Relationships of Vitamin B1, B12, Folate and the Cognitive Ability of the Thai Rural Elderly

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Abstract

The comparisons of the levels of vitamin B1, B12 and folate between the elderly with good and poor cognitive ability are the goals of this study. 203 subjects enrolled in 3 geriatric centers of Ratchaburi province and nearby were recruited. All the subjects were tested with structured Thai Mini Mental State Examination (TMSE) questionnaire by trained examiners. With the cut off point of 23 out of 30 in TMSE, 31 per cent were designated as poor cognitive group. Radiodilution assay was used to determine the level of serum B12 and red cell folate while the TPP effect was processed by spectrophotometry. The prevalence of vitamin B1, B12 and folate deficiency were 30.2 per cent, 3.8 per cent and 8.2 per cent consecutively. None of the studied vitamin levels was shown to be significantly different between the poor and good cognitive group suggesting no proved indication to the use of vitamin B1, B12 and folate in the healthy elderly with poor cognitive function.

It is well known that many vitamins of the B-group, especially thiamin, nicotinic acid, pyridoxine, folic acid and cyanocobalamin play important roles in brain metabolism[1,2]. In addition, their deficiencies are associated with neurological and psychological disorders[3-6]. Consequently, it is tempting to consider these deficiencies may be the causative factors or even exacerbate the underlying brain pathology. The widespread use of vitamin B in various forms is, therefore, very common for the sake of improving brain performance especially among those feeling decreased cognitive ability i.e. the elderly who already suffer most from high risk of adverse drug reaction from polypharmacy[7].

The purpose of our study was, firstly, to look for the epidemiology of cognitive impairment among the Thai elderly living fairly independently in a rural community. Secondly, the prevalence of vitamin B deficiency particularly thiamin, cyanocobalamin and folic acid among the Thai elderly are also required. Finally, the differences of the concerned vitamin B levels between those of the

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elderly with normal cognitive scores and those with poor cognitive scores are needed to verify the benefit of increment of body vitamin B level.

Population and Method

The study design was a cross-sectional study. The sample population were selected by systematic randomization from the name lists of the members enrolling in three geriatric day centers in Ratchaburi and Samut Songkhram province which are 100 kilometres and 60 kilometres south of Bangkok respectively. All of them were well living in the rural community independently attending the geriatric day centers for the purpose of health promotion and socialization. They were asked to starve for 12 hours before the arrival of the research team at the day centers in the morning and had venupuncture done. After all the blood samples were obtained, they were quickly transported within a cool container back to our laboratory in Siriraj Hospital. Consequently, the sample population were assessed for their cognitive ability by employing Thai Mental State Examination (TMSE), a mental test specifically developed for the Thai elderly by "Train the Brain Forum Committee of Thailand" in which geriatricians, neurologists, psychiatrists and psychologists from every teaching hospital in Thailand participated(8). TMSE is based on 6 categories namely orientation (6 points), registration (3 points), attention (5 points), calculation (3 points), language and abstract thinking (10 points) and recall (3 points). The total score was 30 points with the average of 27.38 ± 2.02 points among the normal healthy Thai elderly surveyed in 1993. The cut-off point for the normal cognitive ability is a score over 23 points (mean - 2 SD) while the elderly who scored 23 or less would be allocated in the poor cognitive group.

Regarding the biochemical assay of the vitamin level, all the blood samples were kept under -20°C and tests more closely associated with tissue-bound vitamin i.e. functional tests, were employed indicating their long term nutritional status. Thus, thiamin pyrophosphate (TPP) effect, rather than just erythrocyte transketolase level, reflected the thiamin status. The 3 milliliter heparinized whole blood was processed by spectrophotometry to determine TPP effect. Radiodilution assay employing Co^{57} isotope was used to determine the level of serum B12. Finally, microbioassay using lactobacillus casei ATCC 7469 and spectrophotometry were the methods for determining red cell folate(9).

Statistical analyses used in our study were percentage, means and standard deviation as well as the student *t* test for the comparisons of various vitamin levels between the two groups of the sample population i.e. the normal and poor cognitive groups identified by their performance on TMSE.

