B Vitamins, Vitamin C and Hematological Measurements in Overweight and Obese Thais in Bangkok

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Abstract

The dynamic changes of socio-economics leading to the industrialisation of countries are known to affect lifestyle and nutritional behaviours of the population. Review of the literature on the prevalence of obesity showed increasing numbers of the overweight and obese during the past decade. However, information on health and nutritional status of the obese in Thailand has not been widely publicized. This study reveals the vitamin status and hematological picture in 270 overweight and obese Thais in Bangkok, Thailand, compared with 175 normal subjects. No statistically significant differences in haemoglobin and hematocrit were observed in the overweight compared with the control subjects. The prevalence of anaemia was 9.8 per cent among male and 17.2 per cent among female overweight and obese subjects compared with 2.6 per cent and 21.2 per cent in male and female normal controls using the cut-off point of haemoglobin concentration as an indicator of anaemia. Prevalence of hypertension was exhibited in both male and female overweight and obese subjects. Even if there were no statistically significant differences in vitamin B_1, B_2 and B_6 in overweight and obese subjects compared with the controls, high percentages of vitamin C and vitamin B_2 deficiencies were observed. Vitamin B_2 deficiency was detected in 19.7 per cent of overweight and obese males as well as in 28.7 per cent of overweight and obese females using glutathione reductase activity coefficient (α EGR) < 1.5 as the cut-off point. However, clinical signs of vitamin B_2 deficiencies were rare. There was also a high percentage of vitamin C (antioxidant vitamin) deficiency in 51.5 per cent of the overweight and obese subjects and 41.7 per cent of the controls, respectively. The results suggest more attention should be paid

to health study and nutritional problems for the overweight and obese population, especially concerning vitamins and oxidative stress. Further research is still needed in these aspects.

Key word : Thiamin, Riboflavin, Pyridoxin, Vitamin C, Anaemia, Obese

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The prevalence of obesity has increased dramatically over the past decade[1]. It has been reported that over 22 per cent of the adult American population is obese (body mass index, BMI ≥30 kg/m^2), with the prevalence in some ethnic groups approaching 40 per cent[1,2]. The prevalence of overweight and obesity (BMI ≥25 kg/m^2) has not increased in the same manner, but it includes another one-third of the population. The fact that Thailand is rapidly approaching the status of a newly industrialised country is well reflected in some demographic and economic indicators[3]. A total of 23.6 per cent of Thai female construction site workers was reported to be obese[4]. Obesity is found in 11 per cent of Thai elderly[5]. Moderate to severe obesity is increasingly found and might be associated with clear health risks, including hypertension, diabetes and dyslipidemia[6].

In the past few years, there have been dramatic advances in the research of overweight and obese Thais. Exploratory papers have reported abnormal lipid profiles[7], erythrocyte antioxidant enzyme[8], and serum leptin[9]. Therefore, this study investigated vitamin B and C status and hematological measurements in healthy, overweight and obese Thai people compared with apparently healthy subjects in order to provide preliminary baseline information for further studies, health promotion and nutritional intervention.

MATERIAL AND METHOD

Study Population

Sixty-one male and 209 female overweight and obese Thai volunteers, including 38 male and 137 female normal subjects, comprised the study population. Thai volunteers who attended the Out-patient Department, General Practice Section, Rajvithi Hospital, Bangkok, for a physical check-up, were investigated in this study. They all attended the clinic of their own accord and were well except for minor ailments and the typical diseases of obese people such as hypertension, mild to moderate degree of cardiovascular diseases and non-insulin dependent diabetes mellitus, which were diagnosed by physical and biochemical laboratory examinations for the inclusion criteria. Age, marital status, place of origin, drinking and smoking habits were assessed by standardised questionnaires. The same medical doctor conducted physical examinations throughout the study.

