COMPILATION OF ANATOMICAL, PHYSIOLOGICAL AND METABOLIC CHARACTERISTICS FOR A REFERENCE VIETNAMESE MAN

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Abstract

In general, over the course of the time, the phenomenon of acceleration in physical development may be observed, i.e. the children and adults of the next generation are taller and heavier than in former generation. Our data presented in this paper show a regular trend of acceleration in the development on Vietnamese, but the trend is still slow and was mostly probably influenced by our difficulties in a long time of war. It is hoped that, the acceleration in the development may be increased in the future following the economical acceleration of our country, however it is known that the ratio between the length of different parts of human body is a specific characteristic for human race, sex and group age. Therefore we may estimate these ratio for the prolongation of the utilization of our measured physical data.

The result of studies on water balance of Vietnamese living in comfortable environment air temperature conditions and working in hot environment with different levels of energy expenditure and the elemental composition of sweat of workers in hot environment are also presented as well as the mass of major internal organs of Vietnamese.

The data of food consumption in Viet Nam National institute of Nutrition (1986) show an unbalanced state and deficient food intake in the nutrition of Vietnamese. However, after economical reconstruction in the last years the data of food consumption and food supply are varied. The quantity of protein, fat and milk products increase every time in people's food.

ASSESSMENT OF PHYSICAL MEASURES OF VIETNAMESE

In the compilation of anatomical, physiological and metabolic characteristics for a reference man, the height and weight of man's body are the basic data. These data are not only required for radiation protection, but will have application in other bio-medical sciences, particularly in the evaluation of public health and nutritional status of the people in each country [1].

Our data on the height and weight of Vietnamese are presented in Table 1. They show that the height of male and female adults 20-29 years old is greater than the height of adults in the 40-49 year age range. This acceleration in the development of the height in Vietnamese has been demonstrated by means of a **"horizontal observation"** - a comparison of the data observed in different group ages persons at the same time.

The Fig. 1 indicates the height of male and female Vietnamese in **"vertical observation"** - the comparison of other observed group - ages persons for other periods of time. The data presented in Fig. 1 show also an acceleration in the development of the height of Vietnamese.

Anthropologists have noted the phenomenon of acceleration of body development of a population, referred to as the *secular trend* [2]. The meaning of this term is that, over the course of time the children of the next generation are taller and heavier, and manifestations of puberty may appear earlier than in previous generations.

The rate of the secular trend varies for different populations in fixed time periods, and are the result of difference in nutrition and other environmental factors. For example: Fig. 2 shows the height of Japanese in 1985 [5] and Vietnamese measured in 1992. The data presented in Fig. 2 indicated that the average height of Japanese and Vietnamese females 30-39, 40-49, 50-59, 60-69 years old, and Japanese and Vietnamese males 50-59, 60-69 years

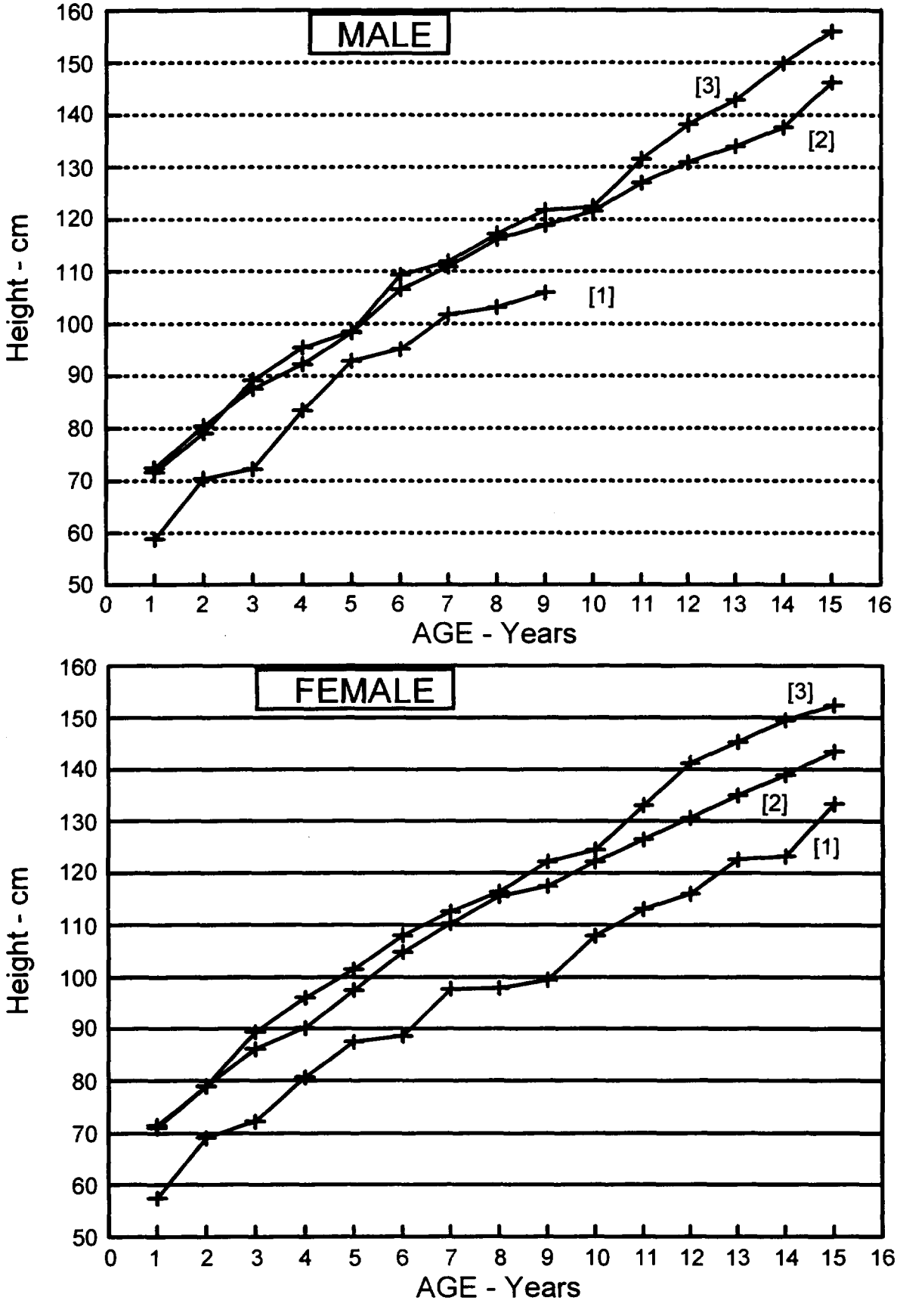
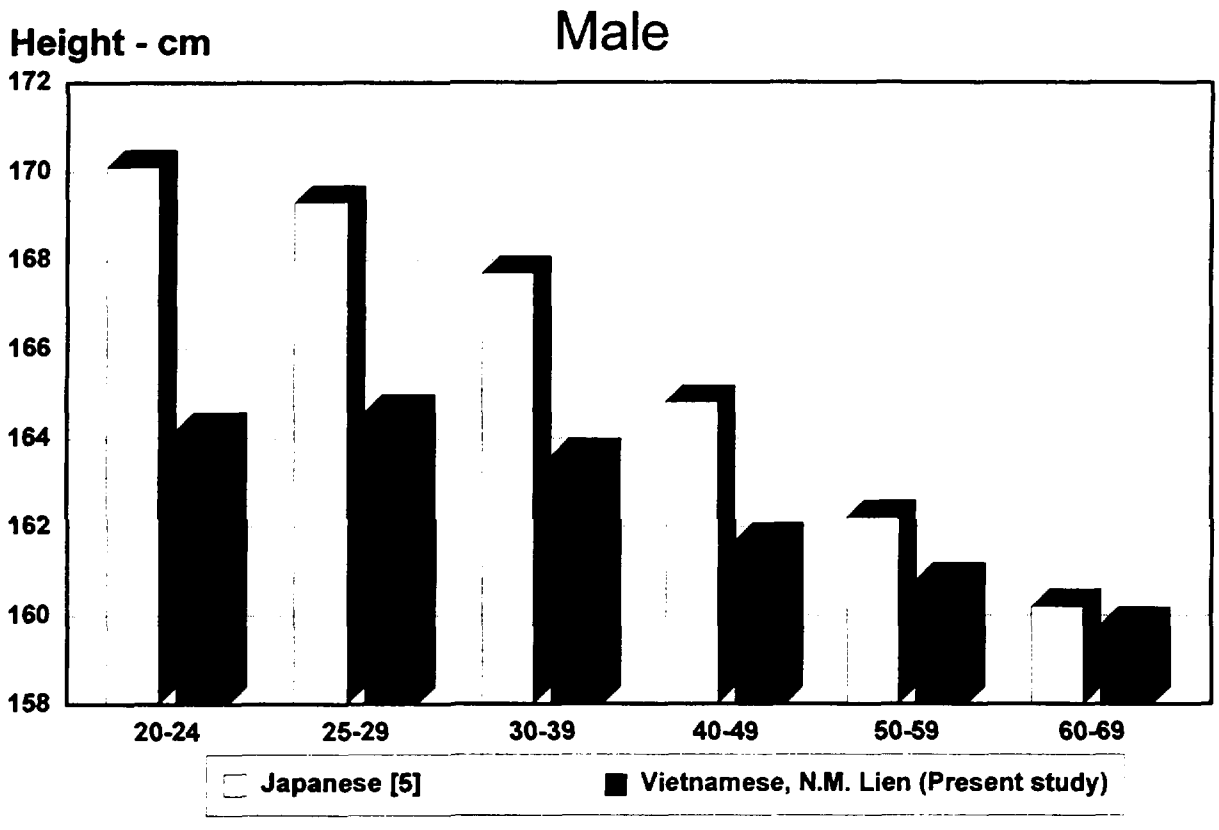


