

## Monitoring of physical development of vocational and technical school students

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### Abstract:

The results of physical development (PD) monitoring in vocational-technical schools (VTS) students of the service sector are presented. The study involved 665 students of 4 VTS in Kharkiv. Qualitative and quantitative differences in PD were found, based on anthropometric and physiometric studies of height, body weight, dynamometry, endurance, lung capacity, chest circumference and chest excursion, their characteristics according to sex, age and specialty that is mastered were revealed. During the monitoring, a high proportion of adolescents with disharmonious PD was registered, mainly due to variations in body weight. Major violations were found among students who received the tailors, cutters, operators of typesetting and layout professions; this fact requires special attention to this group and creates need of effective prevention measures. The using of assessment of PD as adolescent health integral index for improvement of medical and preventive work in VTS is explained.

**Key words:** adolescents, physical development, students of vocational schools, health condition.

### Introduction

The reformation of vocational education with a big flow of information, the intensification of training activities and the transition from the traditional educational process to the one with innovative technologies significantly increases the demands on the health of students, and often noncompliance of hygienic rules and regulation of educational process is reflected on a more valuable - children's health (Shubochkina, E.I., Kulikova, A.V, 2010).

It's important to know the features of the students' health, and living conditions that may have adverse effect on health during their vocational training. Considering the fact that during the most manifested growth and development organism is extremely sensitive to the influence of social factors and decreased attention to social issues during the destabilization of the state, limited funding for preventive orientation in health care lead to loss of control over students' health (Prader, A.N., Largo, R.H., 2011).

As a means of health managing in an educational institution considered monitoring studies. It can detect hygienic, medical, psychological and pedagogical shortcomings of the educational process and identify key areas of preventive and corrective activities. A monitoring allows to establish causal relationships of different pedagogical actions and dynamics of the students' health (Shubochkina, E.I., Lunkin, A.N., 2010).

One of integrative child health indicators, biological maturity of all body systems is physical development (PD). It is considered the most important characteristic of the child's health, as is a set of morphological and functional properties of an organism and determines the stock of physical strength, endurance and work performance (Birnbaum, A.S., Linver, M.R., 2012).

The state of PD of children of a certain age is the basis for predicting the emergence of diseases, which will affect the quality of life for subsequent years. The more significant violations in the PD, the greater are probability of the disease emergence (Lazarus, T.N., Kelechi U.S., 2011).

It is known that the PD is affected by two main groups of factors: endogenous (genotype, the nervous and endocrine systems) and exogenous (climate and environmental impacts, food, a set of social conditions) (Saris, W. H. Niklasson, A.T., 2011).

PD is a sensitive indicator that is easy to change under the influence of various adverse factors, particularly environmental conditions. As a set of features that characterize the state of health of the body at different age, the level of PD is one of the most important indicators of social health and is an objective indicator of sanitary-epidemiological condition (Korobchanskiy, V.O., Vasylichenko, I.O, Vytrishak, S.V., 2008).

While causes of impairments of vocational-technical schools' (VTS) students are multifactorial, the leading are factors specific for the educational process - increasing volume and intensification of training load. Beside general educational load vocational students are accompanied by the study of special subjects and skills

development, due to the effect on the vocational factors. Significant adverse effects on the health of adolescents is provided by social and psychological factors, poor nutrition, lack of sleep, psychological stress in families, physical inactivity, smoking, alcohol and drug use, early labor employment and others. (Molodcov, S.A., Kamaev, I.A., 2001).

Therefore, at the present stage actual problem is development and implementation of monitoring technology as the obligatory one for creating a favorable environment for the development of students with health-saving functions (Ponomaryova, L.I., Mejybetskaya, I.V., 2014).

**Objective**

The aim of the study was to determine the characteristics of the PD of VTS by gender, age and specialty that are mastered.

**Materials and methods**

Monitoring of PD of students was performed during a comprehensive medical examination of adolescents in the process of education. The study involved 665 students of 4 VTS in Kharkiv aged 15-19 years: 149 boys (average age 17.1 ± 0.1) and 516 girls (average age 17.0 ± 0.0), which received education in service sector (9 branches). The comparison of anthropometric and physiometric indicators of PD such as height (cm), body weight (kg), dynamometry (kgs), endurance (s), lung vital capacity (LVC, ml), chest circumference (at rest, inhalation, exhalation, cm) and chest excursion (cm) depending on the age, gender and profession obtained. Assessment harmony of PD was performed on the basis of earlier developed «Line diagrams of pupils' physical development assessment» (Danylenko, G.M., 2012).

