

## HYGIENIC EVALUATION OF PHYSICAL DEVELOPMENT AND HEALTH STATUS OF ADOLESCENTS STUDYING IN YEREVAN HIGH SCHOOLS

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### Abstract

*In the present era of technological progress the problem of maintaining health of children and adolescents is more than important. Adolescent age is considered one of the most important stages during human development. The big biological and psychosocial changes taking place during the second decade of life impact all areas of adolescent life. A large number of recently performed studies have shown worsening of health status of students during study period as well as unfavorable changes in physical development of the growing generation.*

*Our work aimed at studying and giving hygienic evaluation of the physical development and health status of adolescents studying at high school in Yerevan city. We examined 1382 students (56% girls and 44% boys) of 10<sup>th</sup> and 12<sup>th</sup> grades of high schools (aged 14, 15, 17, 18 years). Based on the data obtained from medical examination and evaluation of physical development indicators of the high school students, we performed complex assessment of their health status. As a result, at the start of education (10<sup>th</sup> grade) only 7.4% of children were included in health group I; 31.9% of students were practically healthy but had one or several morphofunctional abnormalities. Chronic disorders were reported in 60.7% of students. The health status of graduating students was worse: at high school graduation the number of students in the group I decreased by almost half ( $p < 0.05$ ) while that in group III increased 1.2-fold. In fact, we report that by completing education not only the number of healthy children decreases but they progress from functional abnormalities to chronic disorders.*

**KEYWORDS:** adolescents, physical development, health status

### INTRODUCTION

The health status of the growing generation is a characteristic indicator for evaluating the welfare of any country [Baranov A *et al.*, 2005]. In the present era of technological progress the problem of maintaining health of children and adolescents is more than important. Adolescent age is considered one of the most important stages during human development. The big biological and psychosocial changes taking place during the second decade of life impact all areas of adolescent life. These are the changes that make the adolescent age

a unique period of life cycle when solid and long-lasting health foundation is laid [World Health Organization, 2014]. It is known that one of important indicators of assessment of health status of children and adolescents is physical development which allows characterizing the morpho-functional status of the organism and by expressing the socio-hygienic wellbeing of the population it is considered a “sensitive indicator of population health” [Baranov A, 1986; Kuchma V, 1996]. According to S. M. Grombach, the status and level of physical development of children should be evaluated objectively and can be considered along with health indicators of pediatric population. In this regard, generalized data on physical development of pediatric population are important for health statistics and allow predicting the development of population and

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perform appropriate steps [Grombach S, 1967].

Physical development reflects the process of organism formation during different stages of postnatal ontogenesis when the genotypic potential is being intensively expressed phenotypically. The deviations from norm of physical development indicators are the first important manifestations of not only impaired functional status of child organism but also of presence of a disease [Baranov A et al., 2008; Veltischev U, Vetrov V, 2007; Geppe N, Podchernyaeva N, 2008; Stromskaya E et al., 1982].

A large number of recently performed studies have shown unfavorable changes in physical development of the growing generation which mainly include low height, body weight deficit or excessive weight [Giguz T et al., 2003; Gricinskaya V, 2009; Lukmanova N, 2007; Hardy L et al., 2017; Machluf Y et al., 2016; Smetanina N et al., 2015].

There are also worrisome data of numerous studies suggesting deterioration of health status of students during their study period. According to a longitudinal study performed by Russian leading researchers among 383 children studying in Moscow, by reaching to 9<sup>th</sup> grade from 1<sup>st</sup> grade the number of healthy children decreases. Among first-graders, the percentage of pupils in health group I was 4.3%, group II – 44.4% and group III – 51.3%, whereas the respective numbers were 0.7%, 32.8% and 62.5% at the end of 9<sup>th</sup> year [Namazova-Baranova L et al., 2015]. The results of scientific research show that during study years the number of children belonging to health groups III-IV progressively increases at the expense of the decreasing number of children in groups I-II. Among 10 year old Russian schoolchildren 52.6% are in group I-II, while this percent becomes 33.5% among 15-year olds. In the same age groups the percentages of children in III-IV group are 48.4% and 66.5%, respectively [Sukhareva L, 2013]. According to Poretskovas' study, almost half of 15-17 year old students are in health group II, 11% are healthy and 37.3% have chronic diseases [Poretskova G, 2015]. The official Russian statistical data reveal that only 10% of graduates of common education schools can be considered healthy [Baranov A, Shcheplyagina L, 2000; Baranov A et al., 2007

