Anaemia and Cognitive Function among Chinese Elderly in Old Folks Homes

SUZANA SHAHAR, LEE, X.K., SITI BALKIS BUDIN, MOKHTAR ABU BAKAR, NOR AINI UMAR & JUNARA MOHD HALIM

ABSTRAK

Hubungan di antara anemia dan fungsi kognitif telah dinilai di kalangan 35 warga tua Cina (24 lelaki dan 11 perempuan) yang berumur antara 60 hingga 85 tahun (min umur 70.1 ± 6.7 tahun) dari lima buah rumah orang tua di sekitar Lembah Klang. Mereka ditemubual untuk memperolehi maklumat status sosial dan kesihatan, pengambilan diet habitual dan fungsi kognitif. Hodkinson Abbreviated Mental Test digunakan untuk ujian fungsi kognitif. Indeks hematologi termasuklah Full Blood Count (FBC), serum ferum, serum feritin, Total Iron Binding Capacity (TIBC), serum folat dan serum vitamin B_{12} diukur menggunakan penganalisa automasi. Pengukuran antropometri dan petunjuk klinikal anemia juga dikaji. Hasil kajian menunjukkan prevalens anemia berdasarkan petunjuk hemoglobin adalah sebanyak 22.9%, manakala anemia kekurangan ferum berdasarkan kriteria-kriteria kekurangan serum ferum, mikrositik dan hipokromi dikesan di kalangan 5.7% sampel. Kekurangan subklinikal folat dan vitamin B_{12} masing-masing didiagnos di kalangan 34.3% dan 8.6% daripada subjek. Walau bagaimanapun, tiada kejadian anemia megaloblastik di kalangan subjek. Terdapat korelasi positif di antara skor kognitif dengan ukurlilit pertengahan lengan atas (MUAC) ($r=0.547$, $p<0.01$) dan indeks jisim tubuh (IJT) ($r=0.501$, $p<0.01$). Kesemua subjek yang mempunyai paras hemoglobin dan serum ferum yang rendah dan kira-kira tiga perempat daripada subjek yang kekurangan folat dan vitamin B_{12} diklasifikasikan sebagai mengalami gangguan kognitif. Sebagai kesimpulan, malpemakanan subklinikal dan anemia memainkan peranan dalam penyusutan fungsi kognitif dalam warga tua.

Kata kunci: status pemakanan dan kesihatan warga tua Cina, anemia, fungsi kognitif, indeks hematologi

ABSTRACT

The relationship between anaemia and cognitive function was evaluated among 35 Chinese elderly (24 men and 11 women) aged 60 to 85 years (mean age 70.1 ± 6.7 years) from five old folks homes in Klang Valley. They were interviewed to obtain information on social and health status, habitual dietary intake and cognitive function. Hodkinson's Abbreviated Mental Test was used to measure the cognitive function. Haematological indices which included Full Blood Count (FBC), serum iron, serum ferritin, Total Iron Binding Capacity (TIBC), serum folate and serum cobalamine (vitamin B_{12}) were *measured using an automated analyzer. Anthropometric measurements and clinical signs of anaemia were also examined. The findings indicated that the prevalence of anaemia as assessed using haemoglobin alone was 22.9%, while iron deficiency anaemia based on low serum iron, microcytic and hypochromic criterion was detected among 5.7% of the sample. Subclinical folate and vitamin B_{12} deficiencies were diagnosed among 34.3% and 8.6% of the subjects. However, there was no occurrence of megaloblastic anaemia. There was a positive correlation between cognitive score with mid upper arm circumference (MUAC) ($r=0.547$, $p<0.01$) and body mass index (BMI) ($r=0.501$, $p < 0.01$). All subjects with low haemoglobin and serum iron and approximately three quarter of subjects with folate and vitamin B_{12} deficiencies were classified as having cognitive impairment. In conclusion, subclinical malnutrition and anaemia may play a role in the deterioration of cognitive function in the elderly.*

Key words: nutritional and health status Chinese elderly, anaemia, cognitive function, haematological indices

INTRODUCTION

In elderly individuals, maintaining good cognitive function is as important as achieving good physical health in order to ensure an optimum independency in daily living (Rosenberg & Miller 1992). However, elderly people are vulnerable to nutritional deficiency including nutrients related to nutritional anaemia such as iron, folate and vitamin B_{12} (cobalamine), that may also play a role in cognitive deficits in old age. Plasma concentration of vitamin B_{12}, B_6 (pyridoxine), folate and homoscystein have been found to be related to visual function and memory among elderly people (Riggs et al. 1996). In addition, poor vitamin B_{12} and folate status were associated with neuropsychotic disturbances among elderly people (Bell et al. 1990). Iron status as measured by serum transferrin and ferritin was also associated with cognitive function (Tucker et al. 1990). More recently, a study among 370 elderly people reported that subjects with low plasma concentration of folate and B_{12} had an increased risk of getting Alzhemeir Disease within 3 years by two folds (Wang et al. 2001). It was reported that even a mild cognitive impairment among elderly people is related to disability and reduced independency (Gussekloo et al. 1997), whilst a severe impairment resulted in high mortality (Liu et al. 1990; Kelman et al. 1994).

