人類生態班

Health Status of Reproductive -age Females in Rural Laos from the Perspective of Anthropometry and Hemoglobin Level.

Kazumi Natsuhara[1], Nobuko Murayama[2], Satoshi Sasak[3], Sengchanh Kounnavong[4], Khampheng Phonglusa[4], Dalaphone Sithideth[4]

[1] Department of nursing, Fukuoka Prefectural University, Fukuoka, Japan
[2] Niigata University of Health and Welfare, Niigata, Japan
[3] National Institute of Health and Nutrition, Tokyo, Japan
[4] National Institute of Public Health, Vientiane, Lao P.D.R.

Abstract

The objectives of this study are to elucidate 1) the health status and its' seasonal variation of reproductive age female villagers in Lahanam zone, Sonkhon district, Savannakhet province of Lao PDR, and 2) the relevant factors in relation to socioeconomic characteristics of their households. Data of the present study were collected in rainy season between 7th and 25th August 2005, and in dry season between 6th and 13th February 2006, based on the authors' field research in five villages. Randomly selected 113 females, 20 to 40 years old, were studied in 2005; rainy season. Within 113 subjects of rainy season survey, 29 subjects were excluded; the person who were pregnant and breast feeding, moved to other place, thus 84 females were studied in 2006; dry season. Measurements were done for anthropometric variables, hemoglobin level, blood pressure, resting metabolic rate (RMR), and difference between two seasons were calculated. Socioeconomic characteristics of the subjects were obtained by village health volunteers, using structured interviews.

From the results of the anthropometric measurements and hemoglobin level, it can be said that the nutritional statuses of the five villagers were better than that of females in the national survey. Furthermore, the percentages of the overweight (BMI over 25) of the present study (16.8% in rainy season and 22.6% in dry season) were higher than the result of adult females in national survey (10.8％). It should be noted that the problems of undernutrition and overnutrition occur in the same village at same time, similarly to a modernizing populations in other developing countries. Among socioeconomic characteristics, the environmental factors such as area of irrigated rice field, and the main sources of the foods played important roles for the health status of the subjects in rural village in the Sonkhon district.

Introduction

Many Asian countries have experienced health transition; decrease of infectious diseases, increase of non-infectious diseases, changes in health-seeking behaviors, and nutritional transition; changes of diet and nutrient intake, reduction of physical activities, changes in body size and composition, in parallel with the post-World War II development. Health status of people in Lao PDR is improving, similarly to many populations in other Asian countries, though their degrees of change and content vary according to the situations and circumstances such as degrees of immediate environmental change and modernization. For example, the maternal mortality ratio decreased from 656 in 1995 to 530 per 100,000 live birth in the year 2000 country as a whole, though it is still high compare to the neighbor countries (UNDP 2005) and data of areas show large difference between that of urban and rural (170 in urban, 580 in rural) (NIOPH, 2001). Another example is that the percentage of

overweight and obesity (BMI>25) was higher in urban area (13.1%) than rural (5.8%) and there was regional difference; it was higher in Central (11.9%) than North (6.0%) and South (6.8%) (NIOPH, 2001). As mentioned above, there are still large gaps of health status among rural communities, which should be diminished in the near future.

Of many aspects of lifestyle, the dietary pattern is recognized as a principal cause of change in disease patterns (WHO, 1990). It has been reported that alteration of dietary pattern and the subsequent health status through modernization depends on the people's socioeconomic and/or cultural characteristics and behavioral patterns (Dressler et al., 1987; Ulijaszek, 2001; Villela and Palinkas, 2000), and thus the changing process differs not only from area to area but also from community to community and even from household to household. Based on the authors' field research in five communities (villages) in the Sonkhon district of Lao PDR, this study aims to elucidate 1) the villagers' health status measured in the anthropometric variables, hemoglobin level and seasonal variations of these variables between rainy season and dry season, and 2) the relevant factors in relation to socioeconomic characteristics of their households.

Subjects and Method

Period of field research: Data of the present study were collected in rainy season between 7th and 25th August 2005, and in dry season between 6th and 13th February 2006.

Background: The subjects of the present study were inhabitants of five villages, i.e. Lahanam thong, Lahanam tha, Thakhamlian, Dongbang, Kockphok in Lahanam zone, Sonkhon district, Savannakhet province, Lao PDR (Fig.1). Tuktuk (public motor vehicles) are available between Lahanam zone and Pakson, the nearest small town, though villagers have to walk or take a boat ride depending on road conditions to get to the town in rainy-season. Regarding stores in the villages, there were not in Kockphok and small and occasionally opened ones in Dongbang, but several well-equipped ones in Lahanamthong, Lahanamtha, Thakhamlian; weather permitting, there is a morning market near these three villages.

