CHAPTER 4

RESULTS

4.1 Characteristics of the studied subjects

4.1.1 Characteristics and demographics data of HIV-infected subjects from 3 sources of recruitment

Due to economic status of the HIV-infected subjects might effect micronutrients status, therefore, we selected the subjects from 3 difference groups to represent of HIV/AIDS patients in Maharaj Nakorn Chiang Mai Hospital. There were no significant differences for the characteristic and demographic data among the 3 groups. Therefore, the three groups were combined for the subsequence data analysis (Table 4.1, Table 4.2).

Table 4.1 Characteristics of HIV-infected subjects from 3 sources

Characteristics	Mean ± SD or number (%)		
	NAPHA Project	**Social Security**	**Pay by themselves**
Age (years)	36.74 ± 7.39	36.88 ± 6.14	40.80 ± 7.5
Gender			
- Male	33 (58.9%)	17 (30.4%)	6 (10.7%)
- Female	55 (80.9%)	9 (13.2%)	4 (5.9%)
BMI (kg/m^2)	21.07 ± 2.61	22.28 ± 3.94	20.16 ± 2.43
Time of using GPO-vir (years)	1.53 ± 0.97	1.62 ± 0.83	1.75 ± 2.35
CD4+ T cell count ($cells/mm^3$)	242 ± 160	264 ± 142	185 ± 65

Table 4.2 Demographics of HIV-infected subjects from 3 sources

Demographics	Number (%)		
	NAPHA Project (n = 88)	**Social Security (n = 26)**	**Pay by themselves (n = 10)**
Education			
- Primary school	35 (39.8%)	9 (34.6%)	1 (10%)
- Secondary school	38 (43.2%)	17 (65.4%)	5 (50%)
- Bachelor degree/ higher	12 (13.6%)	0 (0%)	4 (40%)
Income of family (Baths/month)			
- < 10,000	64 (75.3%)	23 (88.5%)	2 (20%)
- > 10,000	21 (24.7%)	3(11.5%)	8 (80.0%)
Alcohol consumption			
- Yes	12 (9.9%)	7 (5.8%)	-
- No	73 (60.3%)	19 (15.7%)	10 (8.3%)
Smoking	64 (75.3%)	23 (88.5%)	2 (20.0%)
	21 (24.7%)	3(11.5%)	8 (80.0%)
Healthy and nutritional knowledge			
- Little	4 (4.5%)	3 (11.5%)	1 (10%)
- Fair	34 (38.6%)	16 (61.5%)	5 (50%)
- Much	41 (46.6%)	6 (23.1)	4 (40%)
- Very much	1 (1.1%)	1 (3.8%)	0 (0%)
Frequency of exercise			
- No	40 (45.5%)	9 (34.6%)	3 (30%)
- 1-2 times/week	14 (15.9%)	6 (23.1%)	3 (30%)
- 3-5 times/ week	11 (12.5%)	9 (34.6%)	2 (20%)
- every day	15 (17.0%)	2 (7.7%)	1(10%)
Timing of exercise			
- > 20 minutes	5 (5.7%)	3 (11.5%)	2 (20%)
- 20-30 minutes	22 (25.0%)	6 (23.1%)	1 (10%)
- More than 30 minutes	14 (15.9%)	8 (30.8%)	3 (30%)

(1) Categorical variables were compared by using a chi-square test.
* Significantly different between group, $p < 0.001$.

4.1.2 Characteristics and demographics of HIV-infected and healthy subjects

The characteristics of 185 subjects in this study included 124 HIV-infected and 61 healthy subjects were demonstrated in Table 4.3 and Table 4.4. The mean of CD4+ T cell counts was 242.32 ± 150.94 cells/mm^3, range 7-737 cell/mm^3 for HIV-infected subjects and average of time using GPO-vir was 1.57 years, range from 1 month to 8 years. HIV-infected and healthy group had similar mean age (37.19 ± 7.2 years compared with 37.72 ± 7.07 years). However, there was significant difference in BMI between HIV-infected and healthy group (21.28 ± 2.96 compared with 23.25 ± 3.54 kg/m^2). The subject characteristics for discrete variable were presented as percentage of the findings. There were significant differences between HIV-infected and healthy subjects for the proportion of education, income and alcohol consumption. Seventy four percent of HIV-infected subjects completed primary and secondary school. However, most of the healthy subjects completed bachelor degree and higher level of education. The income status with < 10,000 Baths/month was 72.58% for HIV-infected subjects whereas only 44.3% in healthy subjects. The percentage of alcohol consumption was lower in HIV-infected (15.32%) than in healthy subjects (39.34%). There were no significant difference in sex, smoking, healthy and nutritional knowledge, frequency of exercise and time of exercise between HIV-infected and healthy subjects.

When HIV-infected subjects were classified as categories of CD4+ T cell counts which were groups with CD4+ T cell count < 200 cells/mm^3 and ≥ 200 cells/mm^3. There were no significant differences in mean of age, BMI and proportion of sex between those groups. In addition, the two groups did not show significant difference in the proportion of percentage of sex, income status, education, healthy and nutritional knowledge and smoking, drinking status. However, there was only a significant difference in time of using GPO-vir antiretroviral treatment (Table 4.3 and Table 4.4).

Table 4.3 Characteristics of HIV-infected and healthy subjects

Characteristics	Mean ± SD			
	Healthy subjects (n = 61)	HIV-infected subjects		
		Total (n = 124)	CD4+ T cell < 200cells/mm^3 (n = 61)	CD4 + T cell ≥ 200cells/mm^3 (n = 63)
Age (years)	37.72 ± 7.07	37.19 ± 7.20	36.87 ± 7.09	37.32 ± 7.33
Sex				
- Male	30(49.2%)	56(45.2%)	31(52.5%)	25(40.3%)
- Female	31(50.8%)	68(54.8%)	30(50.9%)	38(61.3%)
BMI (kg/m^2)				
- Total	23.25 ± 3.54	21.28 ± 2.96 ^{a*}	21.06 ± 2.56**	21.47 ± 3.31***
- Male	24.28 ± 3.60	21.93 ± 2.73 ^{a*}	21.42 ± 2.73**	22.57 ± 2.66***
- Female	22.25 ± 3.23	20.81 ± 2.96 ^{a*}	20.56 ± 2.17**	21.01 ± 3.47
Time of using GPO-vir drug (years)	-	1.57 ± 1.11	1.13 ± 0.81 ^{b*}	1.98 ± 1.20
CD4+ T cell (cells/mm3)	-	242 ± 151	131 ± 48^{b*}	350 ± 137

^{a*} Significant difference between healthy subjects and total HIV-infected subjects ($p < 0.05$), using Student t-test.
** Significant difference from healthy subjects ($p < 0.05$), using ANOVA.
*** Significant difference from healthy subjects ($p < 0.05$), using ANOVA.
^{b*} Significant difference between HIV group with CD4+ T cell < 200cells/mm^3 and CD4 + T cell ≥ 200cells/mm^3 ($p < 0.001$), using Student t-test.