]. A work performed in Minsk in 2016 has shown that only 8.24% of students in 10-11<sup>th</sup> grades of school are absolutely healthy. Functional abnormalities were found in 49.4% and chronic disorders – in 41.2% of students, whereas only 16.6% in 1-4<sup>th</sup> grades had chronic disorders (11.6% were in group I and 69.4% in group II) [Tananko E, 2016].

A national health survey conducted in 2013-2014 among Armenian school-aged children showed that 33% of adolescents have multiple health complaints, also adolescents commonly have habits of unhealthy nutrition and sedentary lifestyle, as well as mental health issues, however they rarely seek medical advice (02.09.2016 N34 protocol of Armenian Government). These data reflect the fact that diverse factors impact health and health-related behavior of Armenian adolescents including national traditions, difficulties with transitional period, rapid intrusion of technologies into daily life, etc. In this study the adolescents were asked about having been diagnosed by a doctor with a long-standing disease or having disability. Six percent of pupils of age 11-15 and 7% of 17 year olds indicated having a chronic disease or disability for which most of them receive medications [Sargsyan S et al., 2016]. Thirty-five percent of school-aged children had stomachaches several times a week, especially among rural inhabitants. Indicator of multiple health complaints among Armenian school children is among the highest in Europe [Sargsyan S et al., 2016]. Currently according to different data 15-30% of school-aged children and adolescents have chronic diseases or conditions accompanied or manifested by issues in physical development, neurological and mental impairments, endocrine, respiratory and other organ chronic disorders [Melkumova M et al., 2014].

Different studies suggest that like elsewhere in the world, Armenian schoolchildren and adolescents too have multiple issues in regard to their health and health-related behaviors.

The aim of the study was to perform examination of physical development and health status as well as hygienic assessment among students of high schools in Yerevan.

### MATERIAL AND METHODS

We examined 1382 students (56% girls and 44% boys) of 10<sup>th</sup> and 12<sup>th</sup> grades of high schools (aged 14, 15 and 17, 18 years). We studied the anthropometric data of students. For assessment of physical development of children >5 years old Armenia has adopted Clinical Growth Charts proposed by US Centers for Disease Control and Prevention (CDC) with revised 3<sup>rd</sup> and 97<sup>th</sup> percentile curves for weight, height and body mass index according to age and sex (Decree of Minister of Health of Armenia N 1752N, 26.11.2007). Therefore, we used the following charts for determining corresponding percentiles for study subjects:

1. weight by age – 5-20 years (CDC, 2000)
2. height by age – 5-20 years (CDC, 2000)
3. body mass index by age – 5-20 years (CDC, 2000)

The charts assessing weight and height are presented by centile curves from 3<sup>rd</sup> to 97<sup>th</sup> centile (3, 10, 25, 50, 75, 90, 97). The interval between 2 nearest centiles is the centile interval (1, 2, 3, 4, 5, 6, 7, 8). Values within 4 and 5 interval (interval between 25 and 75 centiles) are considered average values. Values within intervals 1, 2 and 3 are very low, low and below average, respectively, and the ones within intervals 6, 7 and 8 are above average, high and very high values. A height below 3<sup>rd</sup> centile for respective age and sex is considered low height and a weight in this category is low weight (CDC and WHO). A height above 97<sup>th</sup> centile for respective age and sex is considered high height. An important issue in adolescent age is early identification of excess weight for which we used the most sensitive indicator of body mass index (BMI). BMI is an anthropometric index derived by dividing weight (kg) by square height (m<sup>2</sup>). Unlike adults whose BMI is interpreted based on the exact certain number, the BMI for children and adolescents has sex- and age-related differences and is interpreted by centile method.