A study in various parts of rural areas of Malaysia indicated that anaemia was prevalent among subgroups of populations such as women at a reproductive age (25%), children (21.9%) and elderly people (22.7%) (Tee et al. 1998). Another study in the East Coast of Malaysia reported a prevalence of iron deficiency anaemia of 35.2% among rural elderly Malays (Suzana et al. 1999b). However, little attention has been given to investigate the relationship between anaemia and cognitive function. In a study among 477 rural elderly Malays, iron deficiency anaemia as measured by serum ferritin had been reported to be associated with poor cognitive function (Zuriati 2003). However, the study only used a single haematological indicator to assess anaemia. Therefore, this study aimed to evaluate the relationship between anaemia and cognitive function among institutionalized Chinese elderly using multiple haematological indices.

MATERIALS AND METHODS

This is a cross-sectional study among 35 Chinese elderly, aged 60 to 85 years, purposely selected from five old folks homes in Klang Valley, Malaysia. The study involved 24 men (68.6%) and 11 women (31.4%), who did not have any mental or terminal illnesses based on medical reports at the old folks homes and were able to communicate. Subjects were interviewed to obtain information on social and health status using a pre-tested questionnaire and on cognitive function using Hodkinson Abbreviated Mental test (Jitapunkul et al. 1991). The test comprised of 10 items of simple questions on memory function. The total score was 10 with score 0-3 classified as severe cognitive impairment; score 4-6 as moderate cognitive impairment; score 7-8 as mild cognitive impairment and score 9-10 as normal cognitive function. The habitual dietary intake was recorded using a validated dietary history questionnaire with some modifications to include Chinese food items (Suzana et al. 2000). Nutritional status was assessed using anthropometric measurements i.e. weight, arm span, mid upper arm circumference (MUAC). Physical examination was also carried out by a medical doctor to identify clinical symptoms related to anaemia.

A total of 6 ml non-fasting venous blood sample was drawn from each volunteer. From each sample, 2 ml was transferred into a tube containing EDTA and stored overnight in a fridge at 4^0C, prior to analysis for Full Blood Count (FBC) using an automated haematological analyzer, Coulter STKS. The FBC of interest was haemoglobin, mean cell volume (MCV) and mean cell haemoglobin (MCH). Another 4 ml of the sample was pipetted into a gel tube added with an accelerator and centrifuged using a tabletop centrifuge HERMLE Z200A at 3500-4000 rpm for 10 minutes soon after the blood was taken. The sample was also stored overnight in a fridge at 4^0C. The sample was analysed for serum ferum and total iron binding capacity (TIBC) using Cobas Integra 800 (Palmer et al. 1995), serum vitamin B_{12} using an automated analyzer, Elecsys 2010 (Erler & Egger 1996), serum feritin and serum folate using an automated analyzer, Axsym System (Smith & Osikowicz 1993). All of the analyses were carried out at the Haematology and Chemical Pathology Laboratories of Hospital Universiti Kebangsaan Malaysia.

Nutrient intake was calculated using a computer program (DIET 4) based on the Malaysian Food Composition Table, 4^th^ Edition (Tee et al. 1997). Nutrients not included in the Malaysian Table, i.e. vitamin B_{12} and folate were estimated using the United Kingdom Food Composition Table (McCance & Widdowson 1992). The cognitive assessment was summarized as a score, with 10 as the maximum score. Anthropometric measurements of weight and armspan were used to calculate body mass index (BMI) (Suzana & Ng 2003). Data was analysed using SPSS version 10.0. Mann-Whitney test was used to determine significant differences between variables, while Spearman Correlation Coefficient was used to examine association between variables.

RESULTS & DISCUSSION

The mean age of the subjects was 70.3 ± 5.5 year for men and 69.9 ± 9.2 year for women. Majority of subjects were not married (74.3%), had been to school (62.9%) and relied on financial assistance from charity bodies (62.9%) (Table 1). Only 31.4% of the subjects were visited by relatives or friends and received some financial assistance from them. Most of the subjects (94.3%) had worked as manual laborers such as cleaner, construction worker, domestic helper and child minder before being resided at the institutions. Approximately 17.1% and 25.7% of the subjects were alcohol drinkers and smokers, respectively, at the time of the study, with more men subjects having these attributes. These findings are similar to a study among non-institutionalized Chinese elderly by Suriah et al. (2000). The subjects shared similar health problems as their non-institutionalized counterparts, with hypertension and joint problems being the most commonly reported diseases (Suzana et al. 2001; Carline 2003). Clinical symptoms of anaemia observed in the subjects were pallor (17.1%), an indication of severe iron deficiency anaemia, followed by smooth and magenta tongue (11.4%) and koilonychias (5.7%). As has been reported among rural elderly Malays by Suzana et al. (2000), the subjects were not regular consumers of vitamin and mineral supplements but had a peculiar belief on food properties, particularly women. Foods that were commonly omitted were chicken ('itchy' food), pineapple, mango and orange ('sharp' food) and food cooked with coconut milk or deep fried ('fatty' food).

