

## Basic health indicators of high school students of rare ethnic San Diu located in Vinh Phuc Province, Vietnam, compared with Kinh

Các chỉ số sức khỏe cơ bản của học sinh trung học phổ thông dân tộc Sán Dìu thuộc tỉnh Vĩnh Phúc, so sánh với học sinh dân tộc Kinh

Do Hong Cuong<sup>a</sup>, Hoang Quy Tinh<sup>b\*</sup>, Vinay Bharadwaj Tatipamula<sup>c</sup>, Le Thanh Do<sup>c,d\*</sup>  
Đỗ Hồng Cường<sup>a</sup>, Hoàng Quý Tinh<sup>b\*</sup>, Vinay Bharadwaj Tatipamula<sup>c</sup>, Lê Thành Đô<sup>c,d\*</sup>

<sup>a</sup>Hanoi Metropolitan University of Vietnam, Hanoi, 100000, Vietnam

<sup>a</sup>Đại học Thủ đô Hà Nội, Hà Nội, 100000, Việt Nam

<sup>b</sup>Faculty of Early Childhood Education, Hanoi National University of Education, Hanoi, 100000, Vietnam

<sup>b</sup>Khoa Giáo dục Mầm non, Đại học Sư phạm Hà Nội, Hà Nội, 100000, Việt Nam

<sup>c</sup>Institute of Research and Development, Duy Tan University, Danang, 550000, Vietnam

<sup>c</sup>Viện Nghiên cứu và Phát triển Công nghệ Cao, Đại học Duy Tân, Đà Nẵng, 550000, Việt Nam

<sup>d</sup>Institute for Global Health Innovations, Duy Tan University, Danang, 550000, Vietnam

<sup>d</sup>Viện Sáng kiến Sức khỏe Toàn cầu, Đại học Duy Tân, Đà Nẵng, 550000, Việt Nam

(Ngày nhận bài: 05/01/2022, ngày phản biện xong: 18/02/2022, ngày chấp nhận đăng: 27/3/2022)

### Abstract

The objective of this research was to identify several morphological and physical strengths of male and female students aged 16-18, contributing to building Vietnamese biological values in the current period. This research on morphological and physical strengths was conducted on 795 high school students, including 406 students of Kinh (50.06%), and 389 students of San Diu (49.94%) in Tam Dao district, Vinh Phuc province. Based on BMI, male and female students in Tam Dao are normal. Morphological index, heart rate, and arterial blood pressure of recruited students are in the normal development rule of Vietnamese adults. The correlation between the standing height of the Kinh and the San Diu people with the heart rate is negative, while the maximum blood pressure and minimum blood pressure are positively correlated. The morphological - physical and physiological functions of the students often change and depend on genetic factors, living conditions, gender, and age. Therefore, the study of these indicators should be conducted regularly in order to build the database for proposing measures to improve human quality and propose appropriate education and training measures .

**Keywords:** Heart rate; blood pressure; height for age; BMI for age; San Diu ethnic.

### Tóm tắt

Mục tiêu của nghiên cứu là xác định một số hình thái, thể lực của nam và nữ lứa tuổi 16-18, góp phần xây dựng chỉ số các sinh học người Việt Nam trong giai đoạn hiện nay. Nghiên cứu này được thực hiện trên 795 học sinh trung học phổ thông, trong đó, học sinh dân tộc Kinh (50,06%) và học sinh dân tộc Sán Dìu (49,94%) tại huyện Tam Đảo, tỉnh Vĩnh Phúc. Dựa vào chỉ số BMI, nam và nữ học sinh ở Tam Đảo đều bình thường. Các chỉ số hình thái, nhịp tim, huyết áp của các học sinh tham gia đều nằm trong giới hạn phát triển bình thường của người Việt Nam trưởng thành. Mỗi tương

\* *Corresponding Authors:* Le Thanh Do; Institute of Research and Development, Duy Tan University, Danang, 550000, Vietnam; Institute for Global Health Innovations, Duy Tan University, Danang, 550000, Vietnam;

*Email:* lethanhdo1@duytan.edu.vn.