Charts evaluating BMI are also presented as centile curves from 3<sup>rd</sup> to 97<sup>th</sup> centiles (3, 10, 25, 50, 75, 85, 90, 95, 97). Values between 3<sup>rd</sup> and 85<sup>th</sup> centiles are considered normal for BMI. Underweight is defined as BMI-for age and sex values below 3<sup>rd</sup> centile. Values below 3<sup>rd</sup> and above 97<sup>th</sup>

centiles indicate problems related to health or nutrition. Age- and sex-related BMI values above 85<sup>th</sup> centile are reported as overweight. Obesity is defined as values equal to or greater than 97<sup>th</sup> centile.

The study of health status of 1382 students studying in X-XII grades of high schools in Yerevan was conducted by 11 narrow specialists (ophthalmologist, LOR specialist, orthopedist-traumatologist, neurologist, cardiologist, dermatologist, endocrinologist, gastroenterologist, allergologist, dentist, surgeon) at the start (September) and end (May) of study period. The morbidity was analysed according to ICD-10.

The method used for health assessment of children and adolescents was “The method of complex health assessment of children and adolescent during mass medical screening” developed in 1982 by S. M. Grombach and modified in 2003. Based on proposed 4 criteria (presence or absence of disease on examination, functional status of system organs, level of organism resistance, level of physical development) the child is assigned to one of health groups [Order of the Ministry of Health of the Russian Federation, 2003]. According to this method, schoolchildren are categorized in 3 health groups: healthy children (health group I), children with functional abnormalities (health group II) and children with chronic diseases in compensated or subcompensated stage (health group III-IV).

The collected data were analysed using SPSS statistical software. Descriptive statistics as well as comparisons between means of two independent variables were used.

### RESULTS AND DISCUSSION

According to weight and height values in students, we categorized them by groups. We found that the majority of both boys and girls have average values for weight. While the mean weight of female students did not change, in male students there is a different pattern: 54.4% of boys 14 years of age have average weight and at 18 years this number reaches 68.1% ( $p < 0.05$ ). The percentage of students with average weight at 15 years was significantly different among males and females – 41.9% and 58.3%, respectively ( $p < 0.05$ ). In all age

groups, girls are more likely to have weight below average: in 14 years 16.3% of them has values below average compared to only 1.6% of boys ( $p<0.05$ ). With increasing age, the percentage of children with low weight declines: 7.8% of girls at 14 years have low weight vs. 1.6% at 18 years ( $p<0.05$ ). In boys, significant difference is reported between groups of students at 14 (7.2%) and 17 years (1.6%) ( $p<0.05$ ). Weight deficit has not been recorded in either female or male students of 14 years. At 15 years, 4.3% of boys and 1.4% of girls have weight deficit. At 17 years, 1.4% of girls and at 18 years 4.3% of boys have weight deficit. In age groups of 14, 15 and 17 years weight above average was more commonly recorded in boys than girls. High weight is also more commonly found in boys: the number of 14 year old boys with high weight is 16-fold, and the number of 15 year old boys is 6-fold higher than number of girls with excessive weight. In younger age group very high values of weight were reported in rare cases (2.4%), and in the older age group they were absent.