Although the subjects were rather deprived with respect to socioeconomic and health profiles, their mean BMIs (23.4 ± 5.1 kg/m^2 for men and 24.7 ± 5.4 kg/m^2 for women) were within the normal range according to the WHO classifications (WHO/UNICEF/UNU 1998). However, women were more likely to be classified as overweight (45.5%) as compared to men (29.2%). Table 2 compares the mean energy and nutrient intakes of the subjects to the Recommended Nutrient Intakes for Malaysia (RNI) (NCCFN 2005). Regardless of gender, mean energy and folate intakes of the subjects did not fulfill the RNI and thus all subjects had the energy and folate intakes below the RNI. The percentages intake from RNI for energy and vitamin B_{12} were higher in women than men ($p<0.05$ for both parameters). The diet of elderly people is often inadequate in energy and nutrients because their meals are low in fat and bulky (Suzana et al. 2000). Furthermore, factors such as inability to take public transport, loss of appetite, chewing difficulty, no regular fruit intake and regularly taking less than three meals/day have been recognized as predictors of dietary inadequacy (Suzana et al. 1999a). A diet that is low in total fat quite often is bulky and thus reduces the energy and nutrient intake among older people (WHO 1990). The estimated folate intake among the subjects were severely below the Malaysian RNI (NCCFN 2005), US RDA (US National Academy of Sciences 1998) and FAO/WHO RDA (FAO/WHO 2002) of 400 μg/day. This is probably due to an inadequate intake of foods rich in folate or the losses of folate during food preparation at high temperature (Ubbink et al. 1993) and long cooking time (Bailey 1992). The consumption of food fortified with folate such as breakfast cereals was also not an accustom among the subjects. However, dietary folate correlated negatively with serum folate, as presented in Table 3. This is probably due to the fact that serum folate reflects the present folate balance (Herbert 1987) and is greatly influenced by current folate intake (Lynch & Green 2001). The red blood cell folate is a more sensitive indicator to assess folate status, but its specification has been questioned because it might also showed subnormal values among individuals with vitamin B_{12} deficiency (Lynch & Green 2001). The proportion of subjects not consuming adequate iron and vitamin B_{12} were not as high as energy and folate. However, more men were found to consume a diet inadequate with these two nutrients as compared to women.

Intake of energy and iron correlated positively with MUAC, BMI and haemoglobin but negatively with age, as shown in Table 3. Similar findings have been reported earlier in a study among rural elderly Malays (Suzana et al. 1999b). This indicates the importance of consuming adequate energy in achieving optimal nutritional status. There is a concern that food intake might be reduced at old age. There was no significant correlation between intake of iron and vitamin B_{12} with serum iron and serum vitamin B_{12}, respectively, probably due to the small sample size. However, there was a negative association between intake of vitamin B_{12} with serum iron ($r= -0.452$, $p<0.01$); folate intake with serum folate ($r= -0.352$, $p<0.05$) and a positive association between folate intake with serum iron ($r=0.568$, $p<0.01$).

Table 4 presents the haematological profiles of the subjects. Men had a higher serum iron concentration as compared to women ($p<0.05$), while subjects at the older age group had a lower haemoglobin concentration as compared to their younger counterpart ($p<0.05$).

Usage of multiple indices to diagnose anaemia is more desirable (Lynch & Green 2001). In this study, low haemoglobin (Hb ≤ 12 g/dL) (WHO/UNICEF/UNU 1998) was used as the main criteria to diagnose anaemia. Other criteria being evaluated were abnormal levels of MCV, MCH, TIBC, serum ferritin, serum folate and serum vitamin B_{12}. Prevalence of anaemia as assessed using haemoglobin alone was 22.9%. This figure is in agreement with the value reported among elderly people in rural areas and estates of Peninsular Malaysia (22.7%) (Tee et al. 1998) but slightly lower than the occurrence of anaemia among rural elderly Malays (35.2%) (Suzana et al. 1999b). From the sample who had been identified as being anaemic using haemoglobin alone, iron deficiency anaemia based on microcytic and hypochromic criteria (MCV, MCH and serum iron) was detected in two subjects (5.7%). Only one subject (2.9%) was classified as anaemic based on an indicator of iron storage, i.e serum ferritin < 32 μg/l. Among the non-anaemic subjects based on haemoglobin, only 3 subjects (11.1%) had low serum iron (serum iron < 6.6 for women and <10.6 for men) (Table 5). A study among rural elderly Malays had also indicated low prevalence of iron deficiency anaemia as assessed using serum ferritin < 12 ng/ ml (Zuriati 2003).