RESULTS

After systematic randomization, there were 123 females and 80 males with a female to male sex ratio of 1.54 : 1 participating in the study. Not all the blood samples obtained were tested for the various vitamin level as some of them were clotted due to error during the process of venupuncture. The mean age of female elderly and male elderly were 68.83 ± 7.25 years and 70.01 ± 5.64 years respectively. The mean age of the whole sample population was 69.3 ± 6.67 years with the minimum value of 60 years and the maximum value of 87 years. The range of TMSE score was from 8 to 30 with the mean of 25.13 ± 4.95 points. As far as the sexual difference of TMSE score is concerned, the mean value of the male and female elderly were 26.26 ± 4.08 and 24.39 ± 5.34 points respectively. The minimum TMSE score of the female elderly was 8 points while that of the male elderly was 14 points, both groups shared the same maximum value of 30 points. When using the cut-off point of over 23 points to differentiate between the normal and poor cognitive group, there were 63 out of 202 cases or 31 per cent who were allocated in the poor cognitive group. In this particular group, the female elderly contributed up to nearly 70 per cent, on the other hand, the poor cognitive male elderly was only 19 out of 80 cases or 23.8 per cent among the male elderly.

Table 1 demonstrates the basic population background between the normal and poor cognitive groups discriminated by TMSE. The P value derived from Chi-square test for the qualitative data and Mann Whitney U-test for the nonparametric quantitative data are also shown.

Regarding the thiamin or vitamin B1 status, the mean value of thiamin pyrophosphate effect was 11.41 ± 8.04 per cent with the minimum value of 0 per cent and the maximum value of 47.6 per cent. With the normal range of 0-15 per cent, the prevalence of thiamin deficiency was 61 out of 202 cases or 30.2 per cent. Among this group, the

Table 1. Comparisons of basic background between the normal and poor cognitive groups.

	Normal group	Abnormal group	P value
1. Sex			
male	61	19	0.083
female	77	44	
2. Age mean ± SD	67.9 ± 5.8	72.4 ± 7.5	0.001
3. Education			
none	5	22	
primary school	109	39	0.000
secondary school and higher	21	2	
4. Financial status			
very poor	10	5	
poor without savings	55	36	0.099
with some savings	54	19	
good	17	3	

Table 2. *t*-tests for the various vitamin B levels of the normal and poor cognitive score groups.

Variable	No. of Cases	Mean	SD	2-Tail Sig.
TPP Effect				
Normal score gr.	138	10.90	7.68	0.209
Abnormal score gr.	63	12.44	8.81	
Vitamin B12				
Normal score gr.	108	408.27	183.83	0.334
Abnormal score gr.	51	460.08	488.48	
Red Cell Folate				
Normal score gr.	103	398.71	142.88	0.489
Abnormal score gr.	44	415.84	122.82	

ratio of male to female elderly was 21 to 40 cases or 1: 1.9, if, however, looking within each sex group, the prevalence of thiamin deficiency was 26.3 per cent in the male group and was 32.8 per cent in the female group.

The mean value of serum cyanocobalamin was 424.89 ± 314.62 pg/ml with the range of 110 to 3727 pg/ml, there was no obvious difference between the mean value of the male and female elderly i.e. 425.48 ± 172.36 and 424.48 ± 384.35 pg/ml. When using the normal range of 200-800 pg/ml, the prevalence of cyanocobalamin deficiency was 6 out of 159 tested cases or merely 3.8 per cent. Interestingly, the abnormal cases were nearly all female, 5 out of total 6 cases. The prevalence of cyanocobalamin deficiency among the female elderly was 5 out of 94 tested cases (5.3%) while that among the male elderly group was 1 out of 65 tested cases, only 1.5 per cent existed.

Concerning the average of red cell folate level in the whole sample population, the value was 403.84 ± 136.99 ng/ml with the range of 32 to 847 ng/ml. By the normal range of red cell folate level of 221-1113 ng/ml, the number of cases having the level less than the lower limit was 12 out of 147 tested cases (8.2%). The prevalence of folate deficiency among the male elderly was 8 out of 62 tested cases or 12.9 per cent while that among the female elderly was 4 out of 85 tested cases or 4.7 per cent. This sexual difference of red cell folate status among the elderly was also revealed by the different mean value of only 361.52 ± 144.17 ng/ml in the male elderly *versus* 434.71 ± 123.45 ng/ml in the female elderly.

Table 2 demonstrates the student *t* test analysis comparing the various vitamin levels between those of the normal cognitive score group and those of the low cognitive score group. The P value after analyzing the statistical significant differences between the normal and poor cognitive score groups were 0.209 for thiamin status, 0.334 for serum cyanocobalamin and 0.489 for red cell folate. This means there was no significant difference of the all three concerned vitamin levels between the elderly with normal and poor cognitive score tested by TMSE.