Hoang Quy Tinh; Faculty of Early Childhood Education, Hanoi National University of Education, Hanoi, 100000, Vietnam;

*Email:* hoangquy\_tinh@yahoo.com

quan giữa chiều cao đứng của học sinh trung học phổ thông cả hai dân tộc với nhịp tim của họ là tương quan nghịch, trong khi huyết áp tối đa và huyết áp tối thiểu có tương quan thuận. Hình thái - thể chất và chức năng sinh lý của học sinh thường thay đổi và phụ thuộc vào các yếu tố di truyền, điều kiện sống, giới tính, lứa tuổi. Vì vậy, việc nghiên cứu các chỉ tiêu này cần được tiến hành thường xuyên để có các số liệu làm cơ sở đề xuất các biện pháp nâng cao chất lượng con người và đề xuất các phương thức giáo dục và đào tạo phù hợp.

*Từ khóa:* Nhịp tim; huyết áp; chiều cao theo tuổi; BMI theo tuổi; dân tộc Sán Diu.

## 1. Introduction

The functional index of the circulatory system studied often focuses on heart rate and blood pressure. Scientists stated that the baby's heart rate in the first few days after birth is about 120-140 beats/minute (bpm), about 110-160 bpm in a nursing baby, about 85-100 bpm in pre-school children, about 70-74 bpm in students (Boxwell 2010). Also, the researchers and doctors stated that the reduction in heart rate during the development of a child is due to the change in metabolic rate and the reduction of the excitability of the sinus node as well as the increase in the tonic effect of the X-ray nerve on the heart (Griffiths et al. 1990).

The next target that many people care about is arterial blood pressure. Arterial blood pressure has been studied since the 19th century by many doctors. Earlier, Kortkoff determined blood pressure by indirect measurement, and this method is still commonly used. Many studies show that there is a change in blood pressure at different stages in the development of a child (Ware and Anderson 1966; Stegall et al. 1968).

In order to contribute to building the biological values of Vietnamese people in the early years of the 21st century, we conducted several periodic indexes and the relationship with the above physical strengths on students of ethnic groups in Vietnam with specific objectives: Identify several circulatory and physical indicators and the relationship between indicators of ethnic high school students of Kinh and San Diu in Tam Dao district, Vinh Phuc province. The results obtained in this research topic can assist students' physical enhancement.

## 2. Methods

### 2.1. Research subjects

A total of 795 high school students aged 16 to 18 years from Kinh (208 boys, 198 girls) and San Diu (190 boys, 199 girls) ethnic groups of Vietnam who were studying at two high schools of Tam Dao district, Vinh Phuc province (Table 1). All the study subjects were active during their academics, and exercise classes, and no one under any medication. Also, research subjects have good health and physical shape, non-smokers, no signs of cardiovascular diseases, no congenital disabilities, no chronic disease, and normal mental-physiological state.

Table 1. Distribution of the participants by gender and age

No.	Age	Kinh		San Diu		Total
		Male	Female	Male	Female	
1	16	72	73	62	68	275
2	17	69	62	65	64	260
3	18	67	63	63	67	260
<b>Total</b>		208	198	190	199	<b>795</b>

Earlier to study, the purpose and study methods were clearly explained to the study subjects, their parents and the staff of the high

schools, and also to the cardiologist. Furthermore, written informed consent obtained from all the subjects and the study was

performed after receiving approvals from the ethical committee of Duy Tan University, Da Nang, Vietnam.

### 2.2. Research Methods

The studies on each subject performed in the morning with overnight fasting. By using standard beam balance, the weight and height of the subjects (in a bathing suit) were measured. Body mass index (BMI) is determined by body weight divided by height (Gray and Fujioka 1991). The heart rate and arterial blood pressure measured was by using a sphygmomanometer (Omron 10, Japan) (Toska and Eriksen 1993). Besides, to study the relationship between the circulatory and physical indicators - the research data was processed according to the statistical probability algorithms in medicine and biology.

### 3. Results and Discussion

#### 3.1. The vertical height of high school students of Kinh and San Diu ethnic groups

Standing height is one of the most basic biological indicators reflecting the growth and development of the human body through the

age classes. Studies in this area show that, at the age of students, standing height varies with age, by gender (Gray and Fujioka 1991).

Through research results on high school students in Tam Dao district, Vinh Phuc province from 16 to 18 years old, we found that, both in Kinh and San Diu students, standing height continued to increase with age. The rate of growth at these ages is not steady, with the age of 16 to 17 years increasing faster than the age of 17 to 18 years, and gradually becomes stable because the children of these ages have passed through puberty. The rate of growth over the ages in men is higher than that of the females, and also, the Kinh is higher than the San Diu at this stage. The reason is that the male puberty period ends later than females. The study's result of Long *et al.* (1996) and Minh *et al.* (1996) on students at these ages also showed similar results. Thus, the development of the standing height of high school age students in Tam Dao district, Vinh Phuc province, is similar to students at this age in other localities in our country (Table 2).