Table 4.4 Demographics of HIV-infected and healthy subjects [(1)]

Demographics	Number (%)			
	Healthy subjects (n = 61)	HIV-infected subjects		
		Total (n = 124)	CD4+ T cells < 200cells/mm^3 (n = 61)	CD4+ T cells ≥ 200cells/mm^3 (n = 63)
Education				
- Primary school	18(29.5%)	45(36.3%)*	20(32.8%) **	25(39.7%) ***
- Secondary school	8(13.1%)	47(37.9%)	27(44.3%)	20(31.8%)
- Bachelor degree/ higher	35(57.4%)	29(23.4%)	12(19.7%)	17(27.0%)
Income of family (Baths/month)				
- < 10,000	27(44.3 %)	90(72.6 %)*	42(68.9%) **	47(74.6%) ***
- > 10,000	34(55.7 %)	32(25.8 %)	17(27.9%)	15(23.8%)
Alcohol consumption	24(39.3%)	19(15.3%)*	11(18.0%) **	8(12.7%) ***
Smoking	7 (11.5%)	12 (9.7%)	7 (11.5%)	5(7.9%)
Health care and nutritional knowledge				
- Little	2(3.3%)	8 (6.5%)	5(8.2%)	3(4.8%)
- Fair	23(37.7%)	57(45.9%)	31(50.8%)	26(41.3%)
- Much	15(24.6%)	54(43.6)	22(36.0%)	32(50.8%)
- Very much	0 (0%)	2(1.6%)	1(1.6%)	1(1.6%)
Frequency of exercise				
- No	28(45.9%)	53(42.7%)	31(50.8%)	22(34.9%)
- 1-2 times/week	7(11.5%)	27(21.8%)	8(13.1%)	19(30.2%)
- 3-5 times/ week	12(19.7%)	22(17.7%)	10(16.4%)	12(19.0%)
- every day	10(16.4%)	18(14.5%)	9(14.8%)	9(14.3%)
Timing of exercise				
- > 20 minutes	4(6.6 %)	11(8.9%)	6(9.8%)	5(7.9%)
- 20-30 minutes	7 (11.5%)	32(25.8%)	10(16.4%)	22(34.9%)
- More than 30 minutes	17(27.9%)	25(20.2%)	11(18.0%)	14(22.2%)

[(1)] Categorical variables were compared by using a chi-square test.

* Significantly different from healthy group, $p < 0.001$.

** Significantly different from healthy group; $p < 0.001$ for education, $p = 0.03$ for income and $p = 0.013$ for drinking.

*** Significantly different from healthy group; $p = 0.02$ for education, $p < 0.001$ for income status and $p = 0.001$ for drinking.

4.2 Micronutrients status in HIV-infected and healthy subjects

4.2.1 Comparison of micronutrient status in HIV-infected and healthy subjects

The distribution of serum vitamin A, E, B12, zinc and selenium between HIV-infected and healthy subjects were shown in Figure 4.1. The comparison of micronutrients status in both groups was summarized in Table 4.5.

Serum vitamin A concentration

Mean serum vitamin A concentrations was not significant difference between HIV-infected and healthy subjects. Although, mean serum vitamin A concentrations in HIV group with CD4+ T cell counts < 200 cells/mm^3 was significant higher than in HIV group with ≥ 200 cells/mm3, however, the percentage of vitamin A deficiency in HIV group with the CD4 ≥ 200 cells/mm^3 was more than the CD4+ T cell counts < 200 cells/mm^3 (3.2% vs. 0%).

Serum vitamin E concentration

Mean of serum vitamin E was not significant difference between HIV-infected and healthy subjects but the percentage of deficiency in HIV-infected subjects were significant higher than the healthy group (21.1% vs. 8.3%). When HIV-infected subjects were divided into 2 groups by categories of CD4+ T cell counts (< 200 and ≥ 200 cells/mm^3). The results showed that there were no differences of mean serum vitamin E and the percentage of deficiency between the two groups.

Serum vitamin B12 concentration

Mean serum vitamin B12 concentrations was not significant difference between HIV-infected and healthy subjects, but the percentage of deficiency in HIV-infected subjects was 3.3% and none of the subjects were found in the healthy subjects. Similar results were also shown that in HIV group with CD4+ T cell counts < 200 and ≥ 200 cells/mm^3 the mean concentration was not significant difference.

Serum zinc concentration

Serum zinc level was also given similar results to those micronutrients described above. The mean concentration was not difference between HIV-infected and healthy subjects and also the group with CD4+ T cell counts < and ≥ 200 cells/mm^3. There was high prevalence of zinc deficiency in both HIV-infected and healthy subjects (17% vs. 23%). In addition, the percentage of deficiency was higher in group with CD4+ T cell counts < 200 than CD4+ T cell counts ≥ 200 cells/mm^3 (20% vs. 14.5%).

Serum selenium concentration

There was no significant difference in mean concentration of serum selenium and the percentage of deficiency between HIV-infected and healthy subjects and also similar results were observed in HIV groups with CD4+ T cell counts < 200 and ≥ 200 cells/mm^3.