When assessing height indicators in high school students it becomes obvious that there is predominance of average values in both sexes. In this case too, average values tend to be more common in higher age group compared to younger group. At 14 years of age 48% of boys and 57.4% of girls have average height, and by 18 years the percentage of high school students with average height significantly increases: 75% and 74.6%, respectively ( $p<0.05$ ). At 15, 17 and 18 years boys more commonly have height below average, and at 14 years girls are more commonly reported to have below average height. Same pattern is also seen for low height: in older age group boys more frequently have low weight than girls while at 14 years the number of girls with low height is about 3.7 times higher than the same number in boys. Stunting is however more common in girls. In 3 age groups (14, 17 and 18) no case of stunting was reported in boys, while in girls we found cases of stunting in all age groups (3.5% overall). While in other age groups the frequencies of height values above average were not significantly different between two sexes, the difference was significant in

14 year old age group. At this age, 28.8% of boys have height above average compared to only 7.8% of girls. The number of high height values were low in all age groups; such cases were not at all detected in groups of 15 year old boys and 18 year old girls. Tall stature was even less frequent: single cases were reported in different age group, and absent in age group of 18 years.

The recorded values of weight and height in high school students allow detecting sex- and age-related differences and following trends in changes of these values.

With increasing age, the number of adolescents with average height and weight increase. In parallel, the number of subjects with values higher than average decreases (especially among males) and the number of children with values below average remains almost unchanged (this number somewhat increases among males). Figure 1 shows that values different from average were especially recorded at 14 years of age and that values above average were noted mostly in boys while values below average – in girls.

The most sensitive indicator of overweight in adolescents is BMI (table 1). By measuring BMI we found that most of adolescents within all age and sex groups had normal weight. Nevertheless, the percentage of 15 years old boys with normal weight (73.2%) was significantly lower than that of 15 year old girls (88.5%) ( $p<0.05$ ).

The fact that with increasing age the frequency of subjects with low weight increases is bothersome. This frequency reaches its maximal value among boys at age 18. Among girls, the maximal frequency is recorded at 17 years and somewhat declines at 18 years. Also bothersome is a significant number of overweight indicators. Although overweight was recorded in all age and sex groups among adolescents, most notable is the group of 15 year old boys where every fifth subject was overweight. The frequencies of overweight and obesity were significantly different in this group compared to both girls of same age ( $p<0.05$ ) and boys of higher age groups ( $p<0.05$ ). It is important to note that the number of overweight and obese girls declines with age, and that no cases of obesity were recorded in the highest age group.

The study of health status of adolescents studying in high schools recorded the following: the health of high school students worsens during their school studies. According to data from different studies, morbidity has increased particularly among school-children. Based on these data and the objectives to reach our aim we conducted the study of health status and morbidity among high school students.

When studying the morbidity among school age adolescents we found that during study years the prevalence of especially chronic diseases increases among students reaching from 1488.6‰ to 1724.7‰. To understand this adverse change we needed to reveal the structure of morbidity and especially which disease groups have contributed to these changes.

As seen from table 2, first three ranking disorders among high school students were disorders of musculoskeletal system and connective tissue, disorders of eye and adnexa, and disorders of respiratory system.

At the start of study, the first rank was held by disorders of musculoskeletal system and connective tissue, second ranking were disorders of eye and adnexa, third ranking were respiratory system disorders. Disorders of nervous system were rank-

TABLE 1.

Body mass index values  
by age and sex groups (%)

Years	Sex	normal weight	insufficient weight	over weight	obesity
14	boys	84	0	11.2	4.8
	girls	84.6	0.8	10.9	3.9
15	boys	73.2	1.6	20.5	4.8
	girls	88.5	1.7	9.1	0.7
17	boys	89	0	10.9	0
	girls	85.7	55	8.7	0
18	boys	82.7	6	11.3	0
	girls	89.8	4.3	5.8	0

ing fourth and disorders of endocrine system including nutrition and metabolism disorders – fifth. There were discrepancies regarding disorders ranking last in the list. The diseases recorded during high school study period among adolescents were mostly due to disorders of body weight. However, there are problems with assessment of indicators of body weight. Data obtained by using WHO (2007) criteria for growth and development of children and adolescents were quite different from those obtained by using percentile charts for