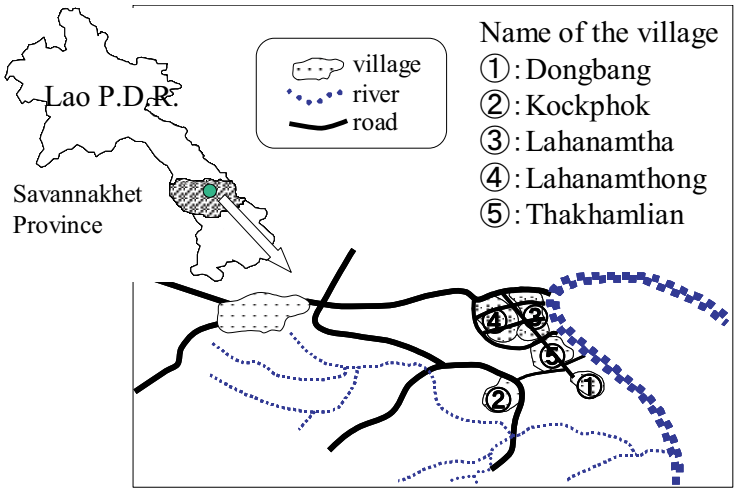

Figure 1. The Location of Savannakhet Province and Five Study Sites.

Subjects: The total number of females aged over 20 years old to 40 years old was 197, 121, 80, 81, 37 in Lahanamthong, Lahanamtha, Thakhamlian, Dongbang, Kockphok, respectively (Census by Health Development Study in Lao P.D.R.) Of them, 42 from Lahanam thong, 35 from Lahanam tha, 12 from Thakamlian, 12 from Dongbang, 12 from Kockphok were selected randomly from different households.

1) Subjects 2005; rainy season: 113 females, 20 to 40 years old were studied

2) Subjects 2006; dry season: Within 113 subjects of rainy season study, 29 subjects were excluded; the person who are pregnant and breast feeding, moved to other place, thus 84 females were studied. The numbers of subjects were 33 from Lahanamthong, 27 from Lahanamtha, 8 from Thakhamlian, 7 from Dongbang, 9 from Kockphok.

Methods

1) Anthropometry: Anthropometric measurements for height, weight, and upper arm circumference were made, using the standard methods (Lohman et al., 1991), and skinfold thicknesses at triceps and subscapular were measured with Holtain calipers. Body Fat scale (TANITA BC-521) was used to measure body fat percentage. Body mass index (BMI) was calculated by dividing body weight (kg) by squared height (m2). Waist and hip circumferences were measured using a standard measurement tape, to the nearest half-centimeter. The waist girth was defined as the minimum circumference between the umbilicus and xiphoid processes at the horizontal level, while hip girth was measured at the maximum circumference around the buttocks posteriorly at the horizontal level. Waist-hip ratio (waist/hip) was calculated by dividing waist circumference (cm) by hip circumference (cm). Seasonal differences between 2005 rainy season survey and 2006 dry season survey were calculated by subtract data of 2005 from data of 2006; same calculation applied to hemoglobin level.

2) Blood pressure: Blood pressure (BP) was measured twice for the subjects at the sitting position, using an electronic digital sphygmomanometer (Omron HEM-757), and the lower value of the measurements was used for analysis

3) Hemoglobin level: Blood hemoglobin level was measured by well trained nurse, using a Hemoglobin monitoring instrument (HemoQue201+).

4) Resting Metabolic Rate (RMR): A Metabolimeter (CORTEX Biophysik MetaLyzer) was used to measure the resting metabolic rate for the subjects of 2005 rainy season survey. Because of a power cut, the measurement could not complete all the subjects. Numbers of Subjects were 7, 6, 21, 28, 7, for Dongbang, Kockphok, Lahanamtha, Lahanamthong, Thakhamlian, respectively.

5) Socioeconomic characteristics: Structured interview was done by well trained Laotian village health volunteers to obtain the information about occupation, working experience in outside of the village, main source of household's income, Radio/TV/Newspaper possession or use, latrine possession and use, water resource and use, animal husbandry, housing condition, land use and food productivity.

6) Medical examination: Laotian physician did medical examination to see if the subject could be involved in the study.