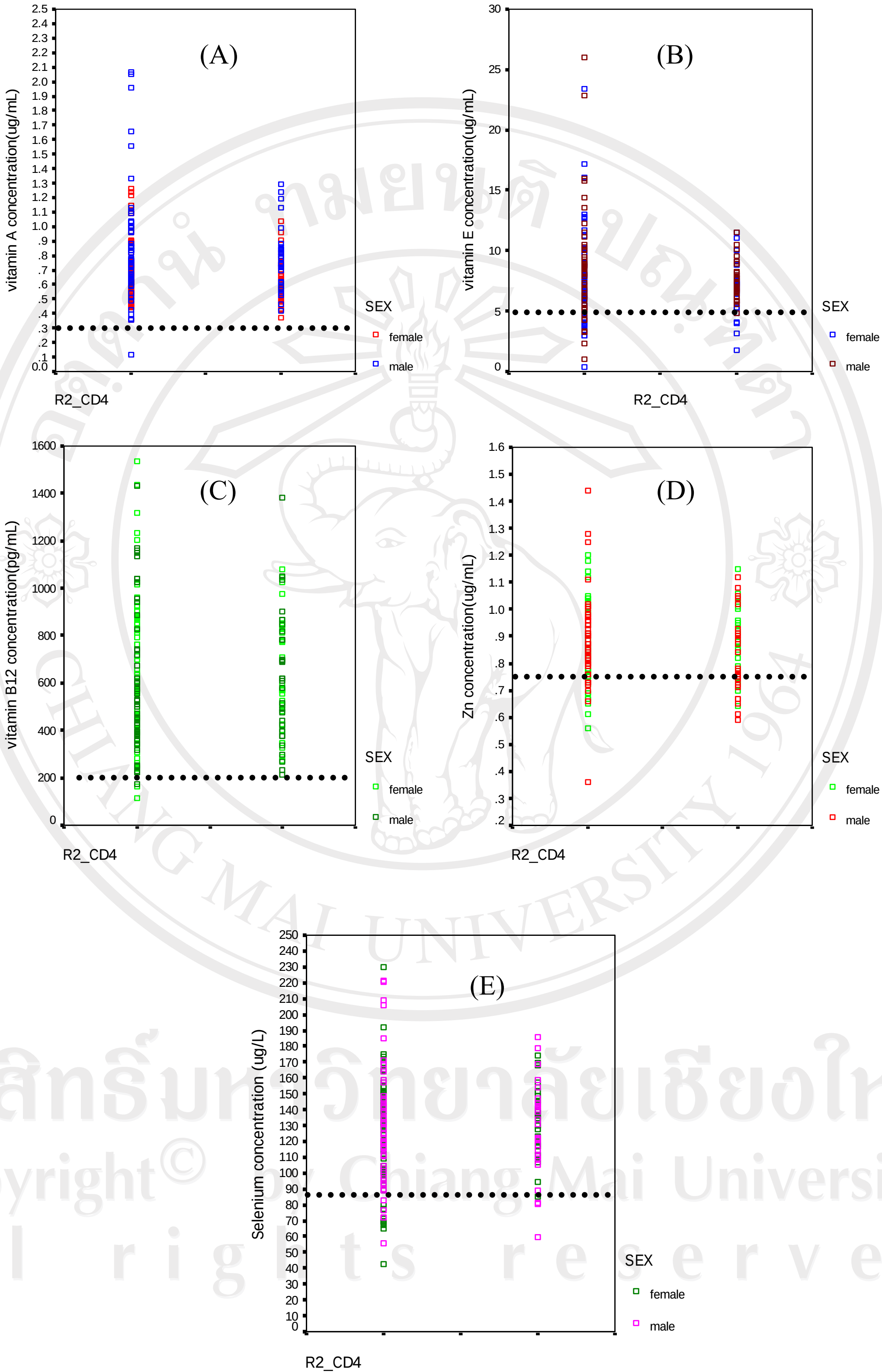

Figure 4.1 Distribution of serum vitamin A (A), vitamin E (B), vitamin B12(C), zinc(D) and selenium(E) concentrations in HIV-infected and healthy subjects

Table 4.5 Comparison of vitamin A, E, B12, zinc and selenium status in HIV-infected and healthy subjects

Micronutrients	Mean ± SD			
	Healthy subjects	Total HIV-infected subjects	HIV-infected subjects	
			CD4+ T cell counts < 200cells/mm^3	CD4 + T cell counts ≥ 200cells/mm^3
Serum vitamin A				
- Mean ± SD (µg/mL)	0.71 ± 0.21	0.76 ± 0.32	0.84 ± 0.37*	0.69 ± 0.24*
- % deficiency	0% (0/58)	1.7 % (2/121)	0% (0/59)	3.2% (2/62)
Serum vitamin E				
- Mean ± SD (µg/mL)	7.17 ±1.88	7.92 ± 4.12	8.05 ± 4.45	7.79 ± 3.81
- % deficiency	8.3% (5/60)	21.1% (26/123)	23% (14/61)	19.4% (12/62)
Serum vitamin B12				
- Mean ± SD (pg/mL)	624.12 ± 254.63	669.89 ± 436.72	700.75 ± 531.46	639.57 ± 318.98
- % deficiency	0% (0/59)	3.3% (4/123)	1.6% (1/61)	4.8% (3/62)

* Significantly difference, $p < 0.05$.

Table 4.5 (continued)

Micronutrients	Mean ± SD			
	Healthy subjects	Total HIV-infected subjects	HIV-infected subjects	
			CD4+ T cells < 200cells/mm^3	CD4 + T cells ≥ 200cells/mm^3
Serum Zinc				
- Mean ± SD (µg/mL)	0.86 ± 0.15	0.85 ± 0.14	0.85 ± 0.16	0.88 ± 0.15
- % deficiency	23.3% (14/60)	17.2% (21/122)	20.0% (12/60)	14.5% (9/62)
Serum Selenium				
- Mean ± SD (µg/L)	133.62 ± 25.35	135.29 ± 34.05	141.46 ± 39.17	130.05 ± 28.48
- % deficiency	4.9% (2/41)	6.8% (5/74)	5.9% (2/34)	7.5% (3/40)

4.2.2 Comparison of serum micronutrients status in HIV-infected and healthy subjects separated by gender

In general, the mean levels of the healthy subjects in both male and female groups were lower than the HIV-infected subjects but not significant difference. Only zinc level was significant higher in HIV-infected subjects than in the healthy group (Table 4.6). However, all micronutrients were within the normal range.