Analytical method

The body weight, of each individual dressed in light clothing, was measured using a carefully calibrated beam balance (Detecto®, Detecto Scale Manufacturing, USA). Height measurements were taken using a vertical-measuring rod. The BMI or Quetelet's index was conventionally calculated as weight in kg/(height in metres)^2. The classifications

of BMI employed were those used by the WHO Expert Committee 1995[10], overweight grade I: BMI=25.00-29.99 kg/m^2; grade II (obese): BMI= 30.00-39.99 kg/m^2; grade III (obese): BMI≥40 kg/ m^2.

From the subjects under study, about 10 ml of venous blood was taken in the morning after fasting overnight. Heparinised blood was used to determine haemoglobin and hematocrit (packed cell volume). Haemoglobin concentration in whole blood was determined by the modified cyanomethemoglobin method[11]. Hematocrit was measured by the micromethod using calibrated heparinised capillary tubes. The tubes of blood were centrifuged for five minutes at 14,000 g (IEC MB microhematocrit centrifuge). Hematocrit was measured using a microhematocrit reader (Hawksley, England). Mean corpuscular haemoglobin concentrations (MCHC) were calculated by dividing the haemoglobin concentration (g/dl) with the hematocrit (%), multiplied by 100.

Red blood cell haemolysate was prepared and stored at -20°C for not longer than one week and used afterwards for vitamin B_1, B_2 and B_6 determinations. The active form of vitamin B_1, B_2, and B_6 are very important coenzymes in many biological mechanisms. In particular, the activity of the erythrocyte enzymes transketolase (ETK), glutathione reductase (EGR) and aspartate aminotransferase (EAST) and their activation coefficients (AC) after stimulation with the respective coenzymes are sensitive indicators of the nutritional status of thiamin, riboflavin and pyridoxin, respectively[12]. Vitamin B_1 status was assessed using erythrocyte transketolase activity[12]. The values of 1.25 α ETK (activation coefficient) and above indicate a real deficiency in vitamin B_1 status. Vitamin B_2 status was assessed using erythrocyte glutathione reductase activity[13]. Values of 1.5 α EGR and above indicate a deficiency in vitamin B_2 status[14]. Vitamin B_6 status was assessed using erythrocyte aspartate aminotransferase activity[15]. Values of 2.00 α EAST and above indicate a deficiency in vitamin B_6 status. Serum vitamin C was determined according to the method described by Liu et al[16]. Values below 5 μg/l indicate a deficiency in vitamin C.

Blood pressure was recorded in a sitting position, using a standardised automatic electronic blood pressure meter.

Statistical analysis

The results were expressed as median, range, and 95 per cent confidence interval (CI). The data were coded and analyzed by using a standard statistical method provided by the Minitab computer programme[17].

RESULTS

Median, range and 95 per cent confidence interval (CI) of age, anthropometric variables, hematological measurements and vitamin status in overweight and control subjects are shown in Table 1. No statistically significant differences in haemoglobin and hematocrit from controls were observed in the overweight, except for MCHC which was higher in the overweight and obese than in the control subjects. Blood pressure was found to be statistically significantly higher in the overweight and obese than that of the control subjects. No statistically significantly differences in vitamin B_1, B_2, B_6 in the overweight and obese were found compared with the control subjects. The medians of vitamin C concentration of the overweight and obese was significantly lower than those of the controls (Table 1). However, only the female overweight and obese showed a statistically significant difference of vitamin C concentration compared with female control subjects (Table 2).

The number and percentage of individuals with hypertension, anaemia and vitamin deficiencies in overweight and obese subjects are shown in Table 3. Prevalence of hypertension was found in both male and female overweight and obese subjects when compared with controls. Prevalence of anaemia was found in the female overweight and obese subjects (17.2% in females, 9.8% in males). The magnitude of anemia was not different from the control group.

The vitamin status of the overweight and obese subjects represented as deficiencies in percentage using the reference cut-off point is shown in Table 3. Vitamin B_2 deficiency in the overweight and obese males was 19.7 per cent compared to 28.7 per cent in the overweight and obese females. There was a high percentage of vitamin C deficiency (51.5% in both sexes) compared to 41.7 per cent in the controls.