Table 2. Standing height by age (cm), by age group, gender, and ethnicity

Gender	Age	Ethnicity						A-B	P (1-2)
		Kinh (1)			San Diu (2)				
		n	A*	Increase	n	B*	Increase		
Male	16	72	161.08±4.51	-	62	160.15±4.71	-	0.93	>0.05
	17	69	163.82±4.21	2.74	65	162.57±3.18	2.42	1.25	>0.05
	18	67	165.83±5.02	2.01	63	163.95±3.47	1.38	1.88	<0.05
			AI/year		2.38	AI/year		1.90	
Female	16	73	<b>152.06±4.31</b>	-	68	<b>151.54±3.43</b>	-	0.52	>0.05
	17	62	<b>153.80±5.34</b>	1.74	64	<b>152.78±3.57</b>	1.24	1.02	>0.05
	18	63	<b>155.08±5.12</b>	1.28	67	<b>153.21±7.46</b>	0.43	1.87	>0.05
			AI/year		1.51	AI/year		0.84	

\*mean ± SD; ANOVA followed by a t-test test with *p* values statistically significant; AI/year: Average increase/year

Comparing results with some previous reports of Long *et al.* (1996) and Thuy *et al.* (2006), the height of students in our study is higher. In our opinion, the increase in the

standing height of high school students in Tam Dao district is due to the socio-economic conditions of Tam Dao in particular. In general, Vinh Phuc in recent years with strong growth

and living standards of people enhanced. However, according to the Ministry of Health Hanoi (2003) reports, the difference in height between San Diu ethnic students and GTSH TK 90 is not much and not significant ( $p>0.05$ ).

### 3.2. Body mass index (BMI)

BMI is determined through the relationship between weight and height. This index is relatively favorable in studying, especially on large numbers of objects. The heavier the person is, the greater the BMI is. Based on BMI, one can assess the nutritional status of the body (Gray and Fujioka 1991).

The results of the study in Table 3 show that with the increase in weight, there is an increase in the average BMI of students with their age. In the same age, the BMI of female students is always higher than that of male students. Also, San Diu's ethnicity is higher than Kinh. The increase in BMI by age indicates the height increase of high school students in Tam Dao district, and Vinh Phuc province is inconsistent and lower than the weight gain. This result is also consistent with the data in the book "GTSH TK90" (Ministry of Health Hanoi 2003), "TSL HSPT" (Thuy *et al.* 2006), as well as, with the studies of Long *et al.* (1996) and Minh *et al.* (1996).

Table 3. BMI of students by age, gender, ethnicity

Gender	Age	Ethnicity						A-B	P (1-2)
		Kinh (1)			San Diu (2)				
		n	A*	Increase	n	B*	Increase		
Male	16	72	<b>17.86±1.09</b>	-	62	<b>18.33±1.88</b>	-	- 0.47	>0.05
	17	69	<b>18.23±1.51</b>	0.37	65	<b>18.63±1.63</b>	0.30	- 0.40	>0.05
	18	67	<b>18.73±2.09</b>	0.50	63	<b>19.35±2.07</b>	0.72	- 0.62	>0.05
			AI/year	0.44		AI/year	0.51		
Female	16	73	<b>18.97±1.54</b>	-	68	<b>19.19±1.98</b>	-	- 0.22	> <b>0.05</b>
	17	62	<b>19.07±2.39</b>	0.10	64	<b>20.01±2.62</b>	0.82	- 0.94	< <b>0.05</b>
	18	63	<b>19.21±2.28</b>	0.14	67	<b>20.45±2.04</b>	0.44	- 1.24	< <b>0.01</b>
			AI/year	0.12		AI/year	0.63		

\*mean ± SD; ANOVA followed by a t-test test with  $p$  values statistically significant; AI/year: Average increase/year

From the results of research on the morphology and physical strengths of Kinh and San Diu ethnic high school students, it is found that the period of 16-18 years is the period of indicators. Morphology - physical strengths still have growth, especially in male students, while female students have slowed down but continue to increase because female students' puberty begins early and also ends earlier than male students. At the age of 16-18, most of the girls have passed puberty, and for many male children still in puberty, there is a rapid growth in morphological - physical indicators.

