

## HYGIENIC ASSESSMENT OF THE ACADEMIC LOAD IN MODERN STUDENTS

Bulycheva EV ✉

Orenburg State Medical University, Orenburg, Russia

In modern school education, a system, developing high academic loads among schoolchildren, is being formed. The loads pose a serious problem, creating inevitable medical consequences, and producing a negative effect on the morbidity and structure of the pathology for this group of children and adolescents. Given the situation, control over the academic load, its rational distribution and initiating supervision over the academic process intensity are relevant. Basic negative factors of academic process organization were found in the course of academic schedule analysis in 1.728 classes and estimating the academic process intensity during 3.500 lessons. The maximum non-conformities to hygienic standards were found in high school students from cities. It was established that a weekly academic load was exceeded after school owing to extended learning activities, and irrational distribution of a weekly academic load because of difficult subjects. Intellectual, sensory and emotional loads were the leading criteria of an intense academic process. Highly intense academic load was noted for such school subjects as Russian, Algebra, Foreign language, Chemistry and Geometry. The same subjects are taught in different major classes with a various degree of intensity. This required scored correction of how difficult the subjects are in senior major classes.

**Key words:** students, schoolchildren, academic schedule, academic load

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✉ **Correspondence should be addressed:** Ekaterina V. Bulycheva  
ul. Sovetskaya, 6, Orenburg, 460000, Russia; e-sosnina@mail.ru

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## ГИГИЕНИЧЕСКАЯ ОЦЕНКА УЧЕБНЫХ НАГРУЗОК У СОВРЕМЕННЫХ УЧАЩИХСЯ

Е. В. Булычева ✉

Оренбургский государственный медицинский университет, Оренбург, Россия

В современном школьном образовании формируется система, программирующая высокие учебные нагрузки среди школьников, которые представляют собой серьезную проблему в аспекте создания неизбежных медицинских последствий, негативно влияя на заболеваемость и структуру патологии этой группы детского и подросткового населения. В сложившихся условиях важным является контроль за учебной нагрузкой, рациональностью ее распределения, а также внедрения контроля за напряженностью учебного процесса. Анализ учебных расписаний у 1728 классов, а также оценка напряженности учебного процесса на 3500 уроках выявила основные негативные факторы организации учебного процесса. Максимальное количество несоответствий гигиеническим требованиям установлено у городских учащихся старших классов. Установлено превышение недельной учебной нагрузки во внеурочное время за счет дополнительных занятий, нерациональное распределение недельной учебной нагрузки с учетом трудности предметов. Ведущими критериями, формирующими напряженность учебного процесса, являлись интеллектуальные, сенсорные и эмоциональные нагрузки. Высокой напряженностью учебного процесса характеризовались уроки русского языка, алгебры, иностранного языка, химии, геометрии. Отмечена различная степень напряженности одних и тех же предметов, преподающихся в классах различного профиля, что требует корректировки балльной оценки трудности предметов в старших профильных классах.

**Ключевые слова:** учащиеся, школьники, учебное расписание, учебная нагрузка

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✉ **Для корреспонденции:** Екатерина Владимировна Булычева  
ул. Советская, д. 6, г. Оренбург, 460000, Россия; e-sosnina@mail.ru

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Under conditions of educational renewal, increased scope of academic information, constant modernization of academic programs, and active use of electronic educational tools it's important to preserve the working capacity of students and mitigate a negative effect produced by the mentioned factors on neuropsychological profiles of students [1]. Non-rational organization of an academic process is especially important for students' health due to its duration, regularity and complexity of its action [2]. Thus, rational planning of an academic day is an important basis which allows balancing between the process of education and processes restoring students' physical and mental functions [3].

The purpose is to provide a hygienic assessment of academic loads in students of modern institutions of general education.

## PATIENTS AND METHODS

Hygienic assessment of academic loads is provided by way of determining the level of a weekly academic load, rational drafting of academic schedules in accordance with the Sanitary Rules and Regulations 1.2.3685–21 in 280 classes of primary school, 869 classes of secondary school, and 579 classes of high school. To estimate the intensity of education, the academic process intensity was assessed during 3,500 lessons at municipal and village schools using a natural experiment with chronometry. It corresponded to the Federal recommendations of rendering medical aid to students ФР РОШУМЗ-16–2015 (version 1.1) 'Hygienic Assessment of Learning Activity Intensity'.

Statistical analysis of the obtained data was done using MS Excel spreadsheets, Statistica 9 computer programme, and