Table 4 shows the correlation coefficients between various parameters in the overweight males

Table 1. Median, range and 95 per cent confidence interval (CI) of age, anthropometric variable, blood pressure and vitamin status in the overweight and control subjects.

Parameter	Total				P-value*
	Overweight (N=270)		Control (N=175)		
	Median (range)	95%CI	Median (range)	95%CI	
Age (yrs)	40.0 (18.0-60.0)	38.0-41.0	39.0 (18.0-60.0)	36.0-40.0	0.546
Weight (kg)	76.0 (54.0-153.0)	74.5-78.5	54.2 (42.5-78.0)	52.8-55.9	0.000
Height (m)	1.57 (1.45-1.86)	1.56-1.58	1.58 (1.43-1.85)	1.56-1.59	0.222
BMI (kg/m^2)	30.68 (25.08-56.00)	30.26-31.23	21.90 (18.47-24.97)	21.55-22.22	0.000
Hb (g/dl)	13.4 (8.3-17.2)	13.2-13.5	13.2 (9.2-17.5)	13.0-13.4	0.178
Hct (%)	40.0 (26.6-50.0)	39.9-40.6	40.0 (27.8-54.0)	39.6-40.4	0.496
MCHC (%)	33.9 (23.8-35.9)	33.7-34.1	33.6 (31.5-36.4)	33.3-33.7	0.001
Diastolic blood pressure	80.0 (57.0-130.0)	80.0-84.0	70.0 (48.0-109.0)	70.0-75.0	0.000
Systolic blood pressure	130.0 (96.0-190.0)	124.9-130.0	111.0 (88.0-184.0)	110.0-115.5	0.000
Vitamin B1 (αETK)	1.08 (0.64-2.39)	1.07-1.11	1.06 (0.66-1.84)	1.04-1.09	0.178
Vitamin B2 (αEGR)	1.34 (0.91-2.26)	1.31-1.39	1.32 (0.91-2.02)	1.30-1.38	0.136
Vitamin B6 (αEAST)	1.46 (0.80-2.59)	1.43-1.54	1.50 (1.01-3.40)	1.35-1.57	0.319
Vitamin C (mg/l)	5.00 (0.00-28.00)	4.50-5.56	6.00 (0.00-23.00)	5.41-6.59	0.023

BMI = body mass index, Hb= haemoglobin, Hct= haematocrit, MCHC = mean corpuscular haemoglobin concentration
αETK = erythrocyte transketolase activity coefficient, αEGR = erythrocyte glutathione reductase activity coefficient,
αEAST = erythrocyte aspartate aminotransferase activity coefficient
*Mann-Whitney U-Wilcoxon Rank Sum W Test (Two-Tailed)

and females, respectively. Significant associations were found between vitamin B_1, B_6, and vitamin C in both the overweight males and females. A negative correlation was found between vitamin B_2, haemoglobin and hematocrit.

DISCUSSION

The distribution of obese subjects in this study, according to the grading of the 1995 WHO group was 43.0, 51.8 and 5.2 per cent for grades I, II and III, respectively, with a predomination of grade II (BMI=30.0-39.99 kg/m^2). This result may indicate the need for counselling and controlling the transformation from grade II to grade III. Overweight and obese females in this study group had higher weight and height than the male overweight and obese subjects. Upon grading of overweight by BMI (kg/m^2), there was a higher prevalence of grade III (BMI $\geq$ 40 kg/m^2) in females than in males. Unequal numbers of male and female overweight subjects participated in this study arising from the fact that females are generally more willing to volunteer than males and females have a tendency to be more socially active than males[18].

High blood pressure, both systolic and diastolic, in overweight and obese subjects presented as an important problem. Obesity is an important risk factor for the development of hypertension[19]. Weight gain promotes hypertension and the risk of hypertension parallels the degree of obesity[20,21]. This might lead to an increased risk of heart disease. Advice and support for behavioural modification, including eating a healthy diet and not smoking, which is a major health risk in males, should be recommended, especially in obese subjects.

Table 2. Median, range and 95 per cent (CI) of age, anthropometric variable, blood pressure and vitamin status in the overweight and control subjects between male and female.