Statistical analyses: Data were analyzed using the SAS program package 9.1. Significance level was set at 0.05. To compare the mean values of different groups, ANOVA and Kruskal Wallis tests were applied. The Spearman correlation analysis was conducted to obtain the correlation matrices between health indicators and socioeconomic characteristics.

Results

Socioeconomic Characteristics: Marital Status, Occupation, Working Experience (Outside of the Village) and Socioeconomic Characteristics of Five Villagers are shown in Table 1. Most of the subjects were farmer, though the half of the subjects from Lahanamthong lived in other subsistence or other roles in their households. Within 113 subjects, 81 subjects possessed a radio and 76 subjects had television. In contrast to the possession of durable consumer goods, almost half the subjects' households had no toilet facility. Table 2 shows the means and standard deviations of age, number of child and family, and socioeconomic characteristic of five villagers. With the exception of a few households (one from Lahanamthong, one from Lahanamtha), almost all subjects'

Table 1. Marital Status, Occupation, Working Experience (Outside of the Village) and Socioeconomic Characteristics of Five Villagers

		Dongbang	Kockphok	Lahanamtha	Lahanamthong	Thakamlian	Total	
2005 Number of Subjects		12	12	35	42	12	113	
Marital Status	Married	9	8	29	28	8	82	
	Not Married	3	4	6	14	4	31	
Occupation	Farmer	8	11	29	21	10	79	**
	Other	4	1	6	21	2	34	
Working Experience Outside of the Village	Yes	1	3	8	13	2	27	
	No	11	9	27	29	10	86	
Radio	Yes	6	10	27	31	7	81	
	No	6	2	8	11	5	32	
Newspaper	Yes	2	0	1	5	2	10	
	No	10	12	34	37	10	103	
TV	Yes	5	5	26	31	9	76	
	No	7	7	9	11	3	37	
Main Source of Income	Rice	9	11	33	37	10	100	
	Other	3	1	2	5	2	13	
Toilet Facility	Flush to Sewage or Septic Tank	0	0	0	0	1	1	***
	Pour Flush	0	2	19	31	4	56	
	No Facilities	12	10	16	11	7	56	
Paddy Cultivation	Yes	12	12	34	40	12	110	
	No	0	0	1	2	0	3	
Irrigated Rice Cultivation	Yes	5	3	23	28	7	66	
	No	7	9	12	14	5	47	
Upland Rice Cultivation	Yes	1	0	1	3	1	6	
	No	11	12	34	39	11	107	
Experience of Rice Shortage	Yes	7	6	8	13	2	36	
	No	5	6	27	29	10	77	
Cooking Fuel[1]	Charcoal	3	4	10	13	6	36	
	Wood	4	4	16	17	2	43	
	Improved Stove, Charcoal & Wood	0	1	1	3	0	5	

1.The Number of Subjects were 7, 9, 27, 33, 8 for Dongbang, Kockphok, Lahanamtha, Lahanamthong, Thakhamlian, respectively.
** Significantly different between village at p<0.01; *** p<0.001.