FIG. 1. Age dependent height from various studies.
1. Mondiere (1875) [3]; 2. Biol. Const. of Vietnamese (1975) [4];
3. Nguyen Manh Lien (Present Study).



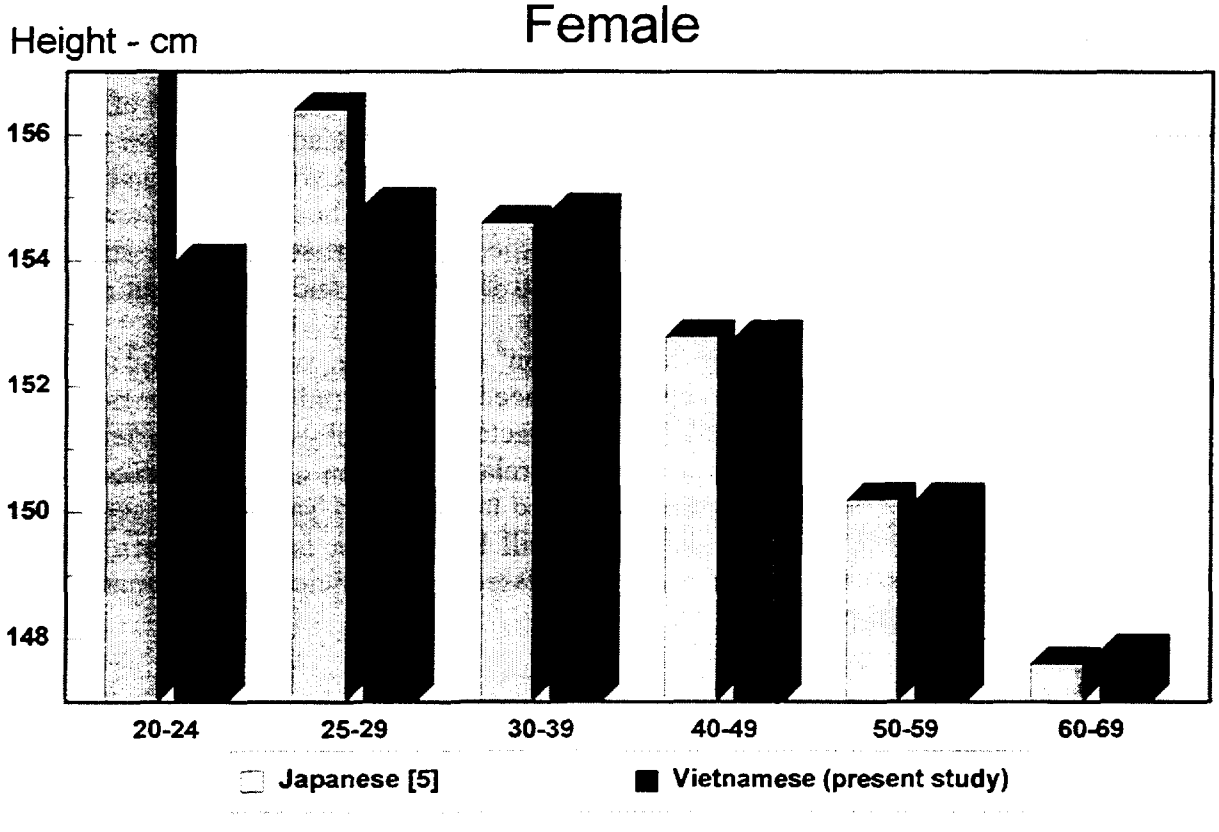


FIG. 2. Average height by age.

old are nearly the same. However, the younger Japanese male and female are taller than young Vietnamese in the same age group. The height of Japanese has increased about (4-6) cm in 30 last years, compared with Vietnamese whose height has increased about (2-3) cm in the same period. The height of Japanese 19 years olds measured annually over a period from 1972 to 1982 shows an increase of about (4-5) cm (Fig. 3).

In the comparison of the secular trends in the Japanese and Vietnamese populations, the increase among the Vietnamese is still slow and was mostly probably influenced by our difficulties during a long period of war.

The development of anthropological parameters is the result of genetic as well of external factors [2]. The genetic factor gives the organism a determined potential for development while external factors, particularly the nutrition conditions supply the necessary material to allow the organism to reach its full development potential [6]. The data on food consumption of Japanese people presented in Table 2 may explain the increased rate growth in the Japanese in 30 last years [7]. The data in Table 2 suggests a parallel increase between the dietary content of protein, vitamins and minerals, and the growth trend in Japanese people over the last 30 years. Since the beginning of the economic reconstruction in Viet Nam, from 1988 to present time, the quantity of protein, fat and milk products in the people's food supply has increased. It is hoped that we will also see an increase in the development of Vietnamese people in the near future.