Parameter	Male				P-value	Female				P-value*
	Overweight (N=61)		Control (N=38)			Overweight (N=209)		Control (N=137)		
	Median (range)	95%CI	Median (range)	95%CI		Median (range)	95%CI	Median (range)	95%CI	
Age (yrs)	40.0 (18.0-59.0)	37.8-44.2	40.0 (19.0-54.0)	32.9-42.1	0.327	40.0 (18.0-60.0)	38.0-42.0	38.0 (18.0-60.0)	36.0-40.0	0.546
Weight (kg)	85.0 (62.4-127.0)	81.2-91.1	62.0 (50.7-78.0)	60.0-64.5	0.000	74.2 (54.0-153.0)	72.8-75.7	52.5 (42.5-78.0)	51.8-54.0	0.000
Height (m)	1.69 (1.51-1.86)	1.67-1.72	1.67 (1.57-1.85)	1.65-1.70	0.645	1.55 (1.45-1.70)	1.55-1.56	1.56 (1.43-1.78)	1.55-1.57	0.222
BMI (kg/m^2)	30.49 (25.12-38.98)	28.99-31.28	22.21 (18.68-24.61)	20.62-23.16	0.000	30.86 (25.08-56.00)	30.27-31.61	21.85 (18.47-24.97)	21.52-22.12	0.000
Hb (g/dl)	14.9 (8.3-17.2)	14.6-15.3	15.2 (12.5-17.5)	14.5-15.4	0.801	13.1 (8.4-16.4)	12.9-13.3	13.0 (9.2-17.0)	12.7-13.2	0.051
Hct (%)	45.3 (26.6-50.0)	44.0-46.0	45.9 (38.8-54.0)	43.9-46.0	0.751	39.5 (27.5-49.0)	39.0-40.0	39.0 (27.8-51.0)	38.0-40.0	0.250
MCHC (%)	33.6 (30.9-35.3)	33.5-34.0	33.2 (31.7-34.6)	32.5-33.7	0.054	33.9 (23.8-35.9)	33.7-34.2	33.6 (31.5-36.4)	33.4-33.8	0.008
Diastolic blood pressure	89.0 (60.0-120.0)	81.8-93.2	77.0 (54.0-104.0)	73.9-80.0	0.000	80.0 (57.0-130.0)	80.0-81.0	70.0 (48.0-109.0)	70.0-73.0	0.000
Systolic blood pressure	130.0 (96.0-170.0)	130.0-137.3	119.5 (96.0-184.0)	113.0-126.0	0.000	125.0 (100.0-190.0)	120.0-130.0	110.0 (88.0-184.0)	110.0-112.0	0.000
Vitamin B1 (αETK)	1.10 (0.65-1.36)	1.06-1.12	1.09 (0.71-1.77)	1.04-1.14	0.317	1.08 (0.64-2.39)	1.07-1.11	1.06 (0.66-1.84)	1.03-1.09	0.178
Vitamin B2 (αEGR)	1.32 (0.91-2.26)	1.23-1.39	1.36 (0.91-1.65)	1.29-1.44	0.632	1.34 (0.94-2.15)	1.31-1.41	1.32 (0.96-2.02)	1.29-1.38	0.136
Vitamin B6 (αEAST)	1.47 (1.03-2.59)	1.34-1.59	1.65 (1.01-2.24)	1.44-1.80	0.582	1.46 (0.80-2.59)	1.42-1.54	1.45 (1.01-3.40)	1.25-1.53	0.319
Vitamin C (mg/l)	3.50 (0.00-28.00)	2.21-4.79	5.25 (0.00-13.00)	3.19-6.27	0.115	5.40 (0.00-28.00)	4.75-6.13	6.25 (0.00-23.00)	5.50-7.00	0.023

BMI = body mass index

αETK = erythrocyte transketolase activity coefficient, αEGR = erythrocyte glutathione reductase activity coefficient,

αEAST = erythrocyte aspartate aminotransferase activity coefficient

*Mann-Whitney U-Wilcoxon Rank Sum W test (Two-Tailed)

Table 3. Number and percentage of individuals with overweight, hypertension, anaemia and vitamin deficiencies compared with the controls.