Compared with the previous studies results (Trong *et al.* 1975; Thuy *et al.* 2006) of morphological research – the current results on physical strength are good. In our opinion, this morphological difference is mainly due to the development of socio-economic conditions in recent years. Although there are still many difficulties, in order to better improve nutrition, care of both material and spirit, physical training, exercise, sports in the family and school, the movement when participating in agricultural production to help the family, moving is still going sets on steep hills, and

mountains terrain may also affect morphological - physical indicators.

### 3.3. Indicators of circulatory physiological functions of ethnic high school students

#### 3.3.1. Heart rates

Heart rate of Kinh and San Diu students decreases with age in all males with 77.78 and

77.01 beats/minute, respectively, at the age of 16 down to 74.31 and 73.98 beats/minute, respectively at age 18. While females of Kinh and San Diu students decrease from 79.55 and 79.21 beats/minute, respectively, at age 16 to 76.98 and 76.25 beats/minute, respectively, at age 18 (Table 4).

Table 4. The heart rate of students by age, gender, ethnicity

Gender	Age	Ethnicity						A-B	P (1-2)
		Kinh (1)			San Diu (2)				
		n	A*	Decrease	n	B*	Decrease		
Male	16	72	77.78±5.42	-	62	77.01±5.56	-	0.77	>0.05
	17	69	76.23±4.26	1.55	65	76.15±4.12	0.86	0.08	>0.05
	18	67	74.31±5.12	1.92	63	73.98±5.01	2.17	0.33	>0.05
			AR/year	1.74	AR/year	1.67			
Female	16	73	79.55±7.57	-	68	79.21±7.25	-	0.34	>0.05
	17	62	79.24±5.12	0.31	64	78.82±8.04	0.39	0.42	>0.05
	18	63	76.98±6.65	2.26	67	76.25±7.01	2.57	0.73	>0.05
			AR/year	1.29	AR/year	1.48			

\*mean ± SD; ANOVA followed by a t-test test with p values statistically significant; AR/ year: Average reduction/year

The rate of decrease in heart rate by age of irregular students, especially in female students, has a statistically significant decrease in heart rate from 0.31 to 0.39 in 16-17 years of age, and 2.26-2.57 in ages 17-18. The females with 18 years of age have a higher heart rate than that of male students with 18 years of age, where p <0.001.

The heart rate of two groups of ethnic students is similar. The heart rate of students decreases with age in both men and women of the two ethnic groups, which proves that the functioning of the heart is improving over the ages. In our study, the frequency of cardiac contractions in female students is always higher than that of male students of the same age. This result is consistent with the results stated by the Ministry of Health Hanoi (2003) and Trong *et al.* (1975).

#### 3.3.2. Arterial blood pressure

*Maximum blood pressure:* The maximum blood pressure of Kinh and San Diu students

increases gradually with age in all males from 116.02 and 116.25 mm of Hg, respectively, at the age of 16 to 116.76 and 118.08 mmHg, respectively, at the age of 18. Similarly, those in females are from 113.97 and 114.32 mmHg, respectively, at the age of 16 to 115.03 and 115.75 mmHg, respectively, at the age of 18. In age groups, the maximum blood pressure of men is higher than that of women, with p <0.05.

The maximum rate of hypertension, according to the age of the students, is quite equal over the ages, in the range of 0.38 to 0.92, and is not statistically significant in terms of differences across ages. Comparison of the maximum blood pressure results of two groups of ethnic minority students: the maximum blood pressure of San Diu students is greater than the maximum blood pressure of Kinh students (except for 16-year-old male school), where p<0.05 (Table 5).

Table 5. Maximum blood pressure of students by age, gender, ethnicity

Gender	Age	Ethnicity						A-B	P (1-2)
		Kinh (1)			San Diu (2)				
		n	A*	Increase	n	B*	Increase		
Male	16	72	116.02±0.98	-	62	116.25±0.87	-	-0.23	>0.05
	17	69	116.71±1.05	0.69	65	117.12±0.94	0.87	-0.41	<0.05
	18	67	116.76±0.97	0.06	63	118.08±1.12	0.96	-1.32	<0.001
	AI/ year			0.38	AI/ year			0.92	
Female	16	73	113.97±0.85	-	62	114.32±0.98	-	-0.35	<0.05
	17	62	114.26±1.08	0.19	65	115.19±0.97	0.77	-0.93	<0.001
	18	63	115.03±1.76	0.77	63	115.75±1.32	0.56	-0.72	<0.01
	AI/ year			0.48	AI/ year			0.67	