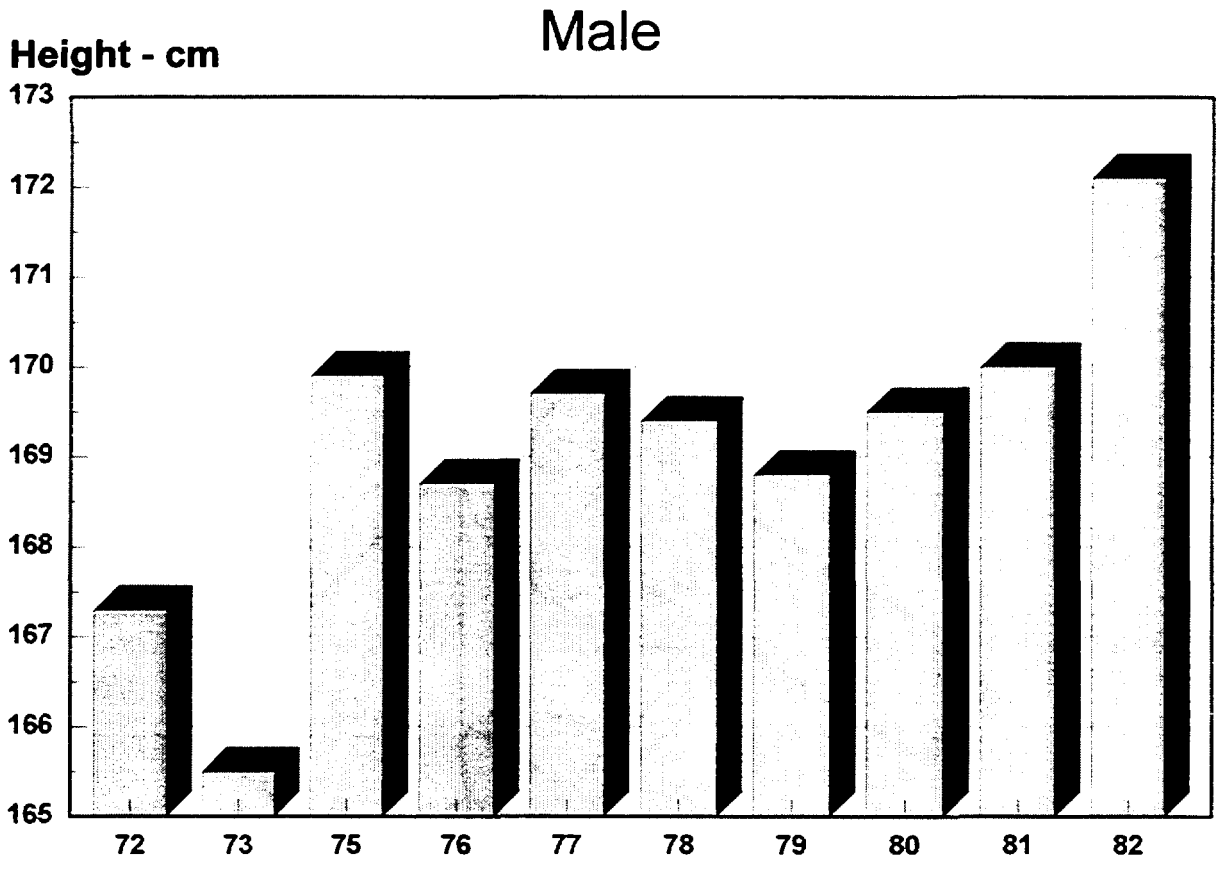
These results indicate an increase in the physical parameters of man with time. However the purpose of our research is to improve internal and external radiation dosimetry. This requires that we obtain the physical constants necessary to establish a dosimetric model for the Vietnamese population similar to the MIRD model [8]. To accomplish this, we can systematically survey the physical parameters of the population annually. This requires considerable time and an adequate number of personal for the measurements. It is not really economical. Therefore, we are seeking a second way to resolve the problem.

In artistic anatomy the term "human canon" is the ratio between the length of different parts of human body and either the body height or height of the head. The *human canon* of adolescent Vietnamese 17-19 years old is presented in Table 3. Following development of our preliminary data (Table 3), we believe that the body lengths and body circumferences may also be influenced the body weight. However, the experience of artistic anatomy shows that there is an intimate relationship between body weight and height, and the "human canon" is specific for each population race, sex and age group.

We hope that, with the aid of the "human canon" coefficients, we can extend the utility of the physical parameter measurements because we need to survey only two parameters every year: population height and weight. With these two factors, other physical parameters can be determined by multiplication of the height and the related "human canon" coefficient. The application of coefficients "human canon" is presented in Fig. 4 and Table 4. The coefficients for the physical parameters presented in Table 4 will be different for each Asian country. However, they may be related if they can be expressed by coefficients of "human canon" characteristic of the Asian population.

ORGAN MEASUREMENTS

The data of major internal organ mass of Vietnamese are presented in Table 5. The following comments summarize our experience in obtaining these measurements:



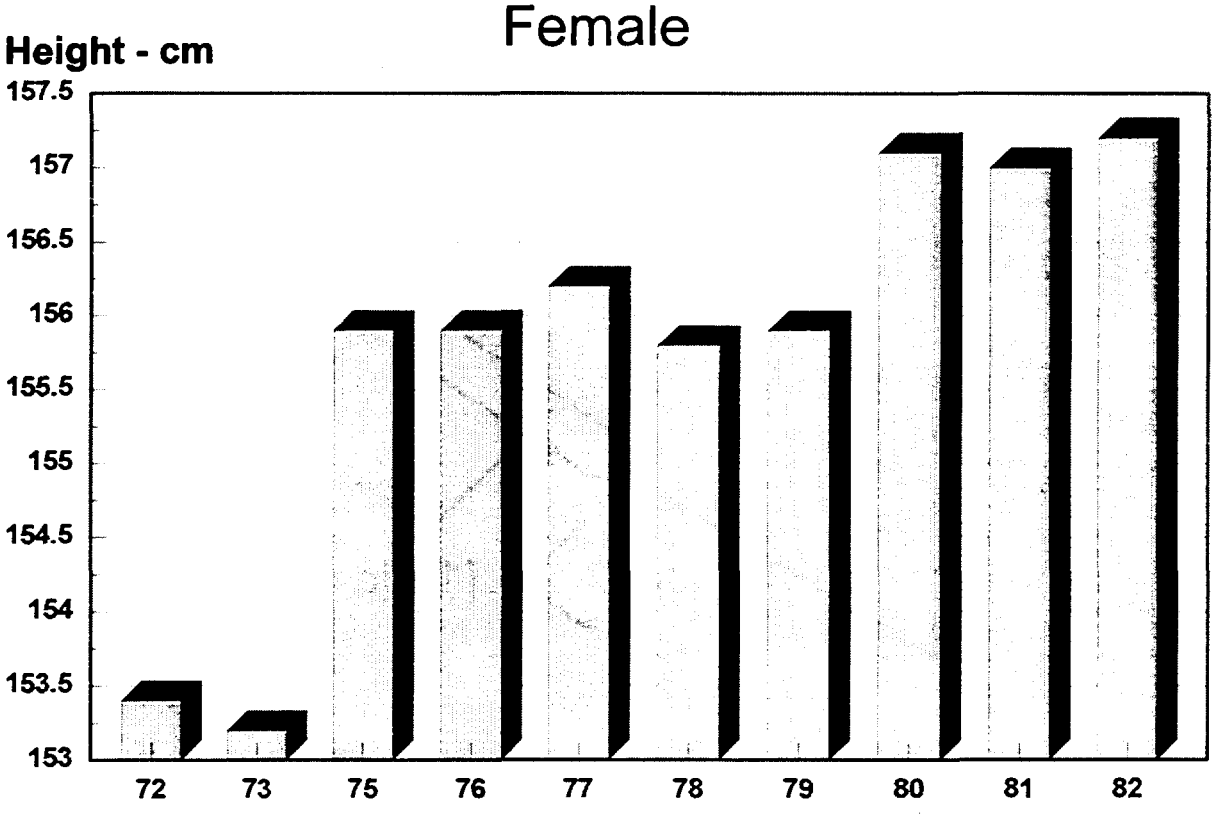


FIG. 3. Average height of 19 year old Japanese.