Table 4.6 Comparison of micronutrients status in HIV-infected and healthy subjects separated by gender

	Mean ± SD					
	Males			**Females**		
	HIV subjects	**healthy subjects**	***p***	**HIV subjects**	**Healthy subjects**	***p***
Vitamin A (µg/mL)	0.86 ± 0.40 (n = 54)	0.78 ± 0.22 (n = 30)	0.447	0.69 ± 0.20 (n = 67)	0.64 ± 0.17 (n = 28)	0.417
Vitamin E (µg/mL)	8.48 ± 4.61 (n = 55)	7.54 ± 1.56 (n = 30)	0.626	7.47 ± 3.66 (n = 68)	6.81 ± 2.11 (n = 30)	0.674
Vitamin B12 (µg/mL)	636.9 ± 466.9 (n = 56)	614.2±277.6 (n = 29)	0.607	679.4 ± 411.4 (n = 67)	633.8 ± 234.7 (n = 30)	0.779
Zinc (µg/mL)	0.88 ± 0.17 (n = 56)	0.82 ± 0.14 (n = 30)	0.037*	0.85 ± 0.14 (n = 66)	0.88 ± 0.12 (n = 30)	0.201
Selenium (µg/mL)	138.19 ± 36.59 (n = 33)	131.99 ± 32.58 (n = 18)	0.551	132.99 ± 32.13 (n = 41)	134.90 ± 18.54 (n = 23)	0.792

4.3 Correlations between CD4+ T cell counts and micronutrient concentrations

This study demonstrated that serum zinc concentration was weak positive correlated with CD4+ T cell counts (r = 0.211, p = 0.020), using the spearman correlation coefficient. Whereas there were no correlation between CD4+ T cell counts and vitamin A (r = - 0.152, p = 0.095), vitamin E (r = - 0.018, p = 0.846), vitamin B12 (r = 0.009, p = 0.925), and selenium (r = - 0.120, p = 0.186), respectively. The results were shown in Figure 4.2.

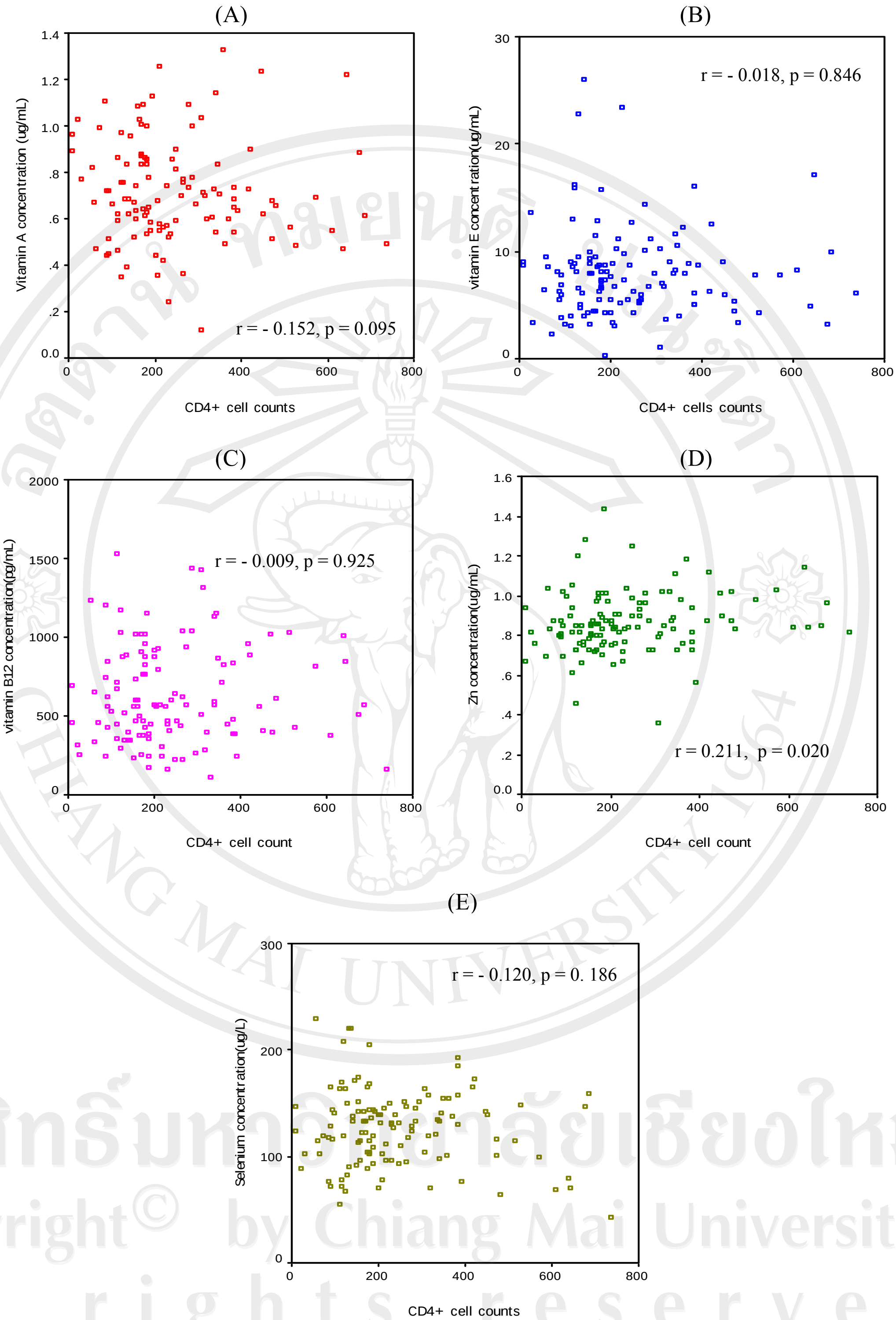

Figure 4.2 Correlation of CD4+ T cell counts with concentration of serum vitamin A (A), vitamin E (B), vitamin B12(C), zinc(D) and selenium(E)

4.4 Food consumption patterns of HIV-infected and healthy subjects

Food intake might influence serum micronutrient level. Therefore, we collected food frequency data recalled 7 days. Food consumption patterns were assessed by using food frequency questionnaire. 121 HIV-infected subjects and 61 healthy subjects were completed to interview the questionnaire about their frequency of consumption of each food source. The sources of food consisted of vitamin A, E, B12, zinc and selenium. Details of dietary patterns were shown in Appendix E. Top ten or top five of food items, which have rich source of each micronutrient and high frequency intake among HIV-infected and healthy subjects were demonstrated in Tables 4.7 to 4.16.