Anaemia in relation to deficiency of vitamin B_{12} and folate can be predicted using haemoglobin concentration, haematocrit value and the occurrence of macrocytic RBC (Lynch & Green 2001). None of the subjects had MCV greater than 9l fl, therefore, there was no occurrence of megaloblastic anaemia. However, four subjects (50.0%) had serum folate of less than 7 nmol/L and 1 subject (12.5%) had serum vitamin B_{12} lower than 165 pmol/L and thus, were at developing megaloblastic anaemia.

The study identified 12 subjects (34.3%) as having folate deficiency (i.e serum folate < 7 nmol/L) and 3 subjects (8.6%) with vitamin B_{12} deficiency (i.e. serum vitamin B_{12} < 165 pmol/L). In a study among the elderly from multiethnic groups in Los Angeles, a lower figure for folate (7.2%) but a higher prevalence for vitamin B_{12} deficiency (28.6%) were reported (Carmel et al. 1999). The high prevalence of folate deficiency among the Chinese subjects in this study could be due to inadequate consumption of foods rich in folate or fortified foods or losses of folate in cooking. They were also not regular consumers of fortified food products such as breakfast cereals neither nor folate supplement. Foods fortified with folate and folate supplementation contain free folic acid that have high bioavailability (Koehler et al. 1997).

Cognitive assessment indicated a median score of 7.0 (5.28 – 7.01) which is the category of mild cognitive function (Jitapunkul et al. 1991). Figure 1 shows that most of the subjects could be having mild cognitive impairment, with more women (45.5%) having this attribute as compared to men (29.2%). The study found that subjects with severe cognitive impairment had a lower haemoglobin level (12.2 ± 1.0g/dL) compared to those with normal cognitive function (13.7 ± 0.8g/dL; $p<0.05$). As have been reported in other studies (Chua 2002; Zuriati 2003) cognitive scores were found to be correlated with indicators of nutritional status including MUAC ($r=0.547$, $p<0.01$) and BMI ($r=0.501$, $p<0.01$).

All subjects with low haemoglobin and serum iron levels and approximately three quarter of subjects with poor folate and vitamin B_{12} status were classified as having a various degrees of cognitive impairment (Table 6). Associations between cognitive function and haematological indices have been shown in other studies. For example, in a study among 28 elderly, haemoglobin level was associated with the tonal-memory-backward, but no correlation with serum iron (Tucker et al. 1990). In another study involving 137 elderly individuals, correlation was found between Shipley-Hartford Abstraction test with plasma folate ($r=0.19$, $p< 0.05$), plasma vitamin B_{12} ($r=0.15$, $p<0.10$) and serum transferin ($r=0.24$, $p<0.01$). In conclusion, decline in cognitive function associated with ageing may be prevented with adequate intake of iron, folate and vitamin B_{12}.

ACKNOWLEDGEMENTS

Financial assistance was received from the Universiti Kebangsaan Malaysia (UKM Grant NN10/02). We are grateful to the elderly subjects, the staff of Department of Nutrition and Dietetics, UKM, the staffs of Haematology and Chemical Pathology laboratories, Hospital UKM, and the staff of the old folk homes involved in this study.

REFERENCES

Bailey, L.B. 1992. Evaluation of a new Recommended Dietary Allowances for folate. *J. Am. Diet Assoc.* 92: 463-468, 471.

Bell, I.R., Edman, J.S. & Miller, J.W. 1990. Relationship of normal serum vitamin B12 and folate levels to cognitive test performance in subtypes of geriatric major depression. *J. Geriatr. Psychiatry Neurol.* 3: 98-105.

Carline, D.C. 2003. Antioxidant nutrient intake and level in the serum among Chinese elderly in Klang Valley. MSc Thesis. Universiti Kebangsaan Malaysia, Department of Nutrition and Dietetics.

Carmel, R., Green, R., Jacobsen, D.W., Rasmussen, K., Florea, M. & Azen, C. 1999. Serum cobalamin, homocysteine and methylmalonic acid concentrations in a multiethnic elderly population: ethnic and sex differences in cobalamin and metabolite abnormalities. *Am. J. Clin. Nutr*. 70: 904-910.

Chua, S.H. 2002. Body composition and functional status among rural elderly Malays in Pasir Mas, Kelantan. *BSc Thesis*. Universiti Kebangsaan Malaysia, Department of Nutrition and Dietetics.

Erler, K. & Egger, M. 1996. Electrochemiluminescence applied to heterogenous immunoassays. *J. Clin. Ligand Assay* 19(suppl): 93-99.