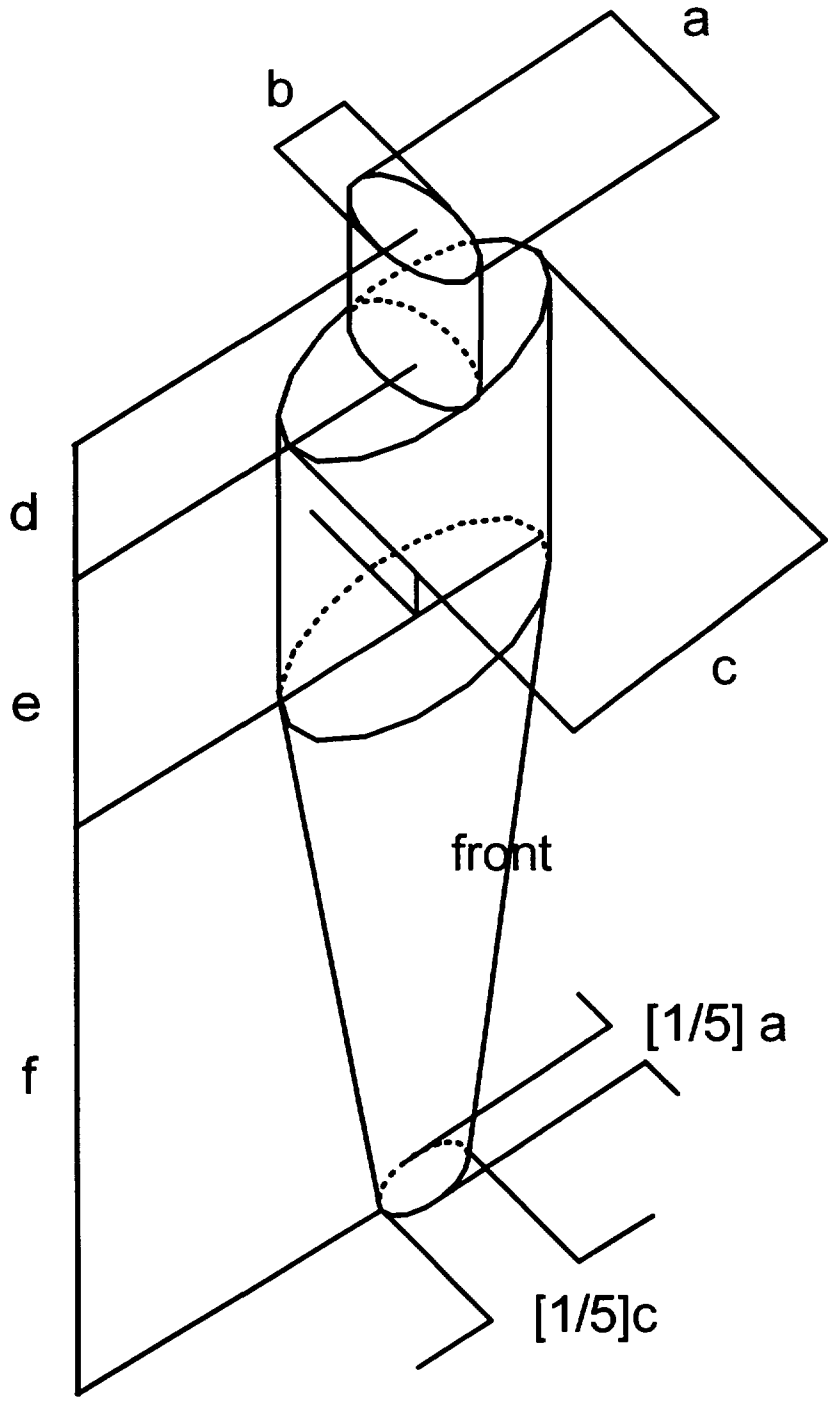


FIG. 4. MIRD Phantom parameters.

TABLE I. HEIGHT AND WEIGHT OF VIETNAMESE (MEASURED IN 1990-1993 VINATOM-IAEA)

Group ages	Males			Females		
	N	Height (cm)	Weight (kg)	N	Height (cm)	Weight (kg)
Newborn	776	48.55 ± 1.93	2.99 ± 0.37	715	48.53 ± 1.80	2.92 ± 0.36
1 year	421	71.58 ± 4.66	7.66 ± 0.29	390	71.47 ± 4.63	7.76 ± 0.28
5 years	812	98.53 ± 4.71	14.49 ± 3.09	734	101.45 ± 4.44	14.56 ± 3.06
10 years	412	122.41 ± 4.98	23.52 ± 3.09	431	124.49 ± 5.36	21.99 ± 2.93
15 years	616	155.99 ± 5.50	40.60 ± 5.72	477	152.32 ± 6.85	40.48 ± 5.10
20-29 years	3030	164.60 ± 4.89	51.52 ± 4.71	1690	154.53 ± 4.46	46.51 ± 5.57
30-39 years	902	163.66 ± 5.53	52.30 ± 5.72	785	153.60 ± 5.20	46.41 ± 5.57
40-49 years	682	162.08 ± 5.52	51.58 ± 7.06	622	152.59 ± 4.53	47.49 ± 6.43
Total adult 20-50 years	4614	164.04 ± 5.06	51.58 ± 5.25	309	153.90 ± 4.66	46.68 ± 5.34

TABLE II. CHANGE IN FOOD CONSUMPTION BY JAPANESE PEOPLE [7]

Categories	1960	1970	1980	1985
Rices	357.8	306.1	225.8	216.1
Wheat flour	64.2	64.8	91.8	91.3
Potatoes	54.1	37.8	63.4	63.2
Vegetables	163.5	249.3	251.4	261.7
Fruits	33.3	81.0	152.2	140.6
Fish & Shellfish	76.9	87.4	92.5	90.0
Meat	17.5	42.5	67.9	71.7
Eggs	20.6	41.2	37.7	40.3
Milk	31.3	68.4	107.8	116.7 (+ milk products)

TABLE III. THE AVERAGE "HUMAN CANON" OF VIETNAMESE ADOLESCENT 17-19 YEARS OLD

Physical Measures	Male		Female	
	In comparison with body height	In comparison with head height	In comparison with body height	In comparison with head height
Height	100.00	676.72	100.00	673.03
Head height	14.77	100.00	14.85	100.00
Sitting height	52.59	355.89	52.57	353.18
Chest circumference	50.29	340.37	53.02	356.91
Chest width	16.34	110.62	16.52	107.80
Chest depth	12.20	82.55	13.47	90.49
Head circumference	33.69	228.03	35.03	235.79
Neck circumference	20.48	138.65	20.82	140.16
Arm circumference	15.37	104.09	16.15	356.91
Thigh circumference	27.76	187.87	30.28	203.83
Forearm circumference	14.11	95.90	14.26	95.98
Shank circumference	19.30	132.26	20.59	138.59

Heart:

When opening the heart, usually we found the clots that form after death. Two basic types are seen: in the first, if the coagulation has occurred rapidly, producing soft uniformly dark red, moist masses. The second kind occurs when the erythrocytes have had time to sediment prior to coagulation. Above the cells, which form a clot similar to the first type, is a pale or bright yellow layer of resume and fibrin. The clots can be easily evacuated by a finger or a forceps, but not a stream of water. We found that the total quantity of the clots in the heart after death is normally 10 to 50 g.