Parameter	Male				Female				Total			
	Overweight		Control		Overweight		Control		Overweight		Control	
	N/Total	%	N/Total	%	N/Total	%	N/Total	%	N/Total	%	N/Total	%
Grading of overweight by BMI (kg/m^2)												
Grade I (BMI = 25.00-29.99)	28/61	45.9	-	-	88/209	42.1	-	-	116/270	43.0	-	-
Grade II (BMI = 30.00-39.99)	33/61	54.1	-	-	107/209	51.2	-	-	140/270	51.8	-	-
Grade III (BMI ≥ 40.00)	-		-	-	14/209	6.7	-	-	14/270	5.2	-	-
Hypertension												
Systolic ≥ 160 mmHg	6/61	9.8	1/38	2.6	9/209	4.3	2/137	1.5	15/270	5.6	3/175	1.7
Diastolic ≥ 95 mmHg	21/61	34.4	1/38	2.6	30/209	14.4	4/137	2.9	51/270	18.9	5/175	2.9
Anaemia												
Male, Hb < 13.0 g/dl	6/61	9.8	1/38	2.6								
Female, Hb < 12.0 g/dl					36/209	17.2	29/137	21.2	42/270	15.6	30/175	17.1
Male, Hct < 40%	6/61	9.8	1/38	2.6								
Female Hct < 36%					33/209	15.8	23/137	16.8	39/270	14.4	24/175	13.7
Both sexes, MCHC < 33%	9/45	14.8	10/26	26.3	23/153	11.0	15/79	10.9	32/198	11.9	25/105	14.3
Vitamin deficiencies												
Vitamin B1 ≥ 1.25 (αETK)	3/61	4.9	7/38	18.4	25/209	12.0	11/137	8.0	28/270	10.4	18/175	10.3
Vitamin B2 ≥ 1.50 (αEGR)	12/61	19.7	9/38	23.7	60/209	28.7	30/137	21.9	72/270	26.7	39/175	22.3
Vitamin B6 ≥ 2.00 (αEAST)	4/57	6.6	3/37	8.1	9/209	4.3	18/137	13.1	13/270	4.8	21/174	12.1
Vitamin C < 5 mg/l	42/61	68.9	19/38	50.0	97/207	46.4	54/137	39.4	139/270	51.5	73/175	41.7

αETK = erythrocyte transketolase activity coefficient, αEGR = erythrocyte glutathione reductase activity coefficient, αEAST = erythrocyte aspartate aminotransferase activity coefficient
N/Total = number of represent result / total number of subjects in each group

Table 4. Correlation coefficients of age, anthropometric variables, blood pressure, vitamin B and C in both overweight and obese males and females (BMI ≥ 25.0 kg/m^2).

Parameter	Hb	Hct	MCHC	Dias BP	Syst BP	Vit B_1	Vit B_2	Vit B_6	Vit C
Age	-0.023	-0.034	0.115	0.165**	0.268**	-0.098	0.004	-0.066	-0.013
Weight	0.219**	0.240**	-0.219**	0.205**	0.200**	0.004	0.059	-0.021	-0.039
Height	0.331**	0.339**	-0.088	0.117	0.086	-0.026	-0.081	-0.013	-0.020
BMI	0.050	0.071	-0.234**	0.162**	0.177**	0.053	0.108	-0.014	0.000
Hb	1.000	0.971**	0.140*	0.140*	0.135*	0.006	-0.235**	0.073	-0.102
Hct	0.971**	1.000	0.018	0.165**	0.137*	-0.005	-0.233**	0.067	-0.095
MCHC	0.140*	0.018	1.000	-0.144*	-0.108	0.104	-0.097	0.136	-0.022
Dias BP	0.140*	0.165**	-0.144*	1.000	0.743**	-0.008	0.017	0.046	-0.029
Syst BP	0.135*	0.137*	-0.108	0.743**	1.000	-0.045	-0.018	-0.015	-0.029
Vit B1	0.006	-0.005	0.104	-0.008	-0.045	1.000	-0.036	0.175**	0.138*
Vit B2	-0.235**	-0.233**	-0.097	-0.036	0.018	-0.036	1.000	0.038	-0.005
Vit B6	0.073	0.067	0.136	0.046	-0.015	0.175**	0.038	1.000	0.148*
Vit C	0.102	-0.095	-0.022	-0.029	-0.029	0.138*	-0.005	0.148*	1.000