FAO/ WHO. 2002. Human vitamin and mineral requirements. Report of a joint FAO/ WHO consultation. WHO and FAO of the United Nations, Rome.

Gussekloo, J., Westedorp, R.G.J., Remarque, E.J., Lagaay, A.M., Heeren, T.J. & Knook, D.L. 1997. Impact of mild cognitive impairment on survival in very elderly people: cohort study. *BMJ* 315: 1053-1054.

Herbert, V. 1987. Making sense of laboratory test of folate status: folate requirements to sustain normality. *Am. J. Hematol.* 26: 199-207.

Jitapunkul, S., Pillay, I. & Ebrahim, S. 1991. The abbreviated mental test: Its use and validity. *Age Ageing* 20: 332-336.

Kelman, H.R., Thomas, C., Kennedy G.J., & Cheng, J. 1994. Cognitive impairment and mortality in older community residents. *Am. J. Public Health* 84: 1255-1260.

Koehler, K.M., Pareo-Tubbeh, S.L., Romeo, L.J., Baumgartner, R.N. & Garry, P.J. 1997. Folate nutrition and older adults: challenges and opportunities. *J. Am. Diet Assoc.* 97: 167-173.

Liu, I.Y., LaCroix, A.Z., White, L.R., Kittner, S.J. & Wolf, P.A. 1990. Cognitive impairment and mortality: A study of possible confounders. *Am. J. Epidemiol.* 132: 136-143.

Lynch, S. & Green, R. 2001. Assessment of nutritional anemias. In: Ramakrishnan U (Ed.) Nutritional Anemias. New York, CRC Press; 23-42.

McCance, R.A. & Widdowson, E.M. 1992. The Composition of Foods (5th ed). United Kingdom: The Crown and the Royal Society of Chemistry.

NCCFN. 2005. Recommended Nutrient Intakes for Malaysia. A Report of the Technical Working Group on Nutritional Guidelines. National Coordinating Committee on Food and Nutrition, Ministry of Health Malaysia, Putrajaya.

Palmer, S.M., Kautman, R.A., Salamone, S.J., Blake-Courtney, J., Bette, W., Wahl, H.P. & Furrer, F. 1995. Cobas integra: clinical laboratory instrument with continuous and random-access capabilities. *Clinical Chemistry* 41: 1751-1760.

Riggs, K.M., Spiro, A., Tucker, K. & Rush, D. 1996. Relationship of vitamin B12, vitamin B6, folate and homocystein to cognitive function the Normative Aging Study. *Am. J. Clin. Nutr.* 63: 306-314.

Rosenberg, I.H. & Miller, J.W. 1992. Nutritional factors in physical and cognitive functions of elderly people. *Am. J. Clin. Nutr.* 55: 1237S-1243S.

Smith, J. & Osikowicz, G. 1993. Abbott Axsym random and continuous access immunoassay system for improved workflow in the clinical laboratory. *Clin. Chem.* 39: 2063-2069.

Suriah, A.R., Chong, T.J., & Yeoh, B.Y. 2000. Nutritional situation of a Chinese Community. Singapore Med. J.(online) http://www.sma.org.sg/smj/3908/articles/3908a2.html (12 February 2003).

Suzana, S., Dixon, R.A. & Earland, J. 1999a. Development of a screening tool for detecting undernutrition and dietary inadequacy among rural elderly in Malaysia: Simple indices to identify individuals at high risk. *Int. J. Food Sci.* 50: 435-444.

Suzana, S., Earland, J., Powers, H.J. & Suriah, A.R. 1999b. Dietary and biochemical nutritional status of rural elderly Malays. *Int. J. Vit. Nutr. Res.* 69(4):277-284.

Suzana, S., Earland, J. & Suriah, A.R. 2000. Dietary intakes and food habits among rural elderly Malays. *Asia Pacific J. Clin. Nutr.* 9(2): 122-129.

Suzana, S., Earland, J. & Suriah, A.R. 2001. Social and health profiles of rural elderly Malays. *Singapore Med. J.* 42(4): 176-177.

Suzana, S. & Ng, S.P. 2003. Predictive equations for estimation of stature in Malaysian elderly people. *Asia Pacific J. Clin. Nutr. 12*(1): 80-84.

Tee, E.S., Ismail, M.N., Azudin, M.N. & Khatijah, I. 1997. *Nutrient Composition of Malaysian Foods* (4th. Ed). Kuala Lumpur: Institute for Medical Research.

Tee, E.S., Khor, G.l., Ng, T.K.W., Zaitun, Y., Chee, H.L. & Safiah, M.Y. 1998. Nutritional assessment of rural villages and estate in Peninsular Malaysia. III. Prevalence of anaemia. *Mal. J. Nutr.* 4: 1-29.

Tucker, D.M., Penland, J.G., Sandstead, H,H,, Milne, D.B., Heck, D.G. & Klevay, L.M. 1990. Nutrition status and brain function in ageing. *Am. J. Clin. Nutr.* 52: 93-102.