The weight of the heart presented in Table 4 and 5 is the weight without of the clots. We think that in the "Reference Man", the weight of the heart can be estimated and, in addition, the average weight of the blood content in the heart in a cycle of heart's beating.

Lungs:

When the thorax is opened, air at atmospheric pressure replaces the negative pressure in the pleural cavity which has maintained with the expansion of the lungs during life, and

causes them to collapse. They appear smaller than they would have in living man's body and no longer completely fill the pleural cavities. In Radiation Protection the weight of the lungs may be used as basic data in the estimation of organ dose, but their true dimensions during the life can be determined by other methods such as measurement of thoracic cavity, pulmonary radiography, measurement of respiratory volumes, etc.

Brain:

The brain's tissue is soft. As one opens the cranium, the brain's dimensions may be deformed. They appear different than they would be living body. Therefore the estimation of true dimensions of the brain may be done by means of craniometry and radiography.

Gastrointestinal system:

The weight and length of the components of gastrointestinal system can be estimated, with their contents, by anatomical measurement and physiological experience.

With regard to the data we have presented, we think that the weight of size of some internal organs such as the heart, lungs, etc. after autopsy may be different than they would be in the living body. The true value of these organs may be estimated through a combination of anatomical, physiological, ultrasound and radiological studies. The weight and size of other organs such as the liver, pancreas, spleen, etc. at autopsy may be similar their true values in the living body.

TABLE IV. MIRD PHANTOM MODEL OF VIETNAMESE (20-29 YEARS OLD)

Parameters	Male			Female		
	N	Mean ± SD	Coefficient "Human Canon"	N	Mean ± SD	Coefficient "Human Canon"
Height (cm)	3030	164.60 ± 4.89	100.00 ± 2.97	1690	154.53 ± 4.46	100.00 ± 2.88
Weight (kg)	3030	51.52 ± 4.71	-	1690	46.51 ± 4.85	-
Chest circ-umference	3030	82.49 ± 4.74	50.40 ± 2.87	1690	81.89 ± 4.20	52.99 ± 2.71
Sitting height (cm)	3030	86.49 ± 4.68	52.54 ± 2.84	1690	81.15 ± 4.27	52.51 ± 2.76
Phantom factors (cm)						
a	150	18.97 ± 0.67	11.52 ± 0.40	150	17.98 ± 0.75	11.63 ± 0.48
b	150	15.95 ± 0.50	9.69 ± 0.30	150	15.30 ± 0.56	9.90 ± 0.19
c	150	40.10 ± 1.42	24.36 ± 0.86	150	36.97 ± 2.11	23.92 ± 1.36
d	150	24.69 ± 1.76	15.00 ± 1.06	150	23.00 ± 1.91	14.88 ± 1.23
e	150	64.61 ± 2.43	39.25 ± 1.47	150	61.60 ± 2.55	39.86 ± 1.65
f	150	75.10 ± 3.72	45.62 ± 2.26	150	70.25 ± 3.68	45.46 ± 2.38

TABLE V. AVERAGE INTERNAL ORGAN WEIGHT OF VIETNAMESE

Organ		Group Ages											
		N	Newborn	N	1 year	N	5 years	N	10 years	N	15 years	N	Total Adult
a. Brain	male	32	355.63 ± 22.07	25	901.20 ± 67.84	25	1157.60 ± 77.74	28	1170.71 ± 77.36	27	1294.07 ± 80.59	78	1320.90 ± 79.70
	female	35	355.57 ± 24.17	26	900.00 ± 58.31	25	1123.20 ± 74.54	27	1138.89 ± 72.50	29	1243.10 ± 78.93	63	1284.13 ± 71.79
b. Breast (right)	female	10	8.20 ± 2.20	11	11.73 ± 3.47	15	17.13 ± 4.22	15	25.93 ± 7.67	16	120.63 ± 27.68	36	249.72 ± 45.43
c. Heart	male	32	17.09 ± 1.70	25	41.40 ± 2.89	25	82.44 ± 5.14	28	125.64 ± 7.61	27	203.93 ± 17.29	78	258.41 ± 25.82
	female	35	17.00 ± 1.97	26	42.00 ± 3.01	25	84.08 ± 5.17	27	119.81 ± 7.66	29	202.34 ± 18.56	63	230.24 ± 24.21
d. Kidney (both)	male	32	27.41 ± 2.78	25	72.04 ± 6.26	25	129.76 ± 11.48	28	194.00 ± 12.21	27	236.37 ± 13.68	78	296.23 ± 13.33
	female	35	26.00 ± 2.20	26	70.00 ± 6.40	25	128.20 ± 9.98	27	186.60 ± 10.75	29	234.10 ± 10.13	63	276.40 ± 12.67
e. Liver	male	32	75.88 ± 5.60	25	210.96 ± 16.82	25	402.80 ± 55.64	28	705.06 ± 76.71	27	1204.44 ± 107.89	78	1417.82 ± 116.91
	female	35	77.60 ± 5.41	26	221.20 ± 65.03	25	362.00 ± 32.72	27	692.20 ± 57.67	29	1161.90 ± 237.58	63	1319.00 ± 105.70
f. Lung (both)	male	32	39.91 ± 4.41	25	120.60 ± 12.52	25	212.24 ± 15.86	28	390.18 ± 19.79	27	643.70 ± 22.37	78	680.06 ± 27.30
	female	35	39.11 ± 4.02	26	119.80 ± 26.71	25	207.20 ± 20.52	27	325.40 ± 20.80	29	570.30 ± 21.17	63	607.50 ± 26.41
g. Ovaries (both)	female	24	0.25 ± 0.11	17	0.60 ± 0.24	25	1.51 ± 0.32	27	2.94 ± 0.51	29	5.19 ± 0.77	63	9.01 ± 1.04
h. Pancreas	male	32	5.53 ± 2.03	25	15.04 ± 4.30	25	40.00 ± 8.04	28	72.00 ± 12.06	27	102.00 ± 17.89	78	124.81 ± 21.55
	female	35	5.97 ± 1.42	26	14.12 ± 3.87	25	36.84 ± 6.31	27	69.81 ± 9.75	29	97.41 ± 21.16	63	110.30 ± 22.01
i. Pituitary gland	male	9	0.10 ± 0.01	11	0.14 ± 0.01	15	0.25 ± 0.05	15	0.34 ± 0.09	17	0.48 ± 0.14	78	0.60 ± 0.12
	female	10	0.11 ± 0.02	11	0.15 ± 0.02	15	0.25 ± 0.05	15	0.36 ± 0.06	16	0.55 ± 0.11	63	0.60 ± 0.11
j. Spleen	male	32	8.03 ± 1.33	25	25.88 ± 5.09	25	46.92 ± 12.01	28	87.92 ± 17.52	27	149.56 ± 28.64	78	165.74 ± 38.68
	female	35	8.03 ± 1.30	26	25.19 ± 6.40	25	41.76 ± 10.19	27	85.93 ± 19.16	29	137.24 ± 21.45	63	139.68 ± 26.71
k. Testes	male	35	0.35 ± 0.11	25	1.03 ± 0.52	25	2.96 ± 1.12	28	4.02 ± 1.72	27	17.6 ± 3.36	78	36.86 ± 4.44
l. Thymus	male	32	13.06 ± 2.19	25	20.00 ± 3.08	25	20.04 ± 3.63	28	15.00 ± 2.92	27	14.93 ± 3.15	78	10.00 ± 2.21
	female	35	11.97 ± 2.14	26	19.92 ± 3.05	25	18.08 ± 3.20	27	15.07 ± 3.04	29	14.97 ± 3.25	63	7.97 ± 2.23
m. Thyroid (L&F)	male	9	2.02 ± 0.27	11	2.95 ± 0.36	15	9.00 ± 1.50	15	20.03 ± 2.73	17	27.99 ± 3.42	78	35.47 ± 4.31
	female	10	2.17 ± 0.35	11	2.82 ± 0.32	15	9.23 ± 2.38	15	18.67 ± 3.02	16	27.75 ± 3.56	63	36.00 ± 3.31