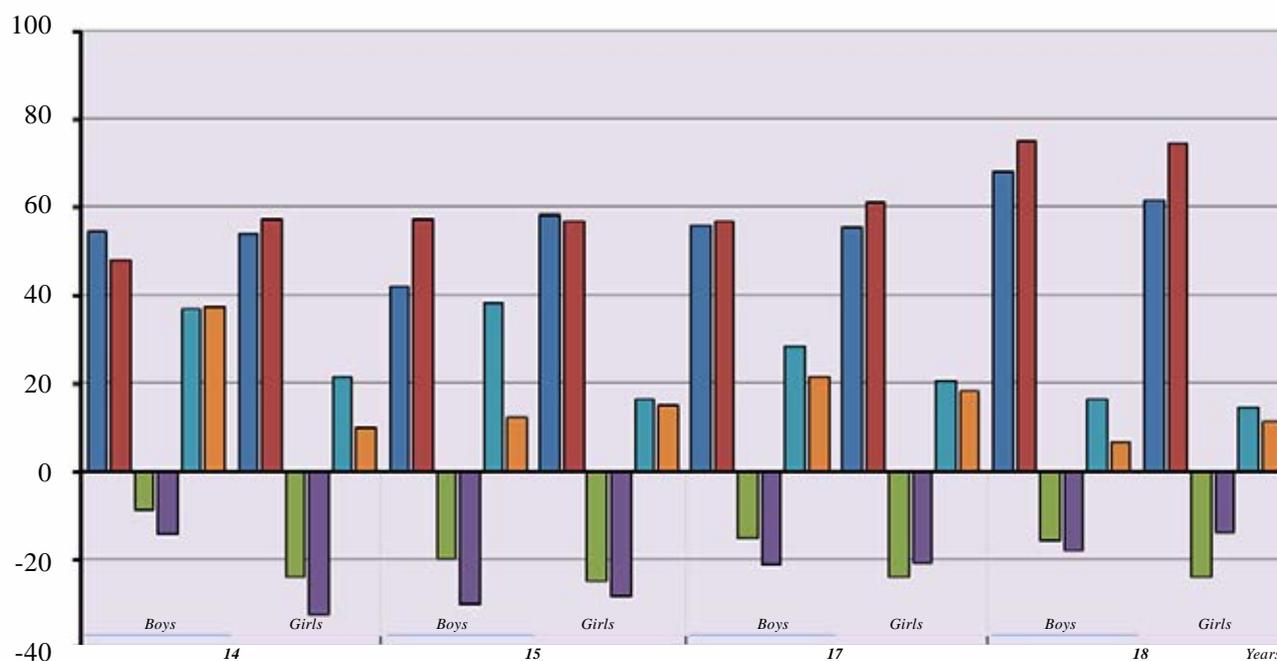


FIGURE 1. Assessment of weight and height values in different age and sex groups

NOTES: ■ - average value weight, ■ - average value height, ■ - below average weight, ■ - below average height, ■ - above average weight, ■ - above average height

5-20 year olds proposed by CDC (2000). Since there are no regional charts for assessing physical development in Armenia yet, and percentile method of assessment allows evaluation within wider range, we considered appropriate to assess physical development and BMI of adolescents with percentile charts, especially taking into account that CDC percentile curves have been used in Armenia for assessing physical development of children over 5 years of age (Minister of Health decree N1752□ 26.11.2007). Sixth rank was held by disorders of skin and subcutaneous tissue followed by digestive system disorders and circulatory disorders at ranks seven and eight, respectively. Symptoms, signs and deviations from norm revealed by clinical and laboratory examination not classified elsewhere ranked ninth. The list of disorders was concluded by disorders of ear and mastoid process.

