation, as r, was used to determine relationships between calories, carbohydrate, fiber, calcium, magnesium, iron, selenium, vitamin B1 and B6, and folate with GDS score. Spearman correlation, as $r_s$ was used to determine relationships between protein, fats, zinc, vitamin B12, D and E, MUFA, PUFA, EPA and DHA with GDS score. Correlations were significant between genders: *P<0·05, **P<0·001 (2-tailed)

2.45 among males and females subjects, respectively. The prevalence of DS among the subjects was 36.6%. Among subjects reporting DS, 21.4% of subjects had mild symptoms and only 7.2% and 8.0%, respectively had moderate and severe symptoms. Among subjects reporting DS, 42.9% of them were female and 30.4% were male. Mild DS were more prevalent ($\chi^2$ =4.17; p<0.05) among females (35.7%) compared to male subjects (16.1%). Furthermore, mild depressive symptoms were prevalent ($\chi^2$ =4.17; p<0.05) among women (35.7%) if compared to males (16.1%). Although not significant, severe DS appeared to be more prevalent among male compared to female.

### Factors associated with GDS score and the risk reporting DS

Among all the background factors, good money satisfaction was significantly associated with low risk reporting DS (OR:0.142; p<0.001). Inconsistent with most previous studies, no association were found between gender and education attainment with depressive symptom (p>0.05) except for financial satisfaction. Such association is supported by previous longitudinal study where they found that financial hardship remained independently associated with depression after controlling for demo- graphic characteristics, measures of socio-economic position, and prior depression symptoms(10).

Increased in calf circumference among women and high calories intake among male were found to be significantly correlated to lower GDS score ($p<0.05$) (Table II). Based on Pearson and Spearman correlations, overall, dietary protein, fiber, calcium, magnesium, iron, zinc, thiamine, pyridoxine, folate, vitamin E, polyunsaturated fatty acids (PUFA) and Docosahexaenoic acid (DHA) were significantly correlated to GDS score, particularly in males but not females.

Based on the linear regression, money satisfaction ($p<0.001$) was found to be associated with GDS score (Table III). Interestingly, in term of nutritional intake, dietary iron, magnesium and folate were significantly associated with GDS score ($p<0.005$). However, all the nutrient intake parameter were no longer significant when further adjustment for multiple nutrients were made in model except for iron intake ($p<0.005$). In the final model, only money satisfaction ($p<0.001$) and dietary iron intake ($p<0.005$) were significantly associated with lower GDS score, indicating less depressive symptoms, even after adjustments for other dietary intake status. Ultimately, 21.9% total variance in GDS score was accounted by the prediction model, $R^2=0.219$, adjusted $R^2=0.173$, $F(5,85) = 4.764$, $p<0.001$ containing money satisfaction, intake of calories, iron, magnesium, thiamine, vitamin B6, Folate and fibre. Overall, money satisfaction had the strongest influence on GDS score followed by dietary intake of iron whereas dietary intake of calcium, folate, magnesium, thiamine and vitamin B6 intake showed relatively small influence on GDS score.

**Table III:** Multiple Linear Regression for association between factors with depressive symptoms

| Variable | SE | OR (95% CI) |
|---|---|---|
| **Sociodemographic** | | |
| Money Satisfactory | 0.608 | **0.403 (3.688 – 1.271)*** |
| **Nutritional status** | | |
| Dietary iron intake | 0.746 | **0.223 (2.870 - 0.99)*** |
| Dietary magnesium intake | 3.804 | 0.044 (8.765 – 6.363) |
| Dietary thiamine intake | 0.865 | 0.099 (0.999 – 2.441) |
| Dietary folate intake | 2.605 | 0.033 (4.707 – 5.969) |

[a]Multiple linear regression by enter method was used to determine the association between each factor and DS risk after adjustment for confounding variables.
Every multiple linear model yielded significant F-values from ANOVA ($p<0.001$) indicating the prediction models for GDS score are significant.
Adjusted correlations were significant: *P<0·05, **P<0·001 (2-tailed)

## DISCUSSION

The present study explored the relationship between nutritional status and dietary intake with depressive symptom among Chinese elderly in Malaysia. Prior studies demonstrated negative association between Chinese ethnicity with depressive symptoms. Traditional Chinese family values such as connectedness and traditional 'filial piety' that was thought to be the reasons for such association however has weakened due to drastic economic transition (11). Although few studies reported significant negative relationship between depression and Chinese (5), it is believed that the rates of depressive symptoms among Chinese elderly are similar to the non-Chinese. Methodological such as different samples and sampling procedure and variant definition of elderly may project biased prevalence rate.