Statistical analysis of the study materials was carried out using the software package MS Excel, SPSS-17. The significance of differences between students of different gender, age and specialty was estimated using the non-parametric U-Mann–Whitney test. The differences were considered as reliable if  $p < 0.05$ .

**Results and discussion**

During the monitoring of the PD in VTS was found the average growth and body weight values in boys and girls ( $p < 0.01$ ). According to students ages was found reliable tendention of growth and body weight increasing, more expressed among boys (table 1). The highest average growth in boys recorded at the age of 18, in girls – at age of 15, body weight – in boys and girls in 19 years.

The average chest circumference (CC) in boys was significantly higher than in girls at rest, inhalation and exhalation ( $p < 0.05$ ). Chest excursion (CE) ranged from 4 to 12 cm, with no significant difference between boys and girls. In boys, the average values of the CC increased gradually from 15 to 19 years; in girls age differences were not found ( $p < 0.05$ ).

Depending on the specialty variations in the average values of height in boys and in girls were significant ( $p < 0.05$ ). The lowest rates of body weight in boys recorded among shoemakers, in girls - in printers, the largest - in boys - among waiters, in girls - among jewelers. The lowest average rates of CC and CE in boys were among cutters and shoemakers, in girls – among printers; the highest – in boys and girls - among cooks.

Table 1. Average rates of physical development of vocational students, (M±m)

Indicators of PD	Average	Age distribution				
<b>Boys</b>						
Age	17.1 ± 0.1	15 (n=4)	16 (n=37)	17 (n=60)	18 (n=39)	19 (n=9)
Height, cm	175.7 ± 0.6	161.5 ± 4.2	174.3 ± 1.1 <sup>1)</sup>	176.3 ± 0.8 <sup>1)</sup>	177.5 ± 1.2 <sup>1)</sup>	176.2 ± 2.2 <sup>2)</sup>
Body weight, kg	67.5 ± 1.1	59.9 ± 7.4	64.4 ± 2.0 <sup>1)</sup>	66.9 ± 1.4 <sup>1)</sup>	70.8 ± 2.3 <sup>1)</sup>	73.0 ± 6.5 <sup>1)2)</sup>
DR, kgs	38.0 ± 0.6	27.5 ± 2.4	37.9 ± 1.3 <sup>1)</sup>	38.8 ± 0.9	38.8 ± 1.1	34.0 ± 4.5 <sup>1)2)</sup>
DL, kgs	36.0 ± 0.7	25.0 ± 2.1	35.1 ± 1.3 <sup>1)</sup>	36.8 ± 1.2	36.7 ± 1.3	36.2 ± 3.6 <sup>2)</sup>
Endurance, s	37.6 ± 2.9	36.8 ± 6.1	38.0 ± 7.5	41.2 ± 4.2 <sup>1)</sup>	36.3 ± 7.9 <sup>1)</sup>	17.8 ± 4.4 <sup>1)2)</sup>
LVC, ml	3485.6 ± 50.9	3025.0 ± 301.0	3411.1 ± 106.7 <sup>1)</sup>	3591.5 ± 78.6	3423.7 ± 82.3	3555.6 ± 310.1 <sup>2)</sup>
CC(rest), cm	88.7 ± 0.6	82.0 ± 1.8	87.1 ± 1.3 <sup>1)</sup>	88.1 ± 0.7	91.1 ± 1.3 <sup>1)</sup>	92.0 ± 3.7 <sup>2)</sup>
CC(inhalation), cm	96.0 ± 0.6	90.3 ± 2.6	94.0 ± 1.3 <sup>1)</sup>	95.6 ± 0.8	98.3 ± 1.3 <sup>1)</sup>	99.8 ± 3.4 <sup>2)</sup>
CC(exhalation), cm	87.7 ± 0.6	81.0 ± 1.8	86.1 ± 1.3 <sup>1)</sup>	87.1 ± 0.7	90.1 ± 1.3 <sup>1)</sup>	91.0 ± 3.7 <sup>2)</sup>
CE, cm	8.3 ± 0.1	9.3 ± 0.9	7.9 ± 0.3 <sup>1)</sup>	8.5 ± 0.2	8.2 ± 0.2	8.8 ± 0.4
<b>Girls</b>						
Age	17.0 ± 0.0	15 (n=19)	16 (n=146)	17 (n=189)	18 (n=123)	19 (n=39)
Height, cm	162.5 ± 0.3	164.6 ± 0.7 <sup>3)</sup>	162.3 ± 0.5 <sup>1)3)</sup>	162.4 ± 0.4 <sup>3)</sup>	162.3 ± 0.5 <sup>3)</sup>	163.2 ± 1.0 <sup>3)</sup>
Body weight, kg	57.2 ± 0.5	56.5 ± 2.2 <sup>3)</sup>	56.3 ± 0.8 <sup>3)</sup>	57.6 ± 0.8 <sup>3)</sup>	56.7 ± 1.0 <sup>3)</sup>	60.1 ± 1.9 <sup>1)2)3)</sup>
DR, kgs	25.1 ± 0.2	24.1 ± 0.9 <sup>3)</sup>	24.3 ± 0.4 <sup>3)</sup>	25.4 ± 0.3 <sup>3)</sup>	25.7 ± 0.4 <sup>3)</sup>	25.3 ± 0.8 <sup>3)</sup>
DL, kgs	24.4 ± 0.2	23.6 ± 0.9	23.3 ± 0.4 <sup>3)</sup>	24.5 ± 0.3 <sup>3)</sup>	25.3 ± 0.4 <sup>3)</sup>	25.4 ± 0.7 <sup>3)</sup>
Endurance, s	23.7 ± 0.7	23.0 ± 2.3 <sup>3)</sup>	23.0 ± 1.0 <sup>3)</sup>	25.4 ± 1.5 <sup>1)3)</sup>	22.9 ± 1.3 <sup>1)3)</sup>	20.8 ± 2.3 <sup>3)</sup>
LVC, ml	2455.7 ±	2346.2 ± 105.4 <sup>3)</sup>	2404.7 ± 42.1 <sup>3)</sup>	2460.9 ± 32.9 <sup>3)</sup>	2462.6 ± 43.1 <sup>3)</sup>	2602.8 ±