Food consumption pattern of vitamin A source was not different between HIV-infected and healthy subjects. Coriander had the highest score of frequency of intake in both groups. The second high score of the frequency intake was egg (Tables 4.7 and 4.8).

Food consumption pattern of vitamin E source in HIV-infected subjects was similar to that of healthy subjects. The highest score of frequency of vitamin E intake was vegetable oil consumption (Tables 4.9 and 4.10). For vitamin B12 consumption, the highest score was pork consumption and score of egg, chicken, liver and milk consumptions, respectively (Tables 4.11 and 4.12).

Food consumption pattern of zinc source was given similar results in HIV-infected and healthy subjects. The highest score of frequency of food zinc intake was pork item and fermented fish/shrimp paste, egg, chicken and soybean items, respectively (Tables 4.13 and 4.14).

Similar results were observed in food consumption pattern of selenium source, the high score was pork and egg consumption in both HIV-infected and healthy group (Tables 4.15 and 4.16).

4.5 Influence of food consumption pattern on micronutrients status of HIV-infected and healthy subjects

Table 4.17 shows mean score of micronutrient derived from frequency of food intake in HIV-infected and healthy subjects. There were no significantly difference of mean score of frequency intake for vitamin A, E, B12 and selenium but only scores of frequency zinc intake was significantly higher in HIV-infected subjects than that in healthy subjects. The all micronutrients level was not different in HIV-infected group with CD4+ T cell counts < 200 and ≥ 200 cells/mm^3.

Table 4.7 Food consumption pattern of rich source of vitamin A in HIV-infected subjects

Food sources	Frequency of intake (Times/week)										Total score	% of total score
	0		1 - 5		6 - 10		11 - 15		16 - 21			
	n	%	n	%	n	%	n	%	n	%		
Coriander	12	9.9	56	46.3	27	22.3	17	14.1	9	7.4	197	40.7
Egg	11	9.1	75	62	30	24.8	3	2.5	2	1.7	152	31.4
Holy basil	35	28.9	83	68.6	2	1.7	1	0.8	0	0	90	18.6
Cabbage	47	38.8	71	58.7	3	2.5	0	0	0	0	77	15.9
Cha-om	48	39.7	71	58.7	1	0.8	1	0.8	0	0	76	15.7
Convolvulus	46	38	74	61.2	1	0.8	0	0	0	0	76	15.7
Kale	51	42.2	68	56.2	2	1.7	0	0	0	0	72	14.9
Lvy gourd	55	45.5	66	54.6	0	0	0	0	0	0	66	13.6
Liver	65	53.7	53	43.8	3	2.5	0	0	0	0	59	12.2
Horse tamarind	66	54.6	52	43.0	2	1.7	1	0.8	0	0	59	12.2

Table 4.8 Food consumption pattern of rich source of vitamin A in healthy subjects

Food sources	Frequency of intake (Times/week)										Total score	% of total score
	0		1 - 5		6 - 10		11 - 15		16 - 21			
	n	%	n	%	n	%	n	%	n	%		
Coriander	3	4.9	24	39.3	19	31.2	7	11.5	8	13.1	115	47.1
Egg	4	6.6	41	67.2	13	21.3	3	4.9	0	0	76	31.2
Horse-tamarind	25	41	30	49.2	5	8.2	0	0	1	1.6	44	18
Holy basil	23	37.7	35	57.4	2	3.3	1	1.6	0	0	42	17.2
Convolvulus	26	42.6	31	50.8	4	6.6	0	0	0	0	39	16
Liver	28	45.9	30	49.2	2	3.3	1	1.6	0	0	37	15.2
Pepermint	25	41	36	59	0	0	0	0	0	0	36	14.8
Cabbage	26	42.6	34	55.7	1	1.6	0	0	0	0	36	14.8
Lvy gourd	28	45.9	32	52.5	1	1.6	0	0	0	0	34	13.9
Mustard, leaves	33	54.1	25	41	2	3.3	1	1.6	0	0	32	13.1

Table 4.9 Food consumption pattern of rich source of vitamin E in HIV-infected subjects

Food sources	Frequency of intake (Times/week)										Total score	% of total score
	0		1 - 5		6 - 10		11 - 15		16 - 21			
	n	%	n	%	n	%	n	%	n	%		
Vegetable oil	5	4.1	35	28.9	44	36.4	19	15.7	17	14.1	248	51.2
Mango (unripe)	27	22.3	69	57	21	17.4	2	1.7	1	0.8	121	25
Peanut	70	57.9	49	40.5	2	1.7	0	0	0	0	53	11
Broccoli	103	85.1	17	14.1	1	0.8	0	0	0	0	19	3.9
Spinach	109	90.1	10	8.3	2	1.7	0	0	0	0	14	2.9

Table 4.10 Food consumption pattern of rich source of vitamin E in healthy subjects

Food sources	Frequency of intake (Times/week)										Total score	% of total score
	0		1 - 5		6 - 10		11 - 15		16 - 21			
	n	%	n	%	n	%	n	%	n	%		
Vegetable oil	3	4.9	15	24.6	22	36.1	14	23	7	11.5	129	52.9
Mango (unripe)	25	41	31	50.8	5	8.2	0	0	0	0	41	16.8
Peanut	24	39.3	34	55.7	3	4.9	0	0	0	0	40	16.4
Spinach	52	85.3	9	14.8	0	0	0	0	0	0	9	3.7
Broccoli	54	88.5	7	11.5	0	0	0	0	0	0	7	2.9

Table 4.11 Food consumption pattern of rich source of vitamin B12 in HIV-infected subjects

Food sources	Frequency of intake (Times/week)										Total score	% of total score
	0		1 - 5		6 - 10		11 - 15		16 - 21			
	n	%	n	%	n	%	n	%	n	%		
Pork	3	2.5	31	25.6	32	26.5	32	26.5	23	19	283	58.5
Egg	11	9.1	75	62	30	24.8	3	2.5	2	1.7	152	31.4
Chicken	33	27.3	72	59.5	14	11.6	2	1.7	0	0	106	21.9
Liver	65	53.7	53	43.8	3	2.5	0	0	0	0	59	12.2
Beef	72	59.5	41	33.9	7	5.8	1	0.8	0	0	58	12
Milk	78	64.5	31	25.6	9	7.4	3	2.5	0	0	58	12
Grouper's walking catfish	87	71.9	33	27.3	0	0	1	0.8	0	0	36	7.4
Cereal	97	80.2	15	12.4	8	6.6	1	0.8	0	0	34	7
Yoghurt	93	76.9	25	20.7	3	2.5	0	0	0	0	31	6.4
Milk, powder	115	95	3	2.5	2	1.7	0	0	0	0	7	1.5