The ranking of diseases recorded at the end of study period is a little different. The first three most common diseases are the same but the rank of musculoskeletal and connective tissue disorders is interchanged with disorders of eye and adnexa. Disorders of nervous system and skin and subcutaneous tissue retain their rankings while disorders of digestive organs move by two ranks higher and become 5th. Endocrine, nutritional and metabolic diseases move to 7<sup>th</sup> rank from fifth. The last three rankings

were not changed and circulatory diseases, clinical and laboratory abnormalities not classified elsewhere and diseases of ear and mastoid were ranking eighth, ninth and tenth, respectively.

As seen from Figure 2, during high school study the prevalence of nervous, digestive, eye, circulatory as well as ear and mastoid process diseases and clinical and laboratory abnormalities not classified elsewhere increases. The prevalence of the following disorders conversely decreased: endocrine, nutritional and metabolic diseases, respiratory, skin and subcutaneous tissue diseases. The prevalence of musculoskeletal and connective tissue disorders did not change notably.

The study of morbidity structure in high school students showed that the most prevalent were diseases of eye and adnexa, musculoskeletal system and respiratory system (table3); these disorders constituted about 73% of total morbidity. At the start of study period the most common were musculoskeletal disorders (25.3%) which remained quite prevalent (25.0%) at the end of the study period while ranking below eye and adnexa disorders. The majority of adolescents (55%) had posture abnormalities, scoliosis or flat feet. Among important contributing factors are long period of homework, often wrong position while working in front of computer. Most of the children with scoliotic deformation of thoracic spine (80%) spend on

**TABLE 2.**  
The prevalence and ranking of functional abnormalities and chronic disorders among high school children during their study period (per 1000 students)

Diseases by classes	Beginning of study	Class	End of study	Class
Endocrine, nutritional and metabolic diseases	157.97	5	93.27	7
Diseases of the nervous system	163.46	4	212.54	4
Diseases of the eye and adnexa	553.57	2	588.69	1
Diseases of the ear and mastoid process	12.36	10	19.88	10
Diseases of the circulatory system	26.1	8	41.28	8
Diseases of the respiratory system	524.73	3	506.12	3
Diseases of the digestive system	97.53	7	122.32	5
Diseases of the skin and subcutaneous tissue	131.87	6	120.8	6
Diseases of the musculoskeletal system and connective tissue	570.05	1	574.92	2
Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified	17.86	9	21.41	9

average 6 hours on homework using computers. At the same time, 1/5 of children with musculoskeletal system abnormalities or diseases spend almost no time at physical activity. Flat feet prevalence in schoolchildren is raising concern. Every third high school student has flat feet in different degrees of severity, more commonly seen in boys: 44% of high school male students have flat feet. It is known to contribute not only to leg pain and fatigue but also cause varicose veins, deformities of knee joint and subsequently vertebral column. Especially concerning is the fact that a fifth of adolescents with flat feet already has deformity of a part of spinal column. Three percent of boys had Osgood-Schlatter disease which was mostly related to active sport training, as presumed.

The analysis of study results revealed that eye and adnexa disorders are quite prevalent among high school students, constituting about 25% of overall morbidity. It is noteworthy that more than half of the children had vision disturbances: their percentage at the beginning of study was 55.3% and reached 58.4% at the end of study. When looking at dynamics of vision disturbances it becomes obvious that the abnormality type and its components undergo certain changes. At the beginning of study period the most prevalent vision disturbances were functional abnormalities (mild myopia –

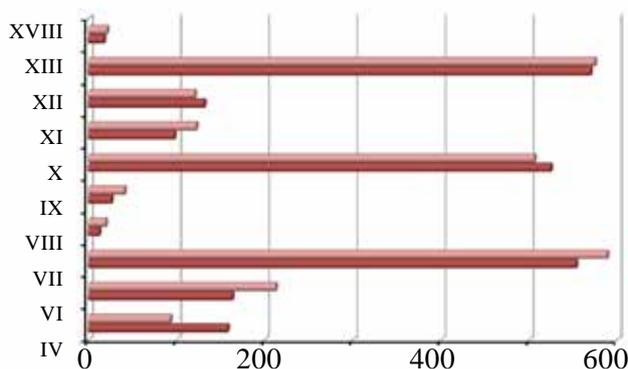


FIGURE 2. The frequency of functional abnormalities and chronic disorders among high school students at the start and end of study period (%)