	± 21.0					2.8 <sup>1)2)3)</sup>
CC (rest), cm	83.4 ± 0.3	82.1 ± 1.2	83.1 ± 0.5 <sup>3)</sup>	83.8 ± 0.5 <sup>3)</sup>	82.7 ± 0.5 <sup>3)</sup>	84.9 ± 1.1 <sup>1)2)3)</sup>
CC (inhalation), cm	90.4 ± 0.3	89.0 ± 1.3 <sup>3)</sup>	90.0 ± 0.5 <sup>3)</sup>	90.8 ± 0.5 <sup>3)</sup>	89.9 ± 0.6 <sup>3)</sup>	91.9 ± 1.1 <sup>1)2)3)</sup>
CC (exhalation), cm	82.4 ± 0.3	81.1 ± 1.2	82.1 ± 0.5 <sup>3)</sup>	82.8 ± 0.5 <sup>3)</sup>	81.7 ± 0.5 <sup>3)</sup>	83.9 ± 1.1 <sup>1)2)3)</sup>
CE, cm	8.0 ± 0.1	7.9 ± 0.3 <sup>3)</sup>	7.9 ± 0.1	8.0 ± 0.1	8.2 ± 0.1	8.0 ± 0.2

<sup>1)</sup> p < 0,05 between the annual PD growth rates  
<sup>2)</sup> p < 0,05 between the PD growth rates for the period from 15 to 19  
<sup>3)</sup> p < 0,05 between the PD values of boys and girls

While analyzing the physiometric performance, spirometric average lung vital capacity (LVC) in boys was higher than girls (p < 0.01). The highest rates were recorded in the 17 year old boys and 19 year old girls.

Gender and age differences found among the indices of muscle strength. Dynamometry right and left hand (DR, DL) determined the average level of muscle power higher in boys than in girls; similar results were shown by the endurance indicator (p < 0.01). Growth of DR, DL and endurance with age in boys happened to 17-18 years, followed by a decrease, in girls – had no significant differences on age.