\*mean ± SD; ANOVA followed by a t-test test with *p* values statistically significant; AI/year: Average increase/year

### 3.3.3. Minimum blood pressure:

The minimum blood pressure of Kinh and San Diu students increases with age in both men (from 74.21 to 74.35 mmHg at the age of 16 to 75.53-75.98 mmHg at the age of 18), and women (from 72.65-73.19 mmHg at the age of

16 to 73.98-74.32 mmHg at the age of 18). The minimum rate of hypertension, according to the age of the students, is quite even across the ages, ranging from 0.57 to 0.82. Also, the minimum blood pressure of males is higher than that of females, with *p* <0.05 (Table 6).

Table 6. Minimum blood pressure of students by age, gender, ethnicity

Gender	Age	Ethnicity						A-B	P (1-2)
		Kinh (1)			San Diu (2)				
		N	A*	Increase	n	B*	Increase		
Male	16	72	74.21±0.84	-	62	74.35±1.32	-	-0.14	>0.05
	17	69	74.67±0.98	0.46	65	75.01±0.79	0.66	-0.34	<0.05
	18	67	75.53±1.02	0.86	63	75.98±1.72	0.97	-0.45	<0.05
	AI/ year			0.66	AI/ year			0.82	
Female	16	73	72.65±0.91	-	68	73.19±1.87	-	-0.54	<0.05
	17	62	73.05±1.85	0.40	64	73.81 ± 1.94	0.62	-0.76	<0.05
	18	63	73.98±1.09	0.93	67	74.32 ± 0.97	0.51	-0.34	>0.05
	AI/ year			0.67	AI/ year			0.57	

\*mean ± SD; ANOVA followed by a t-test test with *p* values statistically significant; AI/year: Average increase/year

From the results, it is concluded that the minimum blood pressure of students of San Diu is greater than of Kinh, except for 16-year-old boys and 18-year-old females. The results of our study are different from the results of earlier reports of the Ministry of Health Hanoi (2003) and Trong *et al.* (1975). The variation explains this phenomenon in the structure and function of

the cardiovascular system during the development of the individual. As age increases, the heart muscle is stronger, the larger the heart chamber is, the more heart volume increases, so the amount of blood pushed into the arteries increases, leading to an increase in blood pressure (Trinh *et al.* 1996; Loan 2001).

### 3.4. Relationship between standing height and some index of circulatory function

The data in Table 7 show that the correlation coefficient between vertical height and heart rate of male and female students of Kinh and San Diu students were negative with -0.51 and -0.54, respectively, -0.79 and -0.81, respectively. It is proved that the correlation between heart rate and vertical height inversely correlated ( $r < 0$ ), i.e., when the student's vertical height increases gradually, the heart rate tends to decrease.

The correlation coefficient between vertical height and maximum blood pressure and minimum blood pressure are positive values. For males, the maximum correlation coefficient blood pressure for Kinh and San Diu was 0.42 and 0.64, respectively, while minimum correlation coefficient blood pressure for Kinh

and San Diu was 0.55 and 0.76, respectively. For females, the maximum correlation coefficient blood pressure for Kinh and San Diu was 0.44 and 0.55, respectively, while minimum correlation coefficient blood pressure for Kinh and San Diu was 0.84 and 0.69, respectively. The correlation between vertical height and maximum blood pressure is proved to be positive ( $r > 0$ ), meaning that when the height of the student's height increases, the maximum blood pressure increases.

Our results show,  $0.3 < |r| \leq 0$ , should correlate the height of standing with maximum blood pressure as well as the minimum blood pressure of the student at the average level. The results of the correlation coefficient between vertical height and some periodic system function indexes shown in Table 7.

Table 7. Correlation between vertical height and some index of circulatory function

Function index of the circulatory system	Ethnicity	The correlation coefficient (r)		Regression ( $y=ax+b$ )	
		Male	Female	Male	Female
Heart rate	Kinh	-0.51	-0.79	$y = -52.541x + 161.93$	$y = -109.59x + 247.09$
	San Diu	-0.54	-0.81	$y = -83.747x + 211.01$	$y = -77.467x + 196.85$
Maximum blood pressure	Kinh	0.42	0.44	$y = 51.889x + 31.237$	$y = 105.6x - 47.292$
	San Diu	0.64	0.51	$y = 76.7x - 7.6021$	$y = 90.83x - 24.418$
Minimum blood pressure	Kinh	0.55	0.84	$y = 59.667x - 21.506$	$y = 103.92x - 84.846$
	San Diu	0.76	0.69	$y = 76.531x - 48.876$	$y = 96.395x - 74.024$