Ubbink, J.B., Vermaak, W.J.H., Van der Merwe, A. & Becker, P.J. 1993. Vitamin B12, vitamin B6 and folate nutritional status in men with hyperhomocysteinemia. *Am. J. Clin. Nutr.* 7: 53.

US National Academy of Sciences. 1998. *Dietary Reference Intakes for Thiamin, Riboflavin, Niacin, Vitamin B6, Folate, Vitamin B_{12}, Panthothenic Acid, Biotin and Choline.* Washington DC, National Academy Press.

Wang, H.X., Wahlin, A., Basun, H., Fastbom, J., Winblad, B. & Fratiglioni, L. 2001. Vitamin B12 and folate in relation to the development of Alzheimer's disease. *Neurology* 56: 1188-1194.

WHO/UNICEF/UNU. 1998. *Iron deficiency anaemia: Prevention assessment and control.* Report of a Joint WHO/UNICEF/UNU consultation. Geneva: WHO.

World Health Organisation (WHO). 1990. *Diet, nutrition and the prevention of chronic diseases.* WHO Technical Report Series No. 797. Geneva: WHO.

Zuriati I. 2003. Subjective global assessment (SGA) and functional status among rural elderly Malays: Simple indices for screening of elderly people at high risk of malnutrition. MSc. Thesis. Universiti Kebangsaan Malaysia, Department of Nutrition and Dietetics.

Suzana Shahar
Lee X. K.
Junara Mohd Halim
Department of Nutrition and Dietetics,
Faculty of Allied Health Sciences,
Universiti Kebangsaan Malaysia,
Jalan Raja Muda Abd. Aziz,
50300 Kuala Lumpur.

Siti Balkis Budin
Department of Biomedical Sciences,
Faculty of Allied Health Sciences,
Universiti Kebangsaan Malaysia,
Jalan Raja Muda Abd. Aziz,
50300 Kuala Lumpur.

Mokhtar Abu Bakar
Nor Aini Umar
Department of Pathology,
Faculty of Medicine,
Universiti Kebangsaan Malaysia,
Jalan Yaacob Latif, Cheras,
56000 Kuala Lumpur.

TABLE 1. Sociodemographic and health characteristics of subjects

Characteristics	Men (n=24)		Women (n=11)		Total (n=35)	
	n	%	n	%	n	%
Marital status						
Married	4	16.7	5	45.5	9	25.7
Never	20	83.3	6	54.5	26	74.3
Education level						
Primary school	17	70.8	5	45.5	22	62.9
Never	7	29.2	6	54.5	26	37.1
Income						
Pension	1	4.2	0	0	1	2.9
Children	1	4.2	0	0	1	2.9
Charity	16	66.7	6	54.5	22	62.9
Others (relatives, friends)	6	25.0	5	45.5	11	31.4
Previous employment status						
Working	24	100	9	81.8	33	94.3
Not working	0	0	2	18.2	2	5.7
Alcohol intake						
Yes	5	20.8	1	9.1	6	17.1
No	11	45.8	6	54.5	17	48.6
Ex-alcohol drinker	8	33.3	4	36.4	12	34.3
Smoking status						
Yes	8	33.3	1	9.1	9	25.7
No	12	50.0	8	72.7	20	57.1
Ex-smoker	4	16.7	2	18.2	6	17.1
Chronic medical conditions						
Diabetes mellitus	4	16.7	2	18.2	6	17.1
Hypertension	8	33.3	7	63.6	15	42.9
Cardiovascular disease	4	16.7	1	9.1	5	14.3
Gout/Arthritis	7	29.2	5	45.5	12	34.3
Respiratory diseases	6	25.0	2	18.2	8	22.9
Renal	1	4.2	0	0	1	2.9
Hepar	0	0	1	9.1	1	2.9
Gastrointestinal/ulcer	2	8.3	0	0	2	5.7
Osteoporosis	1	4.2	1	9.1	2	5.7
Others (skin disease, cataract)	7	29.2	0	0	7	20.0

TABLE 2. Mean energy and nutrient intakes among elderly subjects and % RNI Malaysia

Nutrient	Men (n=24)				Women (n=11)			
	Mean (SD)	**RNI**	**%RNI (SD)**	**%Subject < RNI**	**Mean (SD)**	**RNI**	**%RNI (SD)**	**% Subject < RNI**
Energy (kcal/d)	1299 (140)	2010	64.6 (7.0)	100	1251 (203)	1780	70.3 (11.4)*	100
Iron (mg/d)	9.9 (1.0)	14	70.7 (7.2)	100	10.3 (1.9)	11	93.3 (17.0)	63.6
Folate (μg/d)	106.4 (22.0)	400	26.6 (5.5)	100	95.3 (16.9)	400	23.8 (4.2)	100
Vitamin B_{12}^{α} (μg/d)	3.2 (1.7)	2	157.8 (86.6)	33.3	6.9 (3.6)	2	343.9 (177.6)*	9.1