Like other characteristics of PD, physiometric rates were dependent on the chosen specialty. The highest rates of LVC among boys were observed in printers, the lowest - in typing operators; among girls – in jewelers, printers and waiters, respectively. The highest average results of DR and DL among boys were shown by tailors, among girls –in jewelers; the lowest among boys –in computer operators, among girls – in printers.

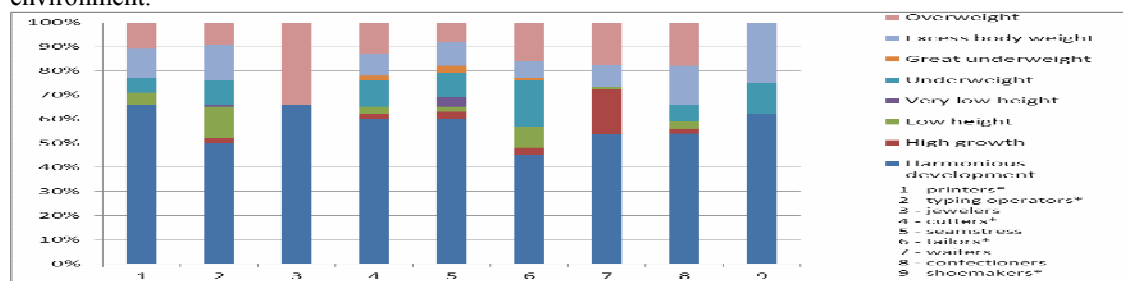
Based on PD of vocational students qualitative analysis found that the number of harmoniously developed teenagers was half of all subjects. Disharmonious development was found in (43.2 ± 2.0) % of adolescents, represented mainly by deviations in weight indicators (table 2).

Table 2. Distribution of students of vocational schools for PD, (M±m)

Assessment of PD	Boys	Girls	General
Harmonious development	52.1 ± 4.2	57.2 ± 2.3	56.1 ± 2.0
Overweight	16.4 ± 3.1	10.7 ± 1.4	12.0 ± 1.3
Excess body weight	13.6 ± 2.9	12.6 ± 1.5	12.8 ± 1.3
Underweight	7.9 ± 2.3	10.1 ± 1.4	9.6 ± 1.2
Great underweight	1.4 ± 1.0	0.8 ± 0.4	1.0 ± 0.4
High growth	2.1 ± 1.2	1.7 ± 0.6	1.8 ± 0.5
Low hight	6.4 ± 2.1	6.9 ± 1.1	6.8 ± 1.0

Among studied in VTS, girls are revealed as more harmoniously developed compared with boys. Disharmonious development among students of both sexes occurred mainly due to overweight, excessive weight gain, and underweight. Also recorded decrease in growth performance among boys and girls. Differences in PD that have been identified among vocational students of both sexes, have no statistical significance (p < 0.1) (with the exception of 17 year-old students, where among boys was significantly more overweight than girls (p < 0.05).

Excess body weight and overweight often recorded among jewelers, cooks and confectioners, underweight - among tailors and cutters, which may be due to specific factors and influence of the work environment.



\* - p < 0.05 – reliable level of differences between gender groups

Fig. Physical development of VTS students

Qualitative analysis of PD, depending on the specialty showed that most of the harmonious development of pupils were among those who studied as a jewelers, printers, shoemakers, the lowest - among tailors and cutters, typesetting operators and layouts (p < 0.05) (Fig.).

These categories of students definitely need increased supervision of the medical staff, being the risk group of disease emergence. Also, individual work and careful consideration of continuing education and future work on the chosen specialty for students with the abuses is needed, because deviations from the normal PD can be caused by the influence of educational and training environment of chosen specialty. This can allow not only to reduce the number of students with disharmonious PD, but also to significantly reduce the number of pre-nosological forms of diseases among VTS students.

## Conclusions

The PD monitoring of adolescents revealed the dependence of anthropometric and physiometric indicators of vocational students from gender, age and chosen specialty; registered a high proportion of adolescents with disharmonious PD, mainly due to variations in body weight. Major violations of physical harmony found among students who received the tailors, cutters, operators of typesetting and layout professions; that requires special attention to the creation of learning environments for this and this population and creates need of timely conducted effective prevention measures and improvement of medical-preventive work among vocational students.

## Prospects for future studies

The further deep study of the physical development as integral indicator of adolescents' health will improve medical-preventive work in VTS.

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