Table 2. Means of Socioeconomic Characteristic of Five Villagers

	Dongbang	Kockphok	Lahanamtha	Lahanamthong	Thakamlian	Total	
Number of Subjects 2005	12	12	35	42	12	113	
Number of Subjects 2006	7	9	27	33	8	84	
Age	24.8 ± 3.9	25.5 ± 4.9	27.9 ± 5.2	24.2 ± 3.2	25.5 ± 3.1	25.7 ± 4.4	*
Number of Child	1.3 ± 0.8	2 ± 1.6	1.9 ± 1.4	1.2 ± 1.1	1.2 ± 1	1.5 ± 1.3	
Number of Family	5.3 ± 1.9	6.3 ± 2.6	6.7 ± 2.7	6.6 ± 2.4	6 ± 2.6	6.4 ± 2.5	
Number of Poultry	22.4 ± 19	12.8 ± 10.2	16.4 ± 18.9	29.4 ± 91	9.1 ± 6.9	20.7 ± 57	
Number of Pig	0.7 ± 1	0.3 ± 0.6	0.9 ± 1.2	1.2 ± 2.6	0.5 ± 0.8	0.9 ± 1.8	
Number of Cattle	3.1 ± 3.4	6.1 ± 5.4	3.8 ± 4.7	4 ± 4.8	6 ± 8.5	4.3 ± 5.2	
Number of Goat and Sheep	1 ± 2.9	1 ± 2.7	1.5 ± 3	1 ± 3	0.8 ± 1.9	1.1 ± 2.8	
Paddy Field (ha)	1.3 ± 0.7	2.8 ± 2.4	2 ± 1	2.3 ± 1.7	2 ± 1.4	2.1 ± 1.5	
Irrigated Rice Field (ha)	0.3 ± 0.4	1.2 ± 2.7	1.3 ± 1.1	1.6 ± 1.7	0.8 ± 0.8	1.3 ± 1.5	*
Upland Rice Field (ha)	0 ± 0.1	0 ± 0	0 ± 0.2	0.1 ± 0.3	0 ± 0.1	0 ± 0.2	
Rice Shortage (Month)	2.5 ± 3.8	1 ± 1.2	0.6 ± 1.2	1.2 ± 2.8	0.2 ± 0.4	1 ± 2.3	
Time to Water (minute)	9.3 ± 8.5	3.8 ± 5.8	9.5 ± 8.7	6.6 ± 6.5	3.3 ± 2.8	7.1 ± 7.4	*
Household income/month (kip)	354285 ± 318269	116666 ± 55901	214629 ± 113008	256875 ± 225938	297500 ± 315175	240060 ± 207303	
Household Income/Month/Number of Family (kip)	84370 ± 82817	24537 ± 22427	41825 ± 30244	45585 ± 44635	61220 ± 78739	46857 ± 48242	
Household Income/Month/Number of Adults (kip)	155500 ± 173085	40231 ± 27081	71206 ± 61273	62041 ± 55272	77991 ± 76245	72088 ± 76678	

* Significantly different between villages at p<0.05.

households cultivate rice, though the area under cultivation varied by household and type of rice field. The mean area of the irrigated rice field was significantly different between village: larger in Lahanamthong and smaller in Dongbang then other villages. The length of rice shortage was negatively correlated with the area of the irrigated rice (Spearman r = -0.23, p=0.017), though data are not shown.

Main source of fruits and vegetables, fish, and drinking water in rainy season 2005 and dry season 2006

were shown in figure 3, 4, 5, respectively. Almost all subjects' main source of meet was market. There were seasonal differences of sources of foods and water between villages, and between seasons.

Anthropometric measurements, hemoglobin level, resting metabolic rate (RMR), and blood pressures: Table 3 shows the means and standard deviations of anthropometric measurements, hemoglobin level, RMR, and blood pressures of the subjects in the five villages in 2005 survey and 2006 survey by village. Mean of RMR was significantly different between villages: higher in Kockphok and lower in Dongbang than other villages, and RMR/weight showed similar tendencies, though difference between villages was not significant. Waist and Waist-hip ratio were the lowest in Lahanamthong and the highest in Kockphok, and differences between villages were significant. Both systolic (SBP) and diastolic blood pressure (DBP) were significantly different between villages; highest in Lahanamtha and lowest in Kockphok. There was no hypertension subject; the cut-off points of hypertension were 90mmHg for DBP and 140mmHg for SBP.

Table 3. Means of Anthropometric mesurements and Hemoglobin Level of Five Villagers in 2005 and 2006