DISCUSSION

Since the TPP effect proposed in 1960 by Brin et al is a functional test suggesting the biochemical deficiency which is better than the test just measuring the plasma level indicating the preliminary deficiency, it is so far the best indicator determining the thiamin status(10). There are wide differences in the proportion who, by their criteria, were thiamin deficient ranging from 68 per cent of geriatric patients admitted to a London hospital to 0 per cent in a survey of elderly residents of Vancouver(11). This may suggest the health-dependent thiamin status as more cases of deficiency are ill. As far as the healthy elderly living in the community is concerned, approximately 30 per cent of the Thai healthy elderly from our study are biochemically thiamin deficient which is quite high compared to those in western countries reflecting the poorer intake of thiamin-rich food. However, their biochemical deficiency does not necessary develop into either pathophysiological deficiency or clinical deficiency. Although there was association between delirium and thiamin deficiency in the hospital setting, there was no association between the TPP effect and mental test score in the community setting(6,12,16). Together with our result of nonsignificant difference between the TPP effect level of the normal and poor cognitive score groups, the benefit of taking vitamin B1 to improve the cognitive performance for the healthy elderly is, therefore, useless let alone the potential hazard of hypervitaminosis from multivitamin formula.

The second and third common vitamin B deficiency in our study were from folic acid (8.2%) and vitamin B12 (3.8%) respectively. This pattern of deficiency is fairly similar to the community-based study in Spain, and the hospital-based study in Thailand(14,15).

There is accumulating evidence that serum B12 tends to decline with age(16). In addition, aging is associated with a mild decline of cognitive skills but a severe decline of complex cognitive function may be attributed to extrinsic factors, such as cobalamin deficiency(17). However, many studies did reveal no association between the cobalamin status and cognitive function(18,19). Moreover, Hughes et al also demonstrated failure of intramuscular injections of vitamin B12 being superior to placebo in improving the mental state of the elderly with low serum B12 level(20). This certainly supports our finding of no difference of serum B12 between the normal and poor cognitive score group.

Another controversial issue concerning the causal relationship between folate deficiency and dementia is still present as the relationship may be in either direction(21). Our finding did share the same finding with those of Elwood et al revealing no association between folate status and mental function in a community survey as the red cell folate level which reflects the vitamin status over a long period of time of both the normal and poor cognitive score groups were not different(18).

SUMMARY

The prevalence of poor cognitive ability among the Thai healthy elderly living in a rural area measured by TMSE is 31 per cent while the prevalence of thiamin, vitamin B12 and folate deficiency are 30.2 per cent, 3.8 per cent and 8.2 per cent respectively. The vitamin levels of those with normal cognitive ability are almost the same as those with poorer cognitive performance. Therefore, there is no actual indication in taking vitamin B complex for raising the vitamin B levels, i.e. improving the brain performance, in the elderly with poor cognitive ability.

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ความสัมพันธ์ของไวตามินบี 1, บี 12 และโฟเลทกับสมรรถภาพการเรียนรู้ในผู้สูงอายุในชนบท

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การศึกษาเปรียบเทียบระดับไวตามิน บี 1, บี 12 และโฟเลท ระหว่างผู้สูงอายุที่มีระดับสมรรถภาพการเรียนรู้ดีกว่ากับกลุ่มที่มีระดับอ่อนกว่า โดยกลุ่มตัวอย่าง 203 ราย อยู่ในชมรมผู้สูงอายุ 3 แห่งของจังหวัดราชบุรี และละแวกใกล้เคียง จากการใช้แบบทดสอบทางสมรรถภาพการเรียนรู้ (Thai Mini Mental State Examination, TMSE) ซึ่งมีค่าจุดตัดที่ 23 จาก 30 คะแนน พบกลุ่มที่มีระดับสมรรถภาพการเรียนรู้ต่ำ 31% ส่วนการวัดระดับไวตามินบี 12 และโฟเลท ใช้วิธี Radiodilution assay การวัด TPP effect ใช้วิธี spectrophotometry พบความชุกของการขาดไวตามิน บี 1, บี 12 และโฟเลท เป็น 30.2%, 3.8% และ 8.2% ตามลำดับ ผลการศึกษาไม่พบว่าระดับไวตามินทั้ง 3 ดังกล่าว มีความแตกต่างกันอย่างมีนัยสำคัญระหว่างกลุ่มมีสมรรถภาพการเรียนรู้ดีและไม่ดี บ่งถึงการไม่มีข้อบ่งชี้ในการใช้ยาไวตามิน บี 1, บี 12 และโฟเลทในผู้สูงอายุในชุมชนที่มีสมรรถภาพการเรียนรู้อ่อน

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