Based on the existing Chinese studies, none of the reported correlated factors (age, gender, retirement and low education level) with depression (11,12) were reported in the present study except for financial problem. Financial strain was revealed to be associated with mental health and wellbeing (13), whilst few studies found that higher risk of depression were demonstrated among people with higher financial income (14).

An insignificant relationship between gender and depressive symptoms presented in this study were also reported in previous local data (5). Association between women and depressive symptoms has been consistently documented in literature as men were thought to have better coping strategies with depression. However, such factors cannot fully explain the 10-fold variation in prevalence rates of depression across different countries, and other factors such as differences in underlying risk factors, cultural attitudes or health care delivery may also play important roles in the development of depressive symptom among general population. Apparently, starting puberty women were at risk of depression compared to men. However, as age increases particularly aged older than 65 years, both men and women show a decline in depression rates, and the prevalence becomes similar between them (15).

Ironically, Chinese elderly who are obese were found to be less likely to have depression which support the 'Jolly Fat' hypothesis. Jolly Fat hypothesis understanding was first mentioned by Palinkas et al., (1996) (16) where they outlined an inverse relationship between obesity and depression. The higher physiologic and functional reserve from greater muscle mass might explain the protective effect of high BMI against depressive symptoms (17) and even support beneficial effect in inflammatory disease. However, rising secular trends of U-shaped relationship was observed where both underweight and extreme obesity tend to increase the risk of DS (27, 28). Based on meta-analysis of longitudinal studies, bidirectional relationship between obesity and depression was confirmed in western countries (21) but unknown in eastern countries. Nonetheless, the conflicting findings from studies in western and eastern are attributable to differences in sex, age, genetic, culture and BMI categories, across the studies. For instance, stigma of obesity and societal demand of thin tend to be relatively less critical in eastern culture if compared to western society.

High rate of overweight and obesity was observed among ageing respondents in this study. As an individual aged, the basal metabolism rate detained caused by loss of muscle mass, increased carbohydrate intake, and less physical activity. Despite insignificant, our study found that overweight and underweight in respondents tends to increase the risk reporting DS, while obesity neither elevates nor reduces the risk compared to normal group. The U shape trend of depression and obesity was documented in previous study as a nature of the association which implies that both obesity and underweight are associated with an increased level of depression (22). Contradictory findings regarding the relationships between obesity and depression may be due to the different measures of obesity (BMI or abdominal fat distribution) used, the different measures of depression, potential sex differences and the u-shaped relationship between body weight and depression (34). The risk reporting DS declined across increasing BMI categories. Though insignificant, compared to respective non-abdominal-obese group, abdominal obesity was more likely to lower the risk reporting DS in female respondents, meanwhile, increase the risk among male respondents.
WHR-measured abdominal obesity independently associated with depression in both genders but not BMI-measured obesity. The abdominal fat distribution (measured by WHR) appeared to be the key mediator of the relationship between obesity and depression (24). However, association was observed between obesity (WC≥88 & BMI≥40kgm-2) and depression in females but not male (25). Ho et al. (17) found negative relationship of BMI with DS among Chinese elderly in Singapore, but no relationships found through WHR and WC measures. Clinically relevant DS at baseline was associated with significant decline in WC-measured abdominal obesity at 4-year follow up among Chinese elder women in Hong Kong (26).