		Dongbang	Kockphok	Lahanamtha	Lahanamthong	Thakhamlian	Total	
	Number of Subjects 2005	12	12	35	42	12	113	
	Number of Subjects 2006	7	9	27	33	8	84	
2005	Height (cm)	152.3±4	151.5±6	152.4±4.9	151.2±5.3	152.8±5.7	151.9±5.1	
	Weight (Kg)	50.7±7.2	53.2±9.1	52.5±9.8	48.7±8.9	52±8.3	50.9±9	
	Body Fat Percentage (%)	31.1±5.2	33.8±6.6	31.9±7	31.1±5.5	32.8±5.5	31.8±6.1	
	Body Mass Index	21.8±2.8	23.2±4.4	22.6±4	21.3±3.5	22.3±3.2	22.1±3.7	
	Upper Arm Circumference	26.4±2.5	27.4±3.9	26.4±3.2	25.3±3.1	26.6±3	26.1±3.2	
	Triceps	19.9±7.1	18.1±7.8	19.1±8.3	18.6±7.5	21.4±6	19.1±7.5	
	Subscapular	25.3±7.6	25.1±8.2	24.7±9.9	23.8±8	25.9±6.6	24.6±8.4	
	Hemoglobin (g/dL)	12.9±1.5	11.8±1.6	12.3±1.1	11.9±1.7	11.7±2.4	12.1±1.6	
	Resting Metabolic Rate[1]	1194±277.2	1643.5±387.2	1428.5±323	1249.6±295.6	1309.1±345.5	1338.7±331.6	*
	Resting Metabolic Rate/Weight[1]	24.6±4	30.5±6.5	28.1±7.6	25.2±6.2	25±7.1	26.5±6.7	
2006	Height (cm)	153.7±4	151.3±6.6	151.7±4.8	150.9±5.6	153.6±6	151.7±5.3	
	Weight (Kg)	54.2±10.4	56.6±11.1	54.1±10.8	48.9±9.4	54.5±10.3	52.4±10.4	
	Body Fat Percentage (%)	33.8±5.8	34.9±7.3	32.9±7.4	31.6±5.6	34.4±5.6	32.8±6.4	
	Body Mass Index	23±4.3	24.7±4.8	23.5±4.4	21.4±3.6	23±3.7	22.7±4.1	
	Upper Arm Circumference (cm)	26.7±3	28.6±4.2	27.0±3.4	25.4±3.3	26.7±3.3	26.5±3.5	
	Triceps (mm)	20.4±8	23.6±10.4	22.8±8.8	20±7.6	24±7.2	21.7±8.3	
	Subscapular (mm)	29.7±6.9	31.7±7.8	28.1±8.3	26.3±7	30.1±8.1	28.1±7.6	
	Hemoglobin (g/dL)	13.1±1.2	12.0±1.6	12.8±1.1	12.9±1.7	11.7±2.1	12.7±1.5	
	Waist (cm)	73.9±6.9	77.8±10.2	73.5±9.4	69.1±7.7	74.3±8.6	72.4±8.8	*
	Hip (cm)	91.4±6.8	92.8±9.1	92.0±7.7	88.5±7.2	91.4±7.8	90.6±7.6	
	Waist/Hip	0.81±0.03	0.84±0.04	0.80±0.05	0.78±0.03	0.81±0.04	0.80±0.04	**
	Systolic Blood Pressure (mmHg)	108±11.2	103.6±8.2	119.4±8.6	106.1±10.9	106±10.8	114.3±10.2	**
	Diastolic Blood Pressure (mmHg)	69.9±7	63.9±5.7	75.1±6.4	69.5±6.6	70±7.3	70.8±5.1	*

1.Number of Subjects were 7, 6, 21, 28, 7, for Dongbang, Kockphok, Lahanamtha, Lahanamthon, Thakhamlian,respectively.
* Significantly different between village at $p<0.05$; ** $p<0.01$.

Table 4. Parasite, Anemia and Body Mass Index of Five Villagers in 2005 and 2006

		Dongbang	Kockphok	Lahanamtha	Lahanamthong	Thakhamlian	Total
Number of Subjects 2005		12	12	35	42	12	113
Number of Subjects 2006		7	9	27	33	8	84
Parasite 2005	No	11	12	28	38	11	100
	Yes	1	0	7	4	1	13
Anemia 2005	No	11	8	29	32	8	88
	Yes	1	4	6	10	4	25
Anemia 2006	No	7	6	26	29	6	74
	Yes	0	3	1	4	2	10
BMI 2005	<18.5	1	0	3	9	1	14
	18.5-<25	10	10	25	27	8	80
	25-<30	1	1	3	6	3	14
	>=30	0	1	4	0	0	5
BMI 2006	<18.5	1	0	1	5	1	8
	18.5-<25	5	6	19	23	4	57
	25-<30	0	2	3	4	3	12
	>=30	1	1	4	1	0	7

Parasite, Anemia and categorical data of BMI are shown in table 4. The operational definition of anemia of the study is hemoglobin level below 11g/dL, category used in the first Lao national health survey in 2000 (NIOPH, 2001), though that of established by WHO is hemoglobin level below 12g/dL (WHO 1968). The percentages of anemia were 22% in 2005 and 12% in 2006. The categorical data of BMI shows that there were undernutrition (BMI below 18.5) and overweight (BMI 25 to below 30) or obesity (BMI over 30) in the same village. No significant difference was observed between villages. Within the interval between the first 2005 and the second 2006 survey, six under nutrition subjects recovered and three subjects became overweight; ten anemia subjects recovered but two subjects became anemia.