Table 4.12 Food consumption pattern of rich source of vitamin B12 in healthy subjects

Food sources	Frequency of intake (Times/week)										Total score	% of total score
	0		1 - 5		6 - 10		11 - 15		16 - 21			
	n	%	n	%	n	%	n	%	n	%		
Pork	0	0	19	31.2	18	29.5	8	13.1	16	26.2	143	58.6
Egg	4	6.6	41	67.2	13	21.3	3	4.9	0	0	76	31.2
Chicken	9	14.8	44	72.1	8	13.1	0	0	0	0	60	24.6
Milk	34	55.7	16	26.2	8	13.1	3	4.9	0	0	41	16.8
Liver	28	45.9	30	49.2	2	3.3	1	1.6	0	0	37	15.2
Beef	31	50.8	26	42.6	4	6.6	0	0	0	0	34	13.9
Grouper's walking catfish	44	72.1	16	26.2	1	1.6	0	0	0	0	18	7.4
Cereal	48	78.7	8	13.1	3	4.9	1	1.6	0	0	17	7
Yoghurt	48	78.7	11	18	2	3.3	0	0	0	0	15	6.2
Milk, powder	58	95.1	3	4.9	0	0	0	0	0	0	3	1.2

Table 4.13 Food consumption pattern of rich source of zinc in HIV-infected subjects

Food sources	Frequency of intake (Times/week)										Total score	% of total score
	0		1 - 5		6 - 10		11 - 15		16 - 21			
	n	%	n	%	n	%	n	%	n	%		
Pork	3	2.5	31	25.6	32	26.5	32	26.5	23	19	283	58.5
Fermented fish/shrimp paste	16	13.2	33	27.3	22	18.2	28	23.1	22	18.2	249	51.5
Egg	11	9.1	75	62	30	24.8	3	2.5	2	1.7	152	31.4
Chicken	33	27.3	72	59.5	14	11.6	2	1.7	0	0	106	21.9
Soybean	41	33.9	61	50.4	18	14.9	1	0.8	0	0	100	20.7
Mackerel	52	43	68	56.2	0	0	1	0.8	0	0	71	14.7
Liver	65	53.7	53	43.8	3	2.5	0	0	0	0	59	12.2
Beef	72	59.5	41	33.9	7	5.8	1	0.8	0	0	58	12
Milk	78	64.5	31	25.6	9	7.4	3	2.5	0	0	58	12
Peanut	70	57.9	49	40.5	2	1.7	0	0	0	0	53	11

Table 4.14 Food consumption pattern of rich source of zinc in healthy subject

Food sources	Frequency of intake (Times/week)										Total score	% of total score
	0		1 - 5		6 - 10		11 - 15		16 - 21			
	n	%	n	%	n	%	n	%	n	%		
Pork	0	0	19	31.2	18	29.5	8	13.1	16	26.2	143	58.6
Fermented fish/Shrimp paste	9	14.8	18	29.5	15	24.6	9	14.8	10	16.4	115	47.1
Egg	4	6.6	41	67.2	13	21.3	3	4.9	0	0	76	31.2
Soybean	18	29.5	31	50.8	7	11.5	4	6.6	1	1.6	61	25
Chicken	9	14.8	44	72.1	8	13.1	0	0	0	0	60	24.6
Milk	34	55.7	16	26.2	8	13.1	3	4.9	0	0	41	16.8
Peanut	24	39.3	34	55.7	3	4.9	0	0	0	0	40	16.4
Liver	28	45.9	30	49.2	2	3.3	1	1.6	0	0	37	15.2
Beef	31	50.8	26	42.6	4	6.6	0	0	0	0	34	13.9
Sesame seed	39	63.9	22	36.1	0	0	0	0	0	0	22	9

Table 4.15 Food consumption pattern of rich source of selenium in HIV-infected subjects

Food sources	Frequency of intake (Times/week)										Total score	% of total score
	0		1 - 5		6 - 10		11 - 15		16 - 21			
	n	%	n	%	n	%	n	%	n	%		
Pork	3	2.5	31	25.6	32	26.5	32	26	23	19	283	58.5
Egg	11	9.1	75	62	30	24.8	3	2.5	2	1.7	152	31.4
Chicken	33	27.3	72	59.5	14	11.6	2	1.7	0	0	106	21.9
Beef	72	59.5	41	33.9	7	5.8	1	0.8	0	0	58	12
Milk	78	64.5	31	25.6	9	7.4	3	2.5	0	0	58	12
Peanut	70	57.9	49	40.5	2	1.7	0	0	0	0	53	11
Grouper's walking catfish	87	71.9	33	27.3	0	0	1	0.8	0	0	36	7.4
Cereal	97	80.2	15	12.4	8	6.6	1	0.8	0	0	34	7
Broccoli	103	85.1	17	14.1	1	0.8	0	0	0	0	19	3.9

Table 4.16 Food consumption pattern of rich source of selenium in healthy subjects

Food sources	Frequency of intake (Times/week)										Total score	% of total score
	0		1 - 5		6 - 10		11 - 15		16 - 21			
	n	%	n	%	n	%	n	%	n	%		
Pork	0	0	19	31.2	18	29.5	8	13	16	26	143	58.6
Egg	4	6.6	41	67.2	13	21.3	3	4.9	0	0	76	31.2
Grouper's walking catfish	9	14.8	44	72.1	8	13.1	0	0	0	0	60	24.6
Milk	34	55.7	16	26.2	8	13.1	3	4.9	0	0	41	16.8
Peanut	24	39.3	34	55.7	3	4.9	0	0	0	0	40	16.4
Beef	31	50.8	26	42.6	4	6.6	0	0	0	0	34	13.9
Chicken	44	72.1	16	26.2	1	1.6	0	0	0	0	18	7.4
Cereal	48	78.7	8	13.1	3	4.9	1	1.6	0	0	17	7
Broccoli	54	88.5	7	11.5	0	0	0	0	0	0	7	2.9