Calories intake of elderly showed similar trend for both gender with previous local studies where women consistently showed lower intake compared to male (27,28). As depression attenuate one's emotional wellbeing, it often seen as one of the driving factor to emotional eating. Theoretically, emotional eaters have a tendency to consume excessive energy-dense food in response to negative emotions and emotional eaters as stated in several experimental studies (29). In spite of that, only a few studies reported such association (40, 41) and more evidences suggest that emotional eating was unrelated to total energy and macronutrient intake (32,33).
In this study, higher dietary folate, magnesium and iron intake were associated with reporting lower DS severity, but not associated with risk reporting DS. These associations vanished when controlling for another nutrient. Results suggest that all the 3 nutrients might be involved in the mechanisms of DS development. This finding supports previous study where they found that depression was negatively associated with dietary magnesium intake among adults and women (34). Magnesium intake was suggested as a protective factor of a newly diagnosed depression and has been proven in intervention studies (35) as it has an effect on biological and transduction pathways implicated in the pathophysiology of depression. Magnesium might play roles in development of DS involving cell signalling, ATP production, and synthesis of DS-related nucleic acids and proteins.
The relationship between folate deficiency and depression as gained much attention in recent years (36) and has been suggested as one of possible treatment for depression since then. Number of authors have posited that lower folate levels are associated with decreased efficacy of antidepressant medication (45). Present study showed parallel finding with Tiemeier et al. where no significant relationship was found between folate deficiency and DS among elderly (55). However, Murakami et al. (41) found that higher folate intake was associated with lower risk of getting DS among Japanese men adults. Furthermore, based on a meta-analysis data, a study (42) supported the hypothesis that low folate status is associated with depression. In contrast, the evidences for the association between folate status and late-life depression remain contradictory (43). Nonetheless, our finding suggests that folate might plays significant but small and limited roles in the development of DS, particularly in men. It was hypothesized that folate is a factor of DS mainly because folate is required for the synthesis and release of serotonin which is a neurotransmitter involved in the regulation of mood.

PUFA and MUFA have been considered as healthy lipids and cardio-protective nutrients as they reduce the incidence of cardiovascular disease. There is a plausible explanation of the relation between dietary fat intake and depression as it is to expect that both CVD and depression might share common determinants. Few cohort studies have demonstrated reported inverse associations between oleic acid (MUFA) intake and depressive symptoms or depression risk (44,45) whereas PUFA yields inconsistence result. Oleic acid contains some bioactive polyphenols with important anti-inflammatory properties and tyrosol that are capable to restore the intracellular antioxidant defences decreased among depressive patients

Previous understanding on the association between iron and DS were less studied and inconsistent. Present study explored the importance of dietary intake of iron contributed to the development of depressive symptom. Maes et al. (46) showed that serum iron transferrin levels were significantly lower in subjects with major depression compared to normal controls. In contrast, Woo et al. (47) found no relationship between iron intake and prevalence of DS among elderly Chinese. Nevertheless, this study suggests that iron might play minor roles in the development of DS in respect to psychological factors.
In general, it is still debatable whether the associations between nutritional status with DS remain unchanged across different subject population group (e.g. smokers

and drinkers), age group, demographic background (e.g. rural and urban), countries, and ethnicity, study designs and assessment tools for DS. Present study applied the observational study which addressing causes and effect are restricted. Although the validity and reliability of 24-hour dietary has been proven to be adequate among home-bound elderly, 1-day dietary recall may not be sufficient to address the usual dietary intake for each individual in respect to multiple-day dietary recall. A larger scale cross-sectional study and clinical intervention study are required to support and confirm present findings.

## CONCLUSION

To the best knowledge, this is the first local study that addresses nutritional issue with depressive among Chinese elderly. Present study found that higher money satisfaction, increased dietary intake of iron, magnesium and folate were significantly associated with low risk of reporting DS among the subjects. However, magnesium and folate intakes were no longer significantly associated with risk of DS after controlling for gender and other nutrients intake. Effective coping strategies should be taught to cope with the enervating symptomatic depression. Drawing on to the present study among Chinese Malaysian, two main vulnerability factors were identified; reduced financial strain and improved overall nutrient intake particularly iron for depression among elderly.


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