Relations between health-related variables and socioeconomic indicators: Table 5 shows the Spearman age controlled correlation coefficients of anthropometric variables, hemoglobin, and blood pressures with socioeconomic indicators. The area of paddy field were positively correlated with body fat percentage, BMI, upper arm circumference, and subscapular in 2005 rainy season survey, and body fat percentage in 2006 dry season survey. Heights of both years were inversely correlated with the length of rice shortage of the subjects' households. SBP was inversely correlated with number of pig, whereas DBP showed positive correlations with number of goat and sheep.

Table 5. The Spearman Partial Correlation Coefficients* of Anthropometric Variables、Hemoglobin and Blood Pressures with Socioeconomic Indicators (n=80)

		Number of Pig	Number of Goat and Sheep	Paddy Field	Rice Sortage	Household Income/Month/Number of Family
2005	Height				−0.28	
	Weight					
	Body Fat Percentage			0.24		
	Body Mass Index			0.24		
	Upper Arm Circumference			0.25		
	Triceps					
	Subscapular			0.25		
	Hemoglobin					
2006	Height				−0.27	
	Weight					
	Body Fat Percentage			0.23		
	Body Mass Index					
	Upper Arm Circumference					
	Triceps					
	Subscapular					
	Hemoglobin					
	Waist					
	Hip					
	Systolic Blood Pressure	−0.26				−0.23
	Diastolic Blood Pressure		0.23			

* Age is controlled.
・Correlation coefficients are shown in cases of significant level ($p<0.05$).
・Poultry, Cattle, Irrigated Rice Field, Upland Rice Field were not significantly correlated with Antropometric Variables, Hemoglobin Level and Blood Pressures.

Seasonal difference of health status: Means of seasonal differences of anthropometric measurements and hemoglobin level between 2006 and 2005 of Five Villagers are shown in table 6. The differences (magnitude of change) of anthropometric measurements during two surveys were significantly different except for height and upper arm circumference (data are not shown). Average amount of seasonal difference of weight as a whole was 1.34kg, and the magnitude of the change varied between villages; the smallest 0.96kg in Thakhamlian, the largest 2.87kg in Dongbang. Mean of hemoglobin change was significantly difference between villages. With the exception of a few variables, body fat percentage of Kockphok, upper arm circumference and hemoglobin level of Thakhamlian, means of seasonal difference of the health related measurements showed positive value.

Table 6. Means of Seasonal Differences of Anthropometric Measurements and Hemoglobin Level between 2006 and 2005 of Five Villagers

Number of Subjects	Dongbang 7	Kockphok 9	Lahanamtha 27	Lahanamthong 33	Thakhamlian 8	Total 84
Height (cm)	0.29±0.48	0.14±0.44	0.12±0.38	0±0.46	0.25±0.42	0.1±0.43
Weight (Kg)	2.87±1.89	1.99±3.14	0.99±1.13	1.21±1.84	0.96±2.03	1.34±1.89
Body Fat Percentage (%)	1.87±1.42	−0.16±2.46	0.57±1.39	1.45±2.21	0.99±1.85	0.99±1.96
Body Mass Index	1.11±0.91	0.79±1.2	0.39±0.5	0.54±0.85	0.33±0.82	0.55±0.81
Upper Arm Circumference	0.01±0.65	0.5±1.17	0.2±0.76	0.48±0.94	−0.1±0.86	0.3±0.89
Triceps	1.6±2.39	4.2±4.47	3.13±3.77	2.13±3.7	1.5±2.64	2.57±3.65
Subscapular	5.43±1.5	4.89±4.37	2.81±3.16	3.48±3.71	3.5±2.78	3.58±3.43
Hemoglobin (g/dL)	0.23±0.36	0.04±1.23	0.44±1.29	1.12±1.19	−0.2±0.84	0.59±1.22 *

* Significantly different between village at $p<0.05$; ** $p<0.01$.

Table 7 gives the Spearman correlation coefficients of seasonal variations of anthropometric variables and hemoglobin level with socioeconomic indicators. The magnitude of change of weight, BMI, triceps, and subscapular were inversely correlated with the area of irrigated rice field. Upper arm circumference change was inversely correlated with household income per month per number of family. Age, number of animals, area of paddy and upland rice fields were not significantly correlated with the variables shown in table 7. Hemoglobin level and body fat percentage were not significantly correlated with any socioeconomic indicators.