PHYSIOLOGICAL DATA

Water balance of Vietnamese

The ICRP Reference Man (1975) [10] represents a population that typically lives in environmental conditions of temperature from 10°C to 20°C. However, the climate of Viet Nam is tropical, warm and humid. In Hanoi 277 days of every year, the average air temperature is higher 20°C. In Ho Chi Minh city, the daily air temperature is higher 25°C throughout the year. The hot environment influences to man's physiological functions such as caloric expenditure, water balance and others. Yas Kuno (1959) [11] shows that, at comfortable air temperatures, water loss by evaporation is passive process. When the air temperature increases above the threshold of skin's temperature, the sweat-glands will start to function, and perceptible perspiration occurs. The increase in sweating will result in increased in excretion of water, electrolytes, vitamins and other substances.

The water balance comprises the water intake and the water output. The water intake consists the fluid drunk and the water in the eaten food, and the water formed by the oxidation of carbohydrate, protein and fat (metabolic water). The output water consists the urine, the water in the faeces, and water evaporated from the skin and the lungs.

Methods

1. Experimental Study on Water Balance

Subjects: 6 male volunteers with an average age 36.8±3.0 years, an average total body weight 54.45±3.59 kg, an average height 160±4 cm. 6 women volunteers with an average age 35.0±2.0 years, an average total body weight 45.58±5.93 kg, and an average height 153±4cm. The volunteers worked in a laboratory at a level of light energy expenditure. The conditions were comfortable: air temperature, 22°C-26°C; relative humidity, 70%-85%. During the 3 day study the weight of food, water intake, urine and faeces were measured and recorded to the nearest gram. The total body weight was measured before and after each meal to the nearest 50 grams with a medical balance.

2. Experimental Study on Elemental Composition of Sweat of Vietnamese Working in a Hot Environment

The study involved 15 working male volunteers men-workers with an average age 20.7±1.16) years, average weight 53.70±4.26 kg and average height 164±3.8 cm. The volunteers have been in thermochamber under the following conditions:

Air temperature: 28.0±0.1°C and 35.0±0.1°C
Relative humidity: 80.0±2.5 %
Air velocity: 0.2 m/s

Volunteer exercised using the "steps test" with a energy expenditure of 52.21±2.00 w/h.

The total body weight loss was measured before and after each experience a by suspended balance to the nearest 10 grams. The samples of sweat collected from the hand have been determined by flame photometry and atomic absorption spectrophotometry.

3. Monitoring and surveillance study on loss of weight of workers

Evaluation of the working conditions included air temperature, humidity, air velocity and level of energy-expenditure. The weight of total body was measured before and after working time (generally 4 hours). The skin body's surface is calculated by means of Geigy monograms [10].

Results

Water balance

Results obtained from experimental study on physiological characteristics of subjects are presented in Table 6. The data presented in Table 7 show that the subjects did not experience heat strain.

The water balance data for the 12 volunteers are presented in Table 8. [The *Statistical error average* $m = SD / \sqrt{N}$.]

The daily consumption of boiled water and tea of Vietnamese is different than Caucasian. The high quantity of water content of solid food in Vietnamese meals is in boiled rice, vegetable broths, soups, ripe fruits, etc. The quantity of metabolic water of Vietnamese is also higher than those of Caucasian. Perhaps it is determined by the greater quantity of rice and vegetable consumed in daily meals.

In normal life, the intake of fluid is largely determined by social custom and habit. At this time, in Viet Nam, the people drink a small quantity of milk, which is used specially in the nutrition of children and patients. The majority of Vietnamese people also drinks a small quantity of alcohol or liquor in holidays, and don't drink other fluids such as wine and mineral water in daily meals. However, beer is used for thirst-quenching as is the tea and boiled water.

We know that the imperceptible water loss consists of the water evaporated from skin and lungs. The imperceptible weight loss consists of the imperceptible water loss and the deficit of weight in respiratory exchange of oxygen and carbonic gas [12]. The composition of the imperceptible weight loss of Vietnamese in comfortable conditions of environment and light energy expenditure are presented in Table 9. According to the data presented in Table 9, it is possible that the imperceptible weight loss of Vietnamese is approximately 30 g/m2 body's surface/hour. There is no difference between man and woman. However, when the air temperature becomes higher than the threshold of skin's temperature, the increase of sweating will occur and the loss of weight of total body becomes greater (Table 7).

The data presented in table 7 show that a person working with middle energy expenditure in hot environment may lose (2-3) kg per day by sweat. For rehydration he can take the same quantity of water. When the energy expenditure and the elevated air temperature increase the quantity of the water loss, water intake also increases to as much as 5 kg per day or more. The elemental composition of sweat of Vietnamese is presented in Table 10.

Pulmonary function

The pulmonary function of Vietnamese living in Hanoi and Ho Chi Minh city were carried out using an electronic spirometer "Fukuda Spiroshift - 3000". Data of respiratory air-flow-volumes were recorded and automatically analyzed by microcomputer (Tables 10 and 11).

It is known that the values of total lung capacity and vital capacity are related to basic variables such as sex, age, body height and mass. The dependence of vital capacity on these variables has been described by predictive equations of Knudson (1976, 1983) [13], ITS (Intermountain Thoracic society) (1979, 1981) [14], ECCS (European Community Coal and

Steel) (1961, 1967) [15], Kristufec P. et al... (1987) [16] and others. Our experience shows that the values of vital capacity for Vietnamese are similar to the values determined by predictive equations of Knudson (1983).