NOTES: ■ - end of study, ■ - beginning of study, IV- Endocrine, nutritional and metabolic diseases, VI- Diseases of the nervous system, VII- Diseases of the eye and adnexa, VIII- Diseases of the ear and mastoid process, IX- Diseases of the circulatory system, X- Diseases of the respiratory system, XI- Diseases of the digestive system, XII- Diseases of the skin and subcutaneous tissue, XIII- Diseases of the musculoskeletal system and connective tissue, XVIII- Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified

78.4%, moderate and high myopia – 21.6%), while by the end of study the frequency of moderate and high myopia became 28.5% (p<0.05). The progression trend in this age group is due to high study load and overuse of technical devices. The survey conducted with the aim of proving or rejecting the above statement showed that during last year of high school (12<sup>th</sup> grade) 25% of children with vi-

TABLE 3.

Dynamics of morbidity structure among adolescents during school study (per 1000)

diseases by classes	beginning of study	number of cases	end of study	number of cases
Endocrine, nutritional and metabolic diseases	7 ± 0.63	115	4,05 ± 0.51	61
Diseases of the nervous system	7.25 ± 0.64	119	9.24 ± 0.75	139
Diseases of the eye and adnexa	24,5 ± 41,06	403	25.58 ± 1.12	385
Diseases of the ear and mastoid process	0.55 ± 0.18	9	0,86 ± 0.24	13
Diseases of the circulatory system	1,16 ± 0.26	19	1,79 ± 0.34	27
Diseases of the respiratory system	23,26 ± 1,04	382	21,99 ± 1.07	331
Diseases of the digestive system	4,32 ± 0.50	71	5.32 ± 0.58	80
Diseases of the skin and subcutaneous tissue	5.85 ± 0.58	96	5,25 ± 0.57	79
Diseases of the musculoskeletal system and connective tissue	25,27 ± 1,07	415	24.98 ± 1.12	376
Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified	0.79 ± 0.22	13	0,93 ± 0.25	14
Total	100	1642	100	1505

sion disturbances of different levels spend 7 hours overall working on computer and preparing homework while children without vision disturbances spend on average 5 hours on these activities. Adding to hours of homework is the fact that a fifth of children with visual disturbances is not aware of computer usage rules and requirements to workspace, therefore not being able to maintain these rules and requirements.

Respiratory diseases were the second most common in the structure of morbidity: 23.3% at the beginning and 22.0% at the end of the study. It is known that external respiratory function an important indicator of functional state of the organism and it is most prone to action of environmental adverse factors in childhood because of functional immaturity. This is the underlying cause of high prevalence of diseases of upper respiratory airways, bronchi and lungs in this age. The prevalence of these diseases declines to a certain degree in adolescence due to reserve capacities of respiratory system, remaining high nevertheless. Among study subjects the reported respiratory diseases were mainly nasal septum deviations with and without respiratory disturbance, chronic tonsillitis, chronic rhinitis and allergic rhinitis.

Nervous system diseases were the fourth most common both at start and at end of study period (despite increasing prevalence - 7.25% and 9.24%, respectively). Analysis of morbidity within this group showed that the most common neurological disorders in children were tension headache, migraine, essential tremor and vegeto-vascular dystonia. The most commonly reported complaints included tension headache due to emotional tension (new school environment, high anxiety level, and stress) as well as straining of head and neck muscles in maintaining prolonged wrong body position. A serious role in straining is attributed to homework because according to the survey, 25% of students spends 5 or more hours on the latter and girls constitute 80% of them: tension headaches were most commonly found in girls (65%) ( $p<0.05$ ).