Significant difference: *p<0.05, **p<0.01

The prevalence of anaemia in the male and female overweight and obese subjects was 9.8 per cent and 17.2 per cent, respectively using the cut-off point of haemoglobin concentration as an indicator of anaemia. The rates of anaemia in the overweight and obese subjects were at the same magnitude as those found in a group of Thai road sweepers (14.8% in males and 15.2 per cent in females)[22], and Thai labourers (11.3% in males and 24.5% in females)[23].

The median values of vitamin C concentration in both sexes of the overweight and obese subjects were found to be lower than those of the control subjects (Table 1). Serum vitamin C concentrations in the males were also found to be lower than the female overweight and obese subjects (Table 2). More than 50 per cent (139 out of 270) of all overweight and obese subjects had vitamin C levels below the normal cut-off point value of 5 mg/l. In a previous report by the authors, it was also found that the antioxidant enzyme superoxide dismutase, glutathione peroxidase and catalase, which are responsible for metabolising reactive oxygen species (ROS), were significantly lower than the normal groups[8]. The low level of vitamin C concentration in overweight and obese subjects might result from high activity metabolism and might be related to decreased oxidative enzymes which require a reducing agent such as vitamin C to maintain the situation.

Although no statistically significantly differences in vitamin B_1, B_2, and B_6 were found when comparing the overweight and obese with normal subjects (Table 1), 26.7 per cent of the overweight and obese subjects were found to have riboflavin deficiency (Table 3). No clinical signs of this vitamin deficiency were observed. The high rate of vitamin B_2 deficiency in Thailand is well known, as confirmed by recent studies undertaken in the elderly [5], road sweepers[22], construction site workers[24], vegetarians[25], new-borns and their mothers from the northeast[26], children and their mothers in a well-baby clinic[12], and preschool children in the northeast of Thailand[14]. Vitamin B_2 deficiency in the overweight and obese subjects might be related to insufficient dietary vitamin intake and increased use of this vitamin in protein, lipid metabolism as found in lower antioxidant enzymes[8]. Therefore, further investigation concerning vitamin B_2 requirements and the actual intake of riboflavin are needed.