Table 4.17 Comparison of the mean scores of micronutrients derived from frequency of food intake between HIV-infected and healthy subjects

Micronutrients	Mean ± SD (Scores/week)			
	Healthy subjects (n = 61)	HIV-infected subject		
		Total subjects (n = 121)	CD4+ T cell counts < 200cells/mm^3 (n = 59)	CD4+ T cell counts ≥ 200cells/mm^3 (n = 62)
Vitamin A	12.58 ± 5.47	11.75 ± 4.14	11.20 ± 4.78	11.51 ± 3.44
Vitamin E	18.52 ± 7.38	18.80 ± 7.47	18.73 ± 7.97	18.87 ± 7.04
Vitamin B12	18.20 ± 6.09	17.00 ± 5.95	17.25 ± 6.87	16.77 ± 4.97
Zinc	17.77 ± 5.14*	15.86 ± 4.50*	16.53 ± 5.32	15.23 ± 3.47
Selenium	19.85 ± 6.47	18.34 ± 6.64	18.79 ± 7.69	17.92 ± 5.48

* Significant difference between groups (Asymp. Sig. 2-tail), when compared by Mann-Whitney U test.

4.6 Influence of BMI, education, income status and alcohol consumption on micronutrients status of HIV-infected and healthy subjects

According to the characteristics and demographics data presented in Table 4.3 and Table 4.4; there were significantly difference of BMI, education, income and alcohol consumption between HIV-infected and healthy subjects.

BMI in HIV group was significant lower than in the healthy group. BMI might be influenced on micronutrient status. Therefore, this study was classified the subjects into 4 groups which consisted of BMI <18.5, 18.5-22.9, 23-24.9 and ≥ 25 kg/m2. There were no significantly difference in mean of all micronutrients between HIV-infected and healthy subjects in all categories (Table 4.18). Therefore, BMI had no influence on micronutrients status.

Similarly, no significant different of all mean serum micronutrients between HIV-infected and healthy subjects when the subjects were classified by education; primary, secondary and bachelor degree or higher level (Table 4.19).

Table 4.20 showed the influence of income status on micronutrients. The subjects were divided into 2 groups (income status ≤ 10,000 and >10,000 Baths/month). The results also showed no significant difference of the mean serum micronutrients between HIV-infected and healthy subjects.

Table 4.21 showed the influence of alcohol consumption on micronutrients. Alcohol consumption defined as drink and not drink in the pass week. Our data showed no significant difference between HIV-infected and healthy subjects in all micronutrients level.

Table 4.18 Comparison of micronutrients status between HIV-infected and healthy subjects separated by BMI

	BMI < 18.5 kg/m^2 Thin		p	BMI 18.5 - 22.9 kg/m^2 Normal		p	BMI 23 - 24.9 kg/m^2 Overweight		p	BMI 25 - 30 kg/m^2 Obesity		p
	HIV	Control		HIV	Control		HIV	Control		HIV	Control	
Vitamin A (µg/mL)	0.61 ± 0.20 (n = 16)	0.71 ± 0.22 (n = 3)	0.434	0.75 ± 0.30 (n = 77)	0.67 ± 0.20 (n = 26)	0.224	0.89 ± 0.38 (n = 16)	0.74 ± 0.19 (n = 15)	0.343	0.93 ± 0.42 (n = 10)	0.77 ± 0.24 (n =14)	0.292
Vitamin E (µg/mL)	5.63 ± 1.87	6.70 ± 1.26	0.219	8.04 ± 4.12	7.01 ± 2.23	0.431	8.46 ± 4.29	7.46 ± 2.10	0.418	9.95 ± 5.41 (n = 11)	7.26 ± 1.01 (n = 16)	0.068
Vitamin B12 (pg/mL)	817.19 ± 728.74	637.67 ± 116.96	0.791	655.62 ± 386.46	581.30 ± 266.22	0.524	661.81 ± 261.05	632.66 ± 235.26	0.752	503.41 ± 294.32 (n = 11)	683.68 ± 275.16 (n = 16)	0.116
Zinc (µg/mL)	0.85 ± 0.11	0.87 ± 0.08	0.560	0.87 ± 0.15	0.86 ± 0.13	0.834	0.87 ± 0.08	0.87 ± 0.16	0.771	0.82 ± 0.15 (n = 11)	0.80 ± 0.12 (n = 16)	0.724
Selenium (µg/L)	112.73 ± 32.16	148.61 ± 32.16	0.087	138.93 ± 32.76 (n = 43)	139.50 ± 21.97 (n = 15)	0.951	152.76 ± 33.37	129.47 ± 16.52	0.056	140.89 ± 31.84	126.04 ± 36.47	0.439

Table 4.19 Comparison of micronutrients status between HIV-infected and healthy subjects separated by education

	Primary school		*p*	Secondary school		*p*	Bachelor degree		*p*
	HIV	Control		HIV	Control		HIV	Control	
Vitamin A (µg/mL)	0.77 ± 0.34 (n = 43)	0.70 ± 0.17 (n = 15)	0.749	0.75 ± 0.33 (n = 47)	0.85 ± 0.27 (n = 8)	0.214	0.77 ± 0.28 (n = 28)	0.68 ± 0.19 (n = 35)	0.151
Vitamin E (µg/mL)	7.98 ± 4.71 (n = 45)	6.71 ± 1.84 (n = 18)	0.308	8.12 ± 4.35 (n = 47)	7.52 ± 2.06 (n = 7)	0.908	7.22 ± 2.59 (n = 28)	7.34 ± 1.87 (n = 35)	0.826
Vitamin B12 (pg/mL)	691.22 ± 504.03	677.20 ± 247.25	0.479	696.35 ± 457.86 (n = 46)	481.09 ± 179.99 (n = 8)	0.273	600.87 ± 286.92 (n = 29)	629.84 ± 266.86 (n = 33)	0.682
Zinc (µg/mL)	0.85 ± 0.17 (n = 43)	0.82 ± 0.13 (n =18)	0.445	0.86 ± 0.14 (n = 47)	0.84 ± 0.12 (n = 8)	0.990	0.87 ± 0.12 (n = 29)	0.87 ± 0.14 (n = 34)	0.864
Selenium (µg/L)	124.10 ± 38.07 (n = 45)	126.01 ± 26.89 (n = 17)	0.851	131.35 ± 34.11 (n = 47)	137.18 ± 31.71 (n = 7)	0.672	123.83 ± 35.18 (n = 28)	131.01 ± 23.82 (n = 33)	0.348