On the other hand, there is an exchange of genetic resources between the new population and indigenous people. From the 1990s of the 20th century, a part of the population from the Red River Delta provinces (Nam Dinh, Thai Binh, Hanoi) went to new economic development, came and settled permanently in many areas of the northern mountainous provinces, in which Tam Dao district, Vinh

Phuc province. Some genetic factors may have improved, affecting biological indicators of children in general and high school students in particular (Loan 2001).

## 4. Conclusions

Through the study results of some biological indicators of Kinh and San Diu ethnic high

school students, Tam Dao district, Vinh Phuc province, we draw some conclusions:

Vertical height and an average increase in dimension of the male students' standing is higher than that of women by age.

Body mass index and an average increase of male and female body mass index were not significantly different by age. Based on physical fitness BMI, male and female students are normal.

The heart rate of Kinh and San Diu, ethnic minority students, is different; gradually decrease with age, the rate of decline in men and women are different, and in the same age, there is also a difference between men and women.

Differences in blood pressure and minimum blood pressure of Kinh and San Diu ethnic minority students; gradually increase with age, different growth rates in men and women, and difference between men and women of the same age

The correlation between the standing height of the Kinh and the San Diu people with the heart rate is negative, while the maximum blood pressure and minimum blood pressure are positively correlated.

The morphological - physical and physiological functions of the students often change and depend on genetic factors, living conditions, gender, and age. Therefore, the study of these indicators should be conducted regularly and synthesized in order to have the data to be the basis for proposing measures to improve human quality and propose measures education and training as appropriate. There need to be more research works on biological indexes on high school students throughout the country, especially those of ethnic minority students in areas with difficult socio-economic conditions. In addition to educating knowledge, it is necessary to pay more attention to fitness

to improve health, enhance students' adaptability to their living environment.

## References

- [1] Boxwell G. (2010), *Neonatal intensive care nursing (2<sup>nd</sup>Ed.)*, Routledge Publishing House.
- [2] Gray D.S, Fujioka K.E. (1991), Use of relative weight and body mass index for the determination of adiposity. *Journal of Clinical Epidemiology*. 44(6): 545-550.
- [3] Griffiths M, Payne P.R, Rivers J.P, Cox M, Stunkard A.J. (1990), Metabolic rate and physical development in children at risk of obesity. *The Lancet* 336(8707): 76-78.
- [4] Loan T.T. (2001), Study the heart rate of students at some high schools in Hanoi city. *Biological Journal* 4(3b): 155-158.
- [5] Long T.D, et al. (1996), Researching the development of age bodies to high schools (6 -18 years old). *Research on Vietnamese biological indicators in the 1990s*.
- [6] Minh T.V, Vuong T.S, Diep T.H, Vinh L.G, et al. (1996), The results of a pilot survey on some anthropometric indicators of ordinary Vietnamese people in Lien Ninh commune, suburban Hanoi. *Initial results of studying some biological indicators of Vietnamese people*. Medical Publishing House, Hanoi.
- [7] Ministry of Health. (2003), *The normal biological values of Vietnamese people in the 90s-twentieth century*. Medical Publishing House, Hanoi.
- [8] Stegall H.F, Kardon M.B, Kemmerer W.T. (1968), Indirect measurement of arterial blood pressure by Doppler ultrasonic sphygmomanometry. *Journal of Applied Physiology* 25(6): 793-798.
- [9] Thuy T.T. (2006), *Basic indicators of physiology and psychology of high school students today*. Education Publishing House, Hanoi.
- [10] Toska K, Eriksen M. (1993), Respiration-synchronous fluctuations in stroke volume, heart rate and arterial pressure in humans. *The Journal of Physiology* 472(1): 501-512.
- [11] Trinh T.D. (1996), Vietnamese arterial blood pressure values. *Initial results of studying some biological indicators of Vietnamese people*. Medical Publishing House, Hanoi.
- [12] Trong N.T.G, et al. (1975), Biological constant of Vietnamese. Medical Publishing House, Hanoi.
- [13] Ware R, Anderson W.L. (1966), Spectral analysis of Korotkoff sounds. *IEEE Transactions on Biomedical Engineering* 13(4): 170-174.