DAILY NUTRITIONAL INTAKE

The daily nutritional intake data are presented in Table 12, 13. The Elemental Composition of daily dietary intake presented in Table 15. From the data presented in Tables 13, 14, 15 there appears to be an increase in per capita food consumption in Viet Nam. The quantities of protein, including the protein from animal origin, and fat in food consumed are higher than the data observed in previous years. As a result of more industrialization in milk production, an increase of milk consumption in all Viet Nam had been observed in the first six month of this year (1993).

TABLE VI. PHYSIOLOGICAL CHARACTERISTICS OF SUBJECTS (AVERAGE DATA IN 3 EXPERIMENTAL DAYS)

No.	Physiological Characteristics	Males	Females
1	Food supply energy	(11.79 ± 0.54) MJ	(8.69 ± 0.52) MJ
2	Rectal temperature	(36.80 ± 0.05)°C	(36.80 ± 0.07)°C
3	Average skin temperature	(33.18 ± 0.12)°C	(33.42 ± 0.13)°C
4	Pulse	(77 ± 2) beats/mn	(77 ± 3) beats/mn

TABLE VII. LOSS OF WEIGHT OF VIETNAMESE IN DIFFERENT CONDITIONS OF WORK AND ENVIRONMENT

Conditions of work (N = number of subject)	Conditions of environment			Loss of weight (g/m^2 body surface/hour)
	Temperature (°C)	Relative humidity (%)	Air velocity (m/s)	
Work in laboratory (N = 12)	20-25	85	0.05 - 0.25	45
Conduction of tractor (N = 12)	37.6 ± 0.7	60	0.25 - 0.90	198 ± 15
Conduction of heavy cars (N = 18)	38.3 ± 0.7	60	0.05 - 0.09	145 ± 16
Conduction of machine elevators (N = 15)	35.9 ± 0.5	70	0.05 - 0.25	242 ± 20
Experience in temperature chamber with medium energy expenditure	25 35	80 80	0.25 0.25	135 ± 13 195 ± 15

The country wide milk intake data in Viet Nam during those 6 months are: 60 million boxes of condensed milk, 3 million boxes of dry milk and 1,6 million liters of sterilized milk. The total intake of these products is equivalent to 73,6 millions of litters sterilized milk, so that the mean daily intake of Vietnamese is 6,2 g of milk per day per capita.

The food consumption data from the Viet Nam National Institute of Nutrition (1986) show an unbalanced state and deficient food intake in the nutrition of Vietnamese. However, after economical reconstruction in the recent years the data of food consumption and food supply are varied. The quantities of protein, fat and milk products in people's food consumption continues to increase.

TABLE VIII. WATER BALANCE OF VIETNAMESE IN COMFORTABLE CONDITIONS OF ENVIRONMENT AND LIGHT ENERGY EXPENDITURE (AVERAGE DATA OF 6 MALE AND 6 FEMALE VOLUNTEERS IN 3 DAYS (x m) ml/24 h)

Contents of water balance	Man		Woman	
	Caucasian	Vietnamese	Caucasian	Vietnamese
Water intake:				
Milk	300		200	
Water drunk	150		100	
Other liquids drunk	1500		1100	
Total liquid drunk	1950	855 ± 58	1400	850 ± 36
Water content of solid food	700	1281 ± 39	450	1027 ± 39
Metabolic water	350	389 ± 20	250	262 ± 17
Total water intake	3000	2525 ± 41	2100	2139 ± 85
Water output	1400		1000	
Faecal water	100	155 ± 16	90	105 ± 33
Urine	850	1093 ± 89	600	849 ± 85
No perceptible water loss	650	1233 ± 84	410	1138 ± 83
Total water output	3000	2481 ± 86	2100	2092 ± 85
Water balance		+ 44		+ 47

TABLE IX. COMPOSITION OF IMPERCEPTIBLE WEIGHT LOSS OF VIETNAMESE WORKING WITH A LIGHT ENERGY EXPENDITURE IN COMFORTABLE CONDITIONS OF ENVIRONMENT (AVERAGE DATA OF 6 MALE AND 6 FEMALE VOLUNTEERS IN A 3 DAY TEST)

Contents	Quantity (g/m^2 body surface/h)
1. Water loss from skin	14-15
2. Water loss from alveolarly surface of lungs	10
3. Weight loss by respiratory exchange of oxygen and carbonic gas	5-6
Total	29-31

TABLE X. QUANTITY AND ELEMENTAL COMPOSITION OF SWEAT FROM 15 MALE VIETNAMESE VOLUNTEERS

Quantity and elemental composition of sweat	Air Conditions	
	28°C	35°C
Quantity of sweat (g/hour)	400 ± 13	581 ± 21
Elemental composition (mg/100 ml)		
Cl	95.90 - 192.50	196.00 - 323.75
Na	44.87 - 87.17	85.10 - 199.87
Ca	0.62 - 1.60	1.22 - 2.40
Mg	0.28 - 0.72	0.64 - 1.45
K	19.2 - 39.2	19.2 - 39.2
Cu	0.006	0.006
Mn	0.006	0.006
Fe	0.1 - 0.2	0.1 - 0.2

TABLE XI. TOTAL LUNG AND VITAL CAPACITY OF VIETNAMESE ($\bar{X}$ ± sd)l

Group Ages	Male			Female		
	N	Total lung capacity	Vital capacity	N	Total lung capacity	Vital capacity
5 years	115	0.75 ± 0.18	0.62 ± 0.15	115	0.62 ± 0.18	0.52 ± 0.15
10 years	115	1.93 ± 0.30	1.59 ± 0.25	115	1.74 ± 0.24	1.45 ± 0.20
15 years	115	3.74 ± 0.48	3.07 ± 0.40	115	3.20 ± 0.33	2.66 ± 0.28
20-29 years	132	4.53 ± 0.54	3.72 ± 0.45	98	3.54 ± 0.38	2.95 ± 0.32
30-39 years	120	4.40 ± 0.82	3.61 ± 0.68	96	3.30 ± 0.58	2.75 ± 0.49
40-49 years	105	4.08 ± 0.78	3.35 ± 0.64	90	2.97 ± 0.68	2.48 ± 0.57
Total Adult 20-50 years	357	4.43 ± 0.70	3.63 ± 0.58	284	3.28 ± 0.54	2.73 ± 0.45

TABLE XII. MINUTE VOLUME AND 8h WORKING VOLUME RESPIRATORY AIR OF VIETNAMESE

Sex	Group Age	N	Minute volume (l/min)			N	8h working volume (liters)		
			Active Level				Active Level		
			Resting	Light	Heave		Resting	Light	Heavy
Male	Newborn	12	0.5						
	1 year	12	1.4						
	5 years	12	3.0	6.0	11.0	12	28800	72000	
	10 years	12	4.5	8.5	14.0	12	34560	81600	
	15 years	12	5.0	20.0	40.0	12	36600	192000	422400
	Total Adult 20-50 years	36	6.5	25.0	45.0	36	37440	204000	453600
Female	Newborn	12	0.5						
	1 year	12	1.4						
	5 years	12	3.0	6.0	11.0	12	28800	72600	
	10 years	12	4.5	8.5	14.0	12	34560	81660	
	15 years	12	5.0	20.0	35.0	12	36600	192000	369600
	Total Adult 20-50 years	36	6.0	20.0	40.0	36	34560	192000	422400