Table 7. The Spearman Correlation Coefficients of Seasonal Difference of Anthropometric Variables and Hemoglobin level with Socioeconomic Indicators (n=84)

	Weight 2006−2005	Body Mass Index 2006−2005	Triceps 2006−2005	Subscapular 2006−2005	Upper Arm Circumference 2006−2005	Hemoglobin 2006−2005
Irrigated Rice Field	−0.28 **	−0.27 *	−0.32 **	−0.22 *		
Household Income/Month/ Number of Family					−0.26 *	

Age, number of animals, area of paddy and upland rice fields were not significantly correlated with the health related variables shown in the table.

Discussion

BMI has been used in many field surveys as the indicator of long-term nutritional status of the individual and group. BMI values below 18.5 are considered as undernutrition; 14 subjects (12.4%) in rainy season and 8 subjects (9.5 %) in dry season had a BMI value of below 18.5 in the present study. According to the Lao national health survey in 2000 (NIOPH, 2001), 18.2 % of the adult females in Lao P.D.R. were categorized in undernutrition, and the percentage of iron deficiency anemia in females was 31.3; the numbers and percentages of anemia subjects were 25 (22.1%) in rainy season and 10 (11.9%) in dry season in the present study. From

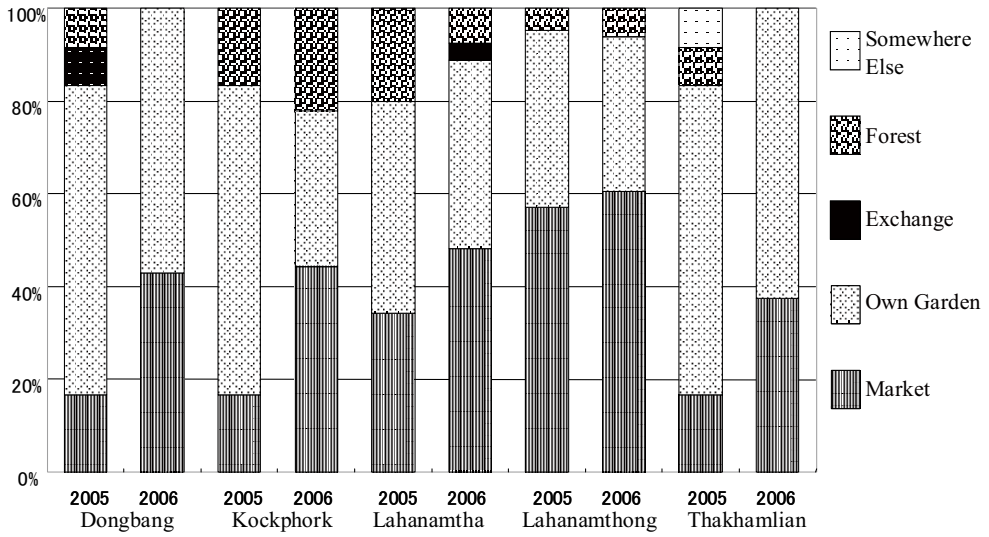

Figure 2. Main Source of Fruits and Vegetables in Rainy Season (2005) and Dry Season (2006)