Regarding endocrine, nutrition and metabolic diseases (7.0% at start and 4.1% at end of study), by graduation the main recorded abnormalities

were related to body weight including low weight and overweight. There were several cases (4) reported for thyroid dysfunction.

Dermatological disorders were also prevalent among adolescents. In 10<sup>th</sup> grade these disorders constituted 5.9% of overall morbidity and 5.3% at graduation with their frequency declined by 8%. The most common disorder in this group among adolescents was teen acne (85%); allergic dermatitis was reported in 11%. The decline in skin diseases prevalence among 17-year old young men and women, according to survey, can be attributed to proper use of skin care products and diet modifications.

The study revealed that digestive diseases prevalence rises during study. In 10<sup>th</sup> grade, 4.3% of students had digestive problems and by 12<sup>th</sup> grade this percentage was 5.3%. The most commonly diagnosed disease was gastroesophageal reflux disease, helminth infestation and constipation. Every sixth student was diagnosed with chronic gastritis. Based on comparative analysis of the survey data, the underlying factors contributing to digestive disorders were unhealthy dietary habits (21.7% of surveyed children reported not having breakfast, most of them remain fasting or near fasting during classes). This idea is supported by the fact that the majority of children with gastritis (56%) do not habitually have breakfast ( $p<0.05$ ) or takes breakfast occasionally, and 80% do not eat during class breaks (8.6% of students do not take any meals during class breaks,  $p<0.05$ ).

The prevalence of circulatory diseases increased by 8% in adolescents during their study. The main abnormalities included vegeto-vascular dystonia and arterial hypertension. Among clinical and laboratory abnormalities, symptoms and deviations from norm not classified elsewhere the most common were tachycardia, bradycardia and systolic arrhythmia. These manifestations of asthenic reaction and instability of autonomous nervous system can be explained also by prolonged time of homework and increased class load. For example, the overwhelming majority (78%) of children with tachycardia spend 5 hours and more on homework while only 39% of children without this abnormality devote the same amount to homework ( $p<0.05$ ).

Ear and mastoid process diseases were the least

prevalent both at the beginning and end of studies (0.6% and 0.9%, respectively). These disorders included hearing impairment, auditory nerve inflammation and otitis.

Based on the data obtained from physical development indicator measurement and medical examination of high school students we performed a complex evaluation of their health status.

Analysis of study data showed that the health status of students of 10<sup>th</sup> and 12<sup>th</sup> grades of Yerevan high schools is raising a lot of concern.

At study beginning (10th grade) health group I included only 7.4% of children (Table 4). Among students, 31.9% are practically healthy but has one or more morpho-functional abnormality. Chronic diseases are reported in 60.7% of students. More unfavorable is the health status of graduates: by graduating high school, the number of group I students decreases by almost half ( $p < 0.05$ ) while that of group III students increases 1.2-fold. In fact, by the end of study not only the number of healthy children decreases but also functional abnormalities progress to chronic disorders.

#### CONCLUSION

As a result of this study, it became clear that in studied age and sex group the majority of adoles-

**TABLE 4.**

**Health groups of high school students at the beginning and end of study period**

health groups	beginning of study		end of study	
	n.	%	n.	%
I	54	7.4	25	3.8
II	232	31.9	158	24.2
III-IV	442	60.7	471	72
total	728	100	654	100

cents have average weight and height. During study, the morbidity increases among high school students. While musculoskeletal system disorders rank first in morbidity structure at the start of studies, at graduation the first rank is held by eye and adnexa diseases. During 3 years of studies the prevalence of especially neurological and endocrine system diseases increases 1.3-fold and 1.5-fold, respectively. A deterioration of health status was reported during the study: health groups III and IV increase in size at the expense of decreasing number of students in health groups I and II.

Our data allow us to conclude that in order to maintain and improve health of high school students it is necessary to develop complex preventive measures involving all levels that impact the health of adolescents, starting from personal and up to macro-factors.

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