TABLE XIII. AVERAGE FOOD CONSUMPTION (g/CAPITA/DAY) IN VIETNAM IN 1990-1991

Food	Rural Regions									Urban Regions		Average of all country
	1-North Mountain	2-North Midland	3-North Delta	4-Middle North	5-Middle Coastal	6-Middle Mountain	7-South Delta	8-South North Area	Average Data	9-Hanoi City	10-Ho Chi Minh City	
Rice	493.0	425.0	480.0	414.0	406.0	497.0	482.0	463.0	457.5	404	404.4	453.6
Other cereals	6.6	59.9	2.8	9.3	-	0.2	2.8	0.8	8.5	13.5	32.2	9.8
Potatoes	44.0	4.6	62.9	106.0	42.1	8.3	5.6	9.2	39.2	12	4.2	36.8
Sugar	0.0	0.0	0.5	0.1	0.4	3.3	0.5	0.2	0.4	1.4	8.9	0.9
Oil seeds	19.7	8.1	4.0	4.8	1.2	0.1	3.3	6.6	5.5	8.6	4.8	5.5
Sofa cake	8.3	19.5	2.0	0.8	0.9	-	2.4	15.0	4.7	29.6	10.3	5.4
Vegetables	265	245	259	186	106	189	125	200	186	213	223	183
Ripe fruits	-	-	1.0	0.6	1.5	14.8	1.7	2.4	1.7	5.8	16.7	2.6
Meat	27.8	17.6	10.7	14.2	13.0	24.2	15.4	27.7	16.8	67	49.4	19.4
Eggs	1.6	1.2	1.8	0.8	1.2	0.5	2.3	4.4	1.7	10.3	7.8	2.2
Fish	13.1	27.5	39.2	61.8	112.0	55.3	99.5	78.7	67.2	32.9	55.6	65.9
Milk	0.0	-	-	-	-	-	-	-	0.0	-	6.7	0.4
Grease and oil	5.0	3.6	2.6	1.6	3.7	0.4	2.2	4.0	2.8	7.4	10.3	3.3
Fish sauce	23.4	21.0	38.3	18.5	36.2	4.3	26.7	22.1	26.4	12.7	13.7	25.4
Number of investigated families	1620	360	5040	1440	1080	206	1080	1080	11906	740	143	12789
Population (x 1000)	5388	4681	9069	8568	6660	2485	14339	3737	54928	54928	1089	59186

TABLE XIV. CHARACTERISTICS AND NUTRITIVE VALUE OF DIET IN VIETNAM (CAPITA/DAY)

Nutritive value		Rural Regions									Urban Regions		Average of all country
		1-North Mountain	2-North Midland	3-North Delta	4-Middle North	5-Middle Coastal	6-Middle Mountain	7-South Delta	8-South North Area	Average Data	9-Hanoi City	10-Ho Chi Minh City	
Energy (Kcal)		2129	1928	1982	1822	1800	1974	1953	1937	1934	1898	1930	1932
Protein (g)	Total	58.8	56.7	55.6	53.0	61.8	65.6	65.2	64.8	59.9	62.4	55.0	59.7
	Animal	8.5	8.0	10.2	14.1	25.6	20.1	23.7	22.6	17.1	19.9	16.5	17.2
Lipids (g)	Total	21.1	18.7	12.3	12.9	15.1	11.8	13.3	18.3	14.8	30.7	27.6	15.8
	Vegetal	11.7	10.7	7.4	6.9	4.9	5.3	5.5	6.5	7.1	9.4	5.0	7.0
Glucid (g)		412	371	400	362	343	389	381	365	378	331	348	376
Mineral (mg)	Calcium	447	693	768	528	472	333	528	629	565	445	339	551
	Phosphorus	788	812	770	749	767	721	804	834	775	819	3396	916
	Iron	10.7	10.8	10.7	9.8	8.9	8.1	9.2	10.1	9.8	10.7	9.6	9.8
Vitamins (mg)	Carotene	3.12	5.05	4.00	2.11	1.89	4.05	1.93	3.41	2.90	3.10	3.14	2.90
Vitamin	A	0.054	0.01	0.074	0.042	0.014	0.005	0.02	0.025	0.044	0.068	0.043	0.065
	B1	0.87	0.56	0.75	0.69	0.60	0.65	0.65	0.74	0.70	0.97	0.58	0.70
	B2	0.40	0.57	0.39	0.37	0.24	0.32	0.25	0.32	0.30	0.44	0.60	0.51
	PP	12.0	10.7	9.68	8.98	8.82	9.88	9.03	9.2	9.5	10.9	8.3	9.5
	C	81.8	69.6	87.8	71.4	29.1	43.4	28.0	44.8	62.9	64.8	30.8	61.2
Percentage of energy from													
	Proteins	11.2	12.1	11.5	11.9	14.1	13.6	14.0	14.0	12.0	13.5	11.8	13.0
	Lipids	9.3	9.0	5.8	6.6	7.8	5.5	6.0	9.0	7.0	15.0	13.5	9.1
	Glucids	79.5	78.9	82.7	81.5	78.4	80.8	80.0	77.0	80.1	71.5	74.7	77.9

TABLE XV. ELEMENTAL COMPOSITION OF DAILY DIETARY INTAKE

Country: Vietnam Regions Sampled: 10 ecol. regions Population Studied: 59186 people Period of Study: 1990-1991			References: Tu Giay Vietnam National Institute of Nutrition Report 1990-1991	
	Mean	Minimum	Maximum	Units
Aluminum	4.5	2.5	6.5	mg
Calcium	551	420	751	mg
Chlorine	11,250	4,260	15,975	mg
Copper	1.2	0.8	1.4	mg
Iodine	0.15	0.05	0.30	mg
Iron	9.8	6.5	12.8	mg
Magnesium	370	225	450	mg
Manganese	4.2	3.6	4.9	mg
Phosphorus	916	720	1,250	mg
Potassium	2,100	1,800	3,500	mg
Sodium	6,020	1,610	8,050	mg
Strontium	2.3	1.8	2.8	µg
Zinc	7.5	6.2	9.1	mg

CONCLUSIONS

1. The comparison of the physical measurement data obtained in this study with earlier data from other authors, and the evaluation of our data for different age groups in each year shows a regular trend of acceleration in the development of Vietnamese, however this trend is still slower than that of other countries.

2. In Radiation protection for the full use of measured physical parameters to avoid impact of this variation over the course of time, we may employ specific ratios between the length of different parts of human body for race, sex and group ages.

3. The weight and size of many internal organs as the heart, lungs, etc. at autopsy may be different than they would be in living man body's organism. It may be necessary to employ a combination of anatomical, physiological, ultrasound and radiological techniques to determine the in-vivo values of these organs. The weight and size of other organs such as the liver, pancreas, and spleen at death autopsy may be similar their true values in living body.

4. The daily water intake of Vietnamese living and working in normal environmental conditions is different than Caucasian. The major part of water intake is the quantity of water content in the boiled rice and soups in Vietnamese meals.

5. In tropical environmental conditions a worker with medium energy expenditure may lose (2-3) kg body weight body and a considerable quantity of minerals per day by sweat. For rehydration he can take the same volumes of water per day and an adequate quantity of mineral salts.

6. The food consumption data from the Viet Nam National Institute of Nutrition (1986) show an unbalanced situation and deficient food intake in the nutrition of Vietnamese. However, after economic reconstruction in recent years the food consumption and food supply data are varied. The quantities of protein, fat and milk products in people's food consumption are continuing to increase.

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