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REFERENCES

1. Kuezamrski RJ, Flegal KM, Cambell SM, Johnson CL. Increasing prevalence of overweight among US adults: The National Health and Nutrition Examination Surveys, 1960-1991. JAMA 1994; 272: 205-11.
2. Flegal KM, Carroll MD, Kuczmarski RJ, et al. Overweight and obesity in the United States: Prevalence and trends, 1960-1994. Int J Obes Relat Metab Disord 1998; 22: 39-47.
3. Pongpaew P, Schelp FP. Elderly in a country going through epidemiological health transition: The example of Thailand. Age & Nutrition 1997; 8: 30-5.
4. Pongpaew P, Tungtrongchitr R, Supawan V, Phonrat B, Schelp FP. Lipid profile and blood pressure in relation to nutritional anthropometry of 117 Thai construction site workers. Intern Med 1994; 10: 34-9.
5. Pongpaew P, Tungtrongchitr R, Lertchavanakul A, et al. Anthropometry, lipid and vitamin status of 215 health-conscious Thai elderly. Int J Vit Nutr Res 1991; 61: 215-23.
6. Kushner RF. Body weight and mortality. Nutr Rev 1993; 51: 127-36.
7. Lertchavanakul A, Maleehuan O, Pongpaew P, Tungtrongchitr R, Vutikes S, Schelp FP. Lipid profiles and blood pressure in relation to body mass index (BMI) of overweight and obese Thai in Bangkok. Intern Med 1998; 14: 66-70.
8. Viroonudomphol D, Pongpaew P, Tungtrongchitr R, et al. Erythrocyte antioxidant enzyme and blood pressure in relation to overweight and obese Thai in Bangkok. Southeast Asian J Trop Med Public Health 2000; 31: 325-34.
9. Tungtrongchitr R, Pongpaew P, Phonrat B, et al. Serum leptin and lipid profiles in Thai obese and overweight subjects. Int J Vit Nutr Res 2001; 71: 74-81.
10. WHO Expert Committee. Physical status: The use and interpretation of anthropometry: Report of a WHO Expert Committee. Geneva: World Health Organization; WHO Tech Rep Ser 1995: 854.
11. International Committee for Standardisation in Haematology: Recommendations for reference method for haemoglobinometry in human blood. (ICSH standard EP 6/2:1977) and specifications for international haemoglobin cyanide reference preparation (ICSH Standard EP 6/3:1977). J Clin Path 1978; 31: 139-43.
12. Changbumrung S, Poshakrishana P, Vudhivai N, Hongtong K, Pongpaew P, Migasena P. Measurements of B_1, B_2, B_6 status in children and their mothers attending a well-baby clinic in Bangkok. Int J Vit Nutr Res 1984; 54: 149-59.
13. Power HJ, Thurnham DI. Physiological effects of marginal riboflavin deficiency in young adults and geriatrics: Reduction in the *in vivo* survival time of erythrocytes. Proc Nutr Soc 1980; 39: 17A.
14. Vudhivai N, Changbumrung S, Schelp FP, et al. Riboflavin status in preschool children in Northeast Thailand: A community survey. J Med Assoc Thai 1986; 69: 543-8.
15. Changbumrung S, Schelp FP, Hongtong K, Buavatana T, Supawan V. Pyridoxine status in preschool children in northeast Thailand: A community survey. Am J Clin Nutr 1985; 41: 770-5.
16. Liu TZ, Chin N, Kiser MD, Bigler WN. Specific spectrophotometry of ascorbic acid in serum or plasma by use of ascorbate oxidase. Clin Chem 1982; 28: 2225-8.
17. Ryan TA, Brian LB, Ryan BF. Minitab student handbook. 2nd ed. Boston: PWS-Kent, 1985.
18. Pongpaew P, Tungtrongchitr R, Phonrat B, et al. Activity, dietary intake and anthropometry of an informal social group of Thai elderly in Bangkok. Arch Gerontol Geriatr 2000; 30: 245-60.
19. Stamler RA, Stamler J, Riedlinger WF, Algera G, Roberts RH. Weight and blood pressure finding in hypertension screening of 1 million Americans. JAMA 1978; 240: 1607-10.
20. Reisen E, Abel R, Modan M, Silverberg DS, Eliahou HE, Modan B. Effect of weight loss without salt restriction on the reduction of blood pressure in overweight hypertensive patients. N Engl J Med 1978; 298: 1-6.
21. Rocchini AP, Key J, Blondie D, et al. The effect of weight loss on the sensitivity of blood pressure to sodium in obese adolescents. N Engl J Med 1989; 321: 580-5.
22. Vudhivai N, Pongpaew P, Tungtrongchitr R, Phonrat B, Horsawat V, Schelp FP. Riboflavin and nutritional status of Thai road sweepers in Bangkok. Intern Med 1997; 13: 77-80.
23. Yamwong P, Sonjai A, Rungpitarangsi V. Prevalence of anaemia in Thai labourers intending to work abroad. Siriraj Hosp Gaz 1991; 43: 1-5.
24. Pongpaew P, Tungtrongchitr R, Tawprasert S, et al. Vitamins, electrolytes and hematological status of urban construction site workers in Bang-kok. Asia Pacific J Clin Nutr 1993; 2: 135-40.
25. Vudhivai N, Ali A, Pongpaew P, et al. Vitamin B_1, B_2, B_6 status of vegetarians. J Med Assoc Thai 1991; 74: 465-70.
26. Vudhivai N, Pongpaew P, Prayurahong B, et al. Vitamin B_1, B_2 and B_6 in relation to anthropometry, haemoglobin and albumin of newborns and their mothers from Northeast Thailand. Int J Vit Nutr Res 1989; 60: 75-80.