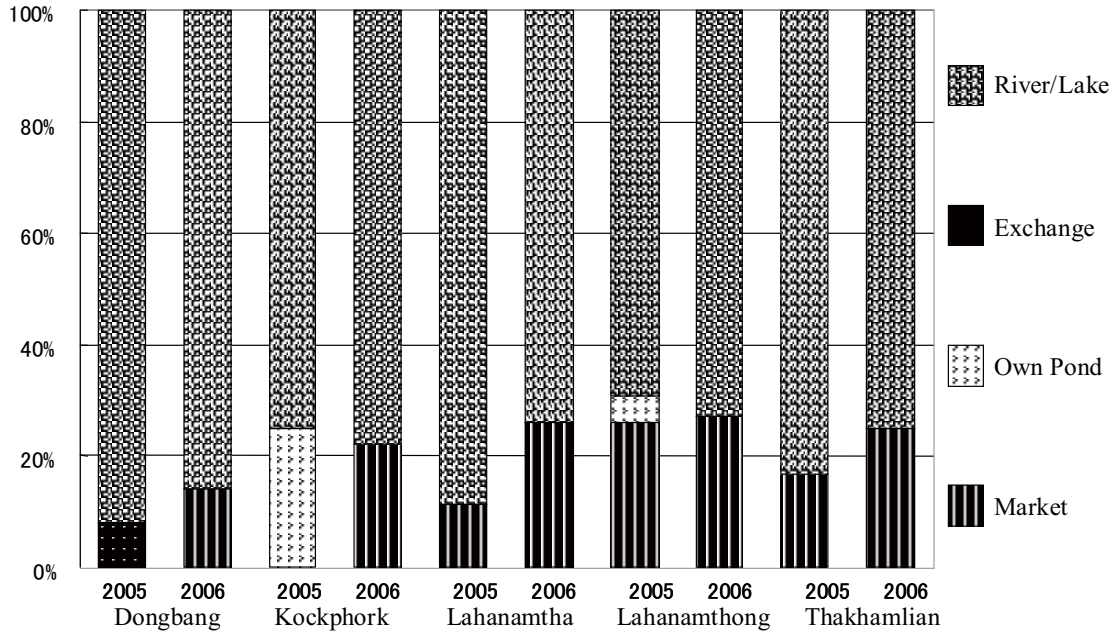

Figure 3. Main Source of Fish in Rainy Season (2005) and Dry Season (2006)

the results of the anthropometric measurements, it can be said that the nutritional statuses of the five villagers were better than that of females in the national survey. Furthermore, the percentages of the overweight (BMI over 25) of the present study (16.8 % in rainy season and 22.6 % in dry season) were higher than the result of adult females in national survey (10.8 %). It should be noted that the problems of undernutrition and overnutrition occur in the same village at same time, similarly to a modernizing populations in other developing countries. (Natsuhara et al., 1999).

One of the important findings in this study was significant intra-individual seasonal variation in the subjects' health status, as shown in table 6. There are two features of causal explanation of the investigated seasonal differences. The first is the changes of main source of foods, shown in Fig. 2 and Fig. 3, foods from immediate environment played more important roles than that from market in rainy season; it may be

related to the terrible road condition to the stores and temporary closure of the morning market on rainy days. The availability of foods from immediate environment such as river and forest depend on the condition of the resource and skills of the hunting and gathering, though getting foods at a store or market is easy if the subjects have cash. Another possible cause of the seasonal difference is the extent of irrigated rice field production, which relates to the labor requirement and added rice production in off-crop season of rain-fed cultivation. As shown in table 7, the area of irrigated rice field was inversely correlated with the magnitude of seasonal difference. In turn, the labor requirement in dry season for irrigated rice field may diminish the change of health-related values, such as weight gain. There is one other thing that is important in the relationship between irrigated rice field and seasonal difference. The length of rice shortage was negatively correlated with the area of the irrigated rice (Spearman r = -0.23, p=0.017), which means the extent of the irrigated field may reduce the extent of the weight loss in pre-harvest rainy season through the stable supply of food.

It seems reasonable to conclude that among socioeconomic characteristics, the environmental factor related to the rice field and the sources of the foods played important roles for the health status of the subjects in rural village in the Sonkhon district. Further studies are needed to clarify the factors related to the health status of the villagers in rural Laos.

References

Dressler, W.W., Mata, A., Chavez, A. and Viteri FE. (1987) Arterial blood pressure and individual modernization in a Mexican community. *Social Science and Medicine*, 24(8): 679-87.

Lohman, T. G., Roche, A. F. and Martorell, R. (1991) Anthropometric standardization reference manual: Abridged edition. Human Kinetics Books.

National Institute of Public Health Lao People's Democratic Republic (2001) National Health Survey, Health Status of the people in Lao PDR.

Natsuhara, K. and Ohtsuka, R. (1999) Nutritional ecology of a modernizing rural community in Papua New Guinea: An assessment from urinalysis. *Man and Culture in Oceania*, 15: 91-111.

The Micronutrient Initiative and United Nations Children's Fund (2003) Vitamin and Mineral Deficiency: A global progress report, The Micronutrient Initiative, Ottawa,

UNDP (2005) Human Development Report 2005: International cooperation at a crossroads: Aid, trade and security in an unequal world. http://hdr.undp.org/reports/global/2005/pdf/HDR05_complete.pdf

Ulijaszek, S.J. (2001) Socioeconomic status, body size and physical activity of adults on Rarotonga, the Cook Islands. *Annals of Human Biology*, 28(5): 554-63.

Villela, G.J. and Palinkas, L.A. (2000) Sociocultural change and health status among the Seri Indians of Sonora, Mexico. *Medical Anthropology*, 19(2):147-72.

WHO (1968) Nutritional anemia: report of a WHO Scientific Group. In *Technical Report Series 405*. World Health Organization, Geneva.

WHO Study Group (1990) Diet, nutrition, and the prevention of chronic disease. In *World Health Organization Technical Report Series 797*. World Health Organization, Geneva.