*$p<0.05$ (Mann-Whitney Test at 2-tailed significance)
$^{\alpha}$ US RDA (US National Academy of Sciences 1998)

TABLE 3. Correlation between dietary nutrients and age, MUAC, BMI and haematological indices [presented as correlation coefficient (r)]

Indices	Energy	Iron	Folate	Vitamin B_{12}
Age	-0.383*	-0.386*	0.002	-0.228
MUAC	0.387*	0.445*	0.162	0.343*
BMI	0.372*	0.406*	0.186	0.177
Haemoglobin	0.391*	0.438**	0.193	0.146
Serum iron	0.277	0.209	0.568**	-0.452**
Serum folate	-0.205	0.030	-0.352*	0.064
Serum vitamin B_{12}	0.086	-0.066	0.139	0.043

*$p<0.05$ (Spearman correlation test)
** $p<0.01$ (Spearman correlation test)

TABLE 4. Profile of haematological indices among subjects according to sex and age group presented as mean and (SD)

Parameter	Men (n = 24) 60-74 Yrs (n = 18)	Men >74 Yrs (n = 6)	Men Total (n = 24)	Women (n = 11) 60-74 Yrs (n = 8)	Women >74 Yrs (n = 3)	Women Total (n = 11)	Total (n = 35) Total (n =35)
Haemoglobin (g/dL)	13.7 (1.4)	12.7 (1.7)	13.4 (1.5)	13.3 (1.3)	11.4 (0.8)[#]	12.8 (1.4)	13.2 (1.5)
MCV (fl)	88.2 (8.8)	84.2 (9.6)	87.2 (8.9)	88.8 (2.5)	82.2 (11.1)	87.0 (6.2)	87.2 (8.1)
MCH (pg)	30.4 (3.4)	29.0 (3.7)	30.0 (3.4)	30.8 (1.0)	28.5 (4.6)	30.2 (2.5)	30.1 (3.1)
Serum iron (μmol/l)	17.4 (7.8)	15.8 (4.6)	17.0 (7.1)	9.3 (3.4)	10.3 (2.5)*	9.5 (3.1)	14.7 (7.0)
TIBC (μmol/)	58.7 (9.2)	52.0 (7.9)	57.0 (9.2)	51.1 (5.0)	45.3 (3.1)	49.5 (5.2)	54.7 (8.8)
Transferrin (%)	30.1 (14.6)	31.9 (13.2)	30.6 (14.0)	18.1 (6.3)	23.1 (7.0)	19.4 (6.6)	27.1 (13.1)
Serum ferritin (μg/ L)	168.3 (103.6)	252.3 (126.7)	189.3 (113.2)	213.7 (92.8)	237.0 (175.1)	220.1 (110.8)	199.0 (111.7)
Serum folate (nmol/L)	10.2 (5.3)	7.7 (2.7)	9.6 (4.9)	11.3 (5.2)	9.2 (2.9)	10.7 (4.6)	10.0 (4.8)
Serum B_{12} (pmol/L)	475.6 (199.2)	395.5 (173.7)	455.5 (192.7)	457.0 (203.5)	529.3 (535.9)	476.7 (295.9)	462.2 (225.8)

[#] $p<0.05$, significant difference between age groups (Mann-Whitney test)
*$p<0.05$, significant difference between sexes (Mann-Whitney test)

TABLE 5. Comparison of haematological profiles between anaemic and non-anaemic subjects [n (%)]

Haematological Indices	Cut-off point of abnormalities	Anaemic Hb ≤ 12 g/dL (n = 8)	Non-anaemic Hb > 12 g/dL (n = 27)	Total (n = 35)
MCV[1] (fl)	<77	2 (25.0)	2 (7.4)	4 (11.4)
	>91	0 (0)	9 (33.3)	9 (25.7)
MCH[1] (pg)	<26	2 (25.0)	2 (7.4)	4 (11.4)
Serum iron[2] (µmol/l)	<6.6 (women) <10.6 (men)	2 (25.0)	3 (11.1)	5 (14.3)
Serum ferritin[3] (µg/l)	<14 (women) <32 (men)	1 (12.5)	0 (0)	1 (2.9)
Serum folate[3] (nmol/l)	<7	4 (50.0)	8 (29.6)	12 (34.3)
Serum vitamin B_{12}[2] (pmol/l)	<165	1 (12.5)	2 (7.4)	3 (8.6)

MCV- mean cell volume mean cell haemoglobin
MCH- mean cell haemoglobin
[1]*Coulter Analytical Instruments*
[2]*Roche Analytical Instruments*
[3]*Abbott Analytical Instruments*