ระดับวิตามินบี วิตามิน ซี และดัชนีชี้วัดทางโลหิตวิทยา ในกลุ่มคนไทยที่มีน้ำหนักเกินและอ้วนในเขตกรุงเทพมหานคร

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การเปลี่ยนแปลงทางสังคมและเศรษฐกิจของประเทศไทยมีผลกระทบต่อชีวิตความเป็นอยู่ พฤติกรรมการบริโภคและภาวะโภชนาการของประชาชน ทำให้จำนวนของผู้ที่มีภาวะโภชนาการเกินและอ้วนเพิ่มขึ้นเป็นอย่างมากในปัจจุบันนี้ อย่างไรก็ตามการเฝ้าระวังและศึกษาภาวะโภชนาการเกินและอ้วนในปัจจุบันยังมีไม่มากนัก คณะผู้วิจัยได้ทำการศึกษาภาวะวิตามินและดัชนีชี้วัดทางโลหิตวิทยาของผู้ที่มีภาวะโภชนาการเกินและอ้วนจำนวน 270 คนในกรุงเทพมหานครเปรียบเทียบกับกลุ่มที่มีภาวะโภชนาการปกติจำนวน 175 คน ไม่พบความแตกต่างของค่าฮีโมโกลบินและฮีมาโตคริตระหว่างกลุ่มผู้มีภาวะโภชนาการเกินและอ้วนกับกลุ่มปกติ เมื่อใช้ระดับฮีโมโกลบินเป็นเกณฑ์ตัดสินภาวะโลหิตจาง พบภาวะโลหิตจางร้อยละ 9.8 และ 17.2 ในกลุ่มผู้มีภาวะโภชนาการเกินและอ้วนชายและหญิง ขณะที่พบภาวะโลหิตจางในกลุ่มที่มีภาวะโภชนาการปรกติชายและหญิงร้อยละ 2.6 และ 21.2 ตามลำดับ นอกจากนั้นความดันโลหิตของกลุ่มผู้มีภาวะโภชนาการเกินและอ้วนมีระดับที่สูงกว่ากลุ่มปกติอย่างมีนัยสำคัญทางสถิติ เมื่อศึกษาถึงภาวะวิตามินคณะผู้วิจัยพบว่าระดับค่าเฉลี่ย (มัธยฐานและพิสัยของค่า coefficient activity) ของวิตามิน บีหนึ่ง บีสอง บีหก ในกลุ่มผู้มีภาวะโภชนาการเกินและอ้วนไม่แตกต่างจากกลุ่มปกติ แต่ก็พบว่าในกลุ่มผู้มีภาวะโภชนาการเกินและอ้วน ชายและหญิงมีภาวะการขาดวิตามิน บีสอง ร้อยละ 19.7 และ 28.7 ตามลำดับโดยใช้ค่า glutathione reductase activity coefficient (α EGR) < 1.5 เป็นเกณฑ์ตัดสิน กลุ่มผู้มีภาวะโภชนาการเกินและอ้วนชายและหญิงมีการขาดวิตามินซีซึ่งเป็นสารต้านอนุมูลอิสระถึงร้อยละ 51.5 เมื่อเปรียบเทียบกับร้อยละ 41.7 ในกลุ่มคนปกติ จากผลการศึกษาครั้งนี้อาจเป็นข้อเสนอแนะช่วยให้เกิดความสนใจที่จะทำการศึกษาวิจัยเกี่ยวกับสุขภาพและปัญหาโภชนาการในกลุ่มผู้มีภาวะโภชนาการเกินพิกัดและอ้วนเพิ่มมากขึ้น โดยเฉพาะอย่างยิ่งเกี่ยวกับภาวะของวิตามินต่าง ๆ และความเครียด

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