Table 4.20 Comparison of micronutrients status between HIV-infected and healthy subjects separated income status

	Income < 10,000 Baths/months			Income ≥ 10,000 Baths/months		
	HIV	**Control**	***p***	**HIV**	**Control**	***p***
Vitamin A (µg/mL)	0.76 ± 0.35 (n = 87)	0.75 ± 0.23 (n = 24)	0.662	0.77 ± 0.25 (n = 31)	0.68 ± 0.19 (n = 34)	0.119
Vitamin E (µg/mL)	8.08 ± 4.49 (n = 88)	6.89 ± 1.80 (n = 26)	0.358	7.25 ± 2.97 (n = 32)	7.39 ± 1.93 (n = 34)	0.824
Vitamin B12 (pg/mL)	669.52 ± 485.52 (n = 88)	594.13 ± 286.53 (n = 26)	0.764	676.38 ± 289.50 (n = 32)	647.75 ± 228.18 (n = 26)	0.659
Zinc (µg/mL)	0.85 ± 0.14 (n = 87)	0.81 ± 0.13 (n = 27)	0.128	0.87 ± 0.16 (n = 32)	0.88 ± 0.13 (n = 33)	0.868
Selenium (µg/L)	133.76 ± 35.44 (n = 87)	127.07 ± 31.40 (n =16)	0.499	141.66 ± 30.14 (n = 18)	137.81 ± 20.18 (n = 25)	0.618

Table 4.21 Comparison of micronutrients status between HIV-infected and healthy subjects separated alcohol consumption status

	Drinker			Non-Drinker		
	HIV	**Control**	***p***	**HIV**	**Control**	***p***
Vitamin A (µg/mL)	0.86 ± 0.531 (n =18)	0.81 ± 0.20 (n = 23)	0.431	0.75 ± 0.27 (n = 100)	0.65 ± 0.19 (n = 35)	0.052
Vitamin E (µg/mL)	7.57 ± 3.24 (n = 18)	7.19 ± 1.44 (n = 24)	0.608	7.91 ± 4.30 (n = 102)	7.16 ± 2.14 (n = 36)	0.837
Vitamin B12 (pg/mL)	636.51 ± 366.41 (n = 19)	642.29 ± 254.97 (n = 23)	0.511	677.90 ± 454.57 (n = 101)	612.51 ± 257.33 (n = 36)	0.826
Zinc (µg/mL)	0.81 ± 0.19 (n = 19)	0.84 ± 0.16 (n = 23)	0.919	0.87 ± 0.13 (n = 100)	0.86 ± 0.12 (n = 37)	0.754
Selenium (µg/L)	143.65 ± 40.30 (n = 15)	130.02 ± 29.69 (n = 16)	0.290	133.65 ± 32.43 (n = 57)	135.93 ± 22.49 (n = 25)	0.751

Duration time of using GPO-vir might also influence micronutrient status. Our HIV-infected subjects were treated GPO-vir with ranged from 1 month to 8 years. We divided HIV group according to the median of time using GPO-vir (1.42 years). Our results indicated in group GPO-vir ≤ 1.42 years, serum vitamin A level was significantly higher in CD4+ T cell counts < 200 cells/mm^3 than group with CD4+ T cell counts ≥ 200 cells/mm^3. The other micronutrients levels were not different in the group with CD4+ T cell counts < 200 and ≥ 200 cells/mm^3. However, the percentage of micronutrients deficiency in group with CD4+ T cell counts ≥ 200 cells/mm^3 was more than group with CD4+ T cell counts > 200 cells/mm^3.

In group with GPO-vir > 1.42 years, the mean concentrations of all micronutrients were not significantly difference between subjects in group with CD4+ T cell counts < 200 and ≥ 200 cells/mm^3. The percentage of micronutrient deficiency seemed to be lower in the group with CD4+ T cell counts ≥ 200 cells/mm^3 compared to the group with GPO-vir < 1.42 years. The results were shown in Table 4.22.

Table 4.22 Comparison of micronutrients status between HIV group with CD4+ T cell count < 200 and ≥ 200 cells/mm^3 separated by time of using GPO-vir

Micronutrients	Time of using GPO-vir ≤ 1.42 years		*p*	Time of using GPO-vir > 1.42 years		*p*
	CD4 < 200	CD4 ≥ 200		CD4 < 200	CD4 ≥ 200	
Serum vitamin A - Mean ± SD (µg/mL) - % deficiency (n/total)	0.86 ± 0.43 0% (0/39)	0.64 ± 0.24 4.5% (1/22)	**0.023**	0.80 ± 0.22 0% (0/17)	0.72 ± 0.24 2.6% (1/39)	0.263
Serum vitamin E - Mean ± SD (µg/mL) - % deficiency (n/total)	8.05 ± 4.87 24.4% (10/41)	7.38 ± 3.57 33.3% (5/22)	0.920	7.67 ± 3.67 23.5% (4/17)	7.38 ± 4.0 17.9% (7/39)	0.824
Serum vitamin B12 - Mean ± SD (pg/mL) - % deficiency (n/total)	755.31 ± 611.37 2.4% (1/41)	613.34 ± 361.53 9.5% (2/21)	0.480	577.28 ± 301.81 0%	655.06 ± 302.28 2.5% (1/40)	0.355
Serum zinc - Mean ± SD (µg/mL) - % deficiency (n/total)	0.84 ± 0.15 20.0% (8/40)	0.83 ± 0.17 22.7% (5/22)	0.947	0.84 ± 0.11 23.5% (4/17)	0.90 ± 0.13 10.3% (4/39)	0.096
Serum Selenium - Mean ± SD (µg/mL) - % deficiency (n/total)	148.02 ± 45.40 9.1% (2/22)	120.67 ± 32.57 15.4% (2/13)	0.052	133.46 ± 18.91 0%	134.17 ± 26.15 3.8% (1/26)	0.938

Remark: Median of time of using GPO-vir = 1.42 years**.**