TABLE 6. Deficiency in haematological indices among subjects of different cognitive function group presented as number (%)

	Low Haemoglobin [Hb≤12 g/dL] (n=8)	Low serum iron [<6.6 (women) <10.6 μmol/l (men)] (n=5)	Folate deficiency [Serum folate <7 nmol/l] (n=12)	Vitamin B12 deficiency [Serum B12 <165 pmol/l] (n=3)
Severe cognitive impairment [score 0-3] (n=7)	3 (37.5)	2 (40.0)	2 (16.7)	1 (33.3)
Moderate cognitive impairment [score 4-6] (n=9)	2 (25.0)	3 (60.0)	4 (33.3)	1 (33.3)
Mild cognitive impairment [score 7-8] (n=12)	3 (37.5)	0 (0)	3 (25.0)	0 (0)
Normal cognitive function [score 9-10] (n=7]	0 (0)	0 (0)	3 (25.0)	1 (33.3)

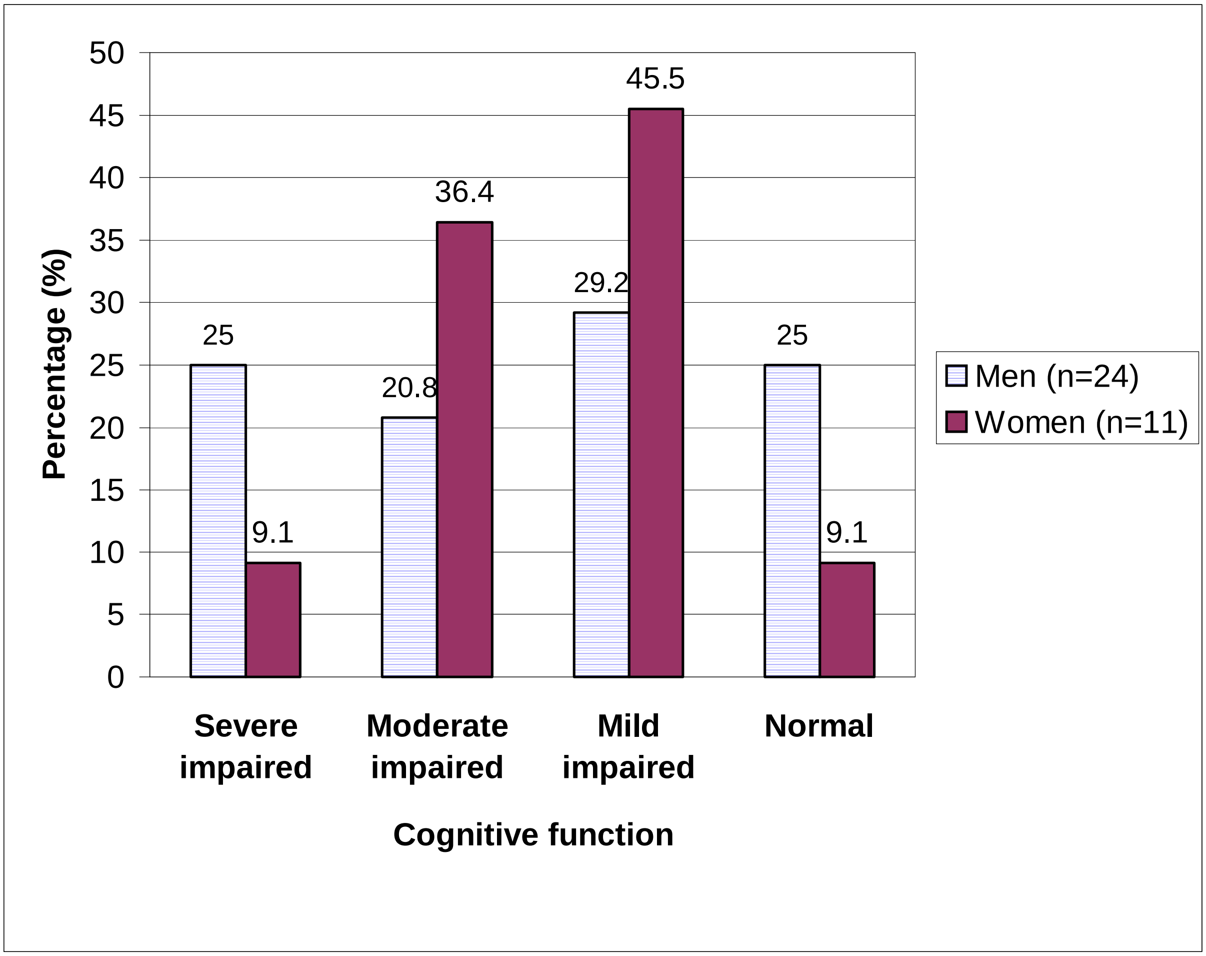

FIGURE 1. Classifications of cognitive function according to sex