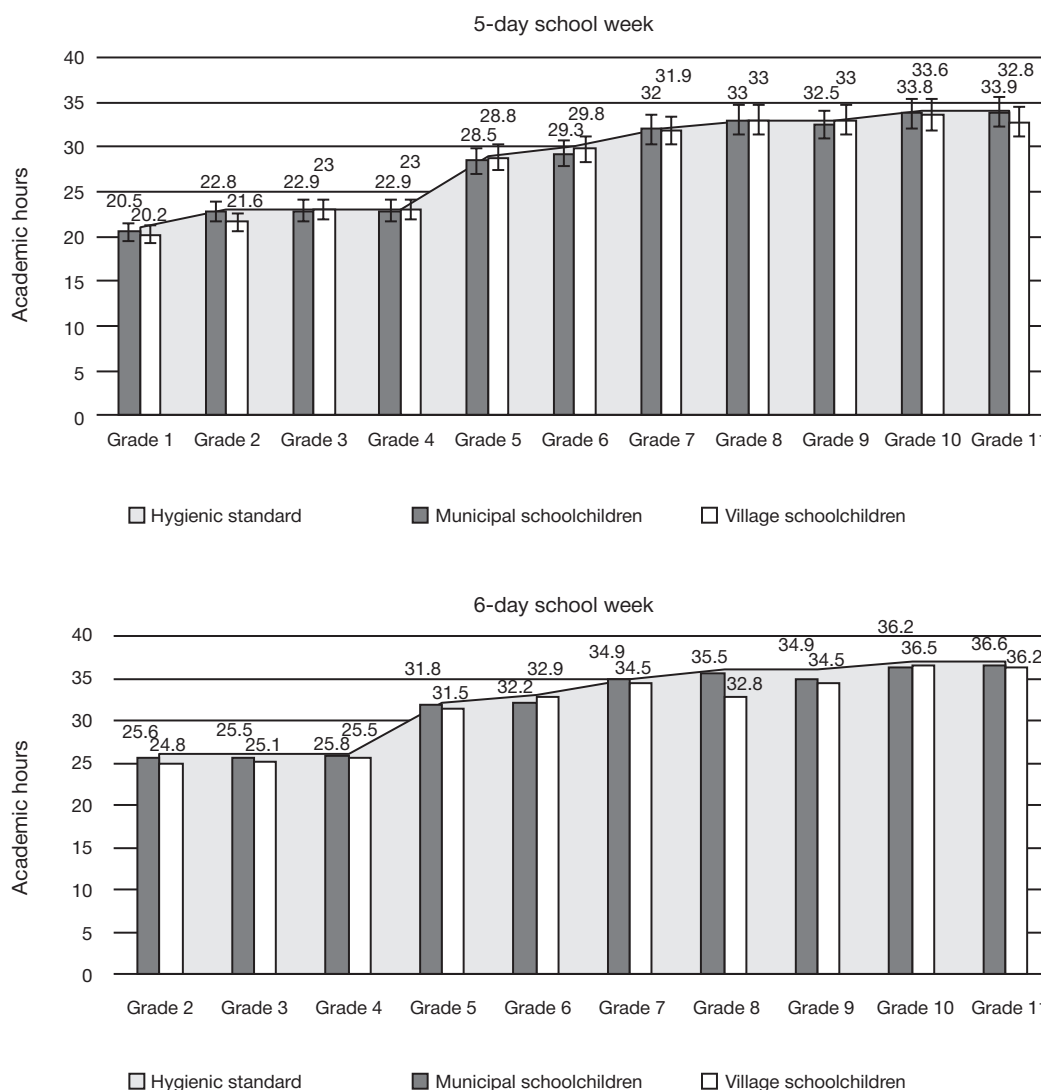


Fig. 1. Indicators of a weekly academic load in schoolchildren from cities and villages

SPSS (Statistical Package for the Social Sciences) program for Windows XP. Statistical processing of the obtained data was performed using standard methods of variation statistics and calculating arithmetic means ( $M$ ), standard deviations ( $\delta$ ), mean error in the arithmetic average ( $m$ ), as preliminary examination of distribution of random values, that correspond to the analyzed values, has revealed their conformity with the normal distribution law ( $\chi$ -square was used as a fitting criterion). To find statistically significant differences, the parametric method (t-test method) with calculation of a non-sampling error and Student's coefficient and non-parametric method with a Mann-Whitney test were used in the compared groups.

#### STUDY OUTCOMES

Compliance with an academic load is an important factor of fatigue prevention in the course of both an academic day and academic week; it is established in every examined school (Fig. 1). At the same time, analysis of weekly extracurricular activity in the form of out-of-school activities, zero lessons, and facultative studies demonstrated that in senior students the accepted values were exceeded by a factor of 1.5 (Fig. 2). The maximum excess up to  $18.6 \pm 1.5$  hours per week in relation to hygienic standards was found in senior students of municipal schools.

A distinctive feature of modern school education is that it is successful when mental activity of students is intensified in the lack of school hours along with an active use of information and communication training aids, actual use of a working schedule significantly different from the agreed one, which doesn't take into account the physiological features of a changed working capacity during an academic day or week in students. It is established that in  $35.8 \pm 0.04\%$  municipal classes and  $23.7 \pm 0.03\%$  rural classes, the schedules are compiled in a non-rational way, where the maximum non-correspondence to hygienic standards is found in schedules of  $64.5 \pm 0.06\%$  senior grades (Fig. 3).

Academic days with the largest and smallest total scores of academic subject difficulty in the form of double-peaked and single-peaked curves were alternated in  $33.2 \pm 0.04\%$  of analyzed schedules of municipal schools and in  $34.3 \pm 0.04\%$  schedules of rural schools (table 1).

It was established that  $66.8\%$  municipal and  $65.7\%$  rural schedules were irrationally developed. In students of secondary and high schools, a maximum number of schedules not corresponding to the requirements has been developed. Thus, in  $38.5 \pm 0.06\%$  schedules of secondary municipal school students, the maximum total scoring load was determined both during warming-up and impaired productivity; in  $36.3 \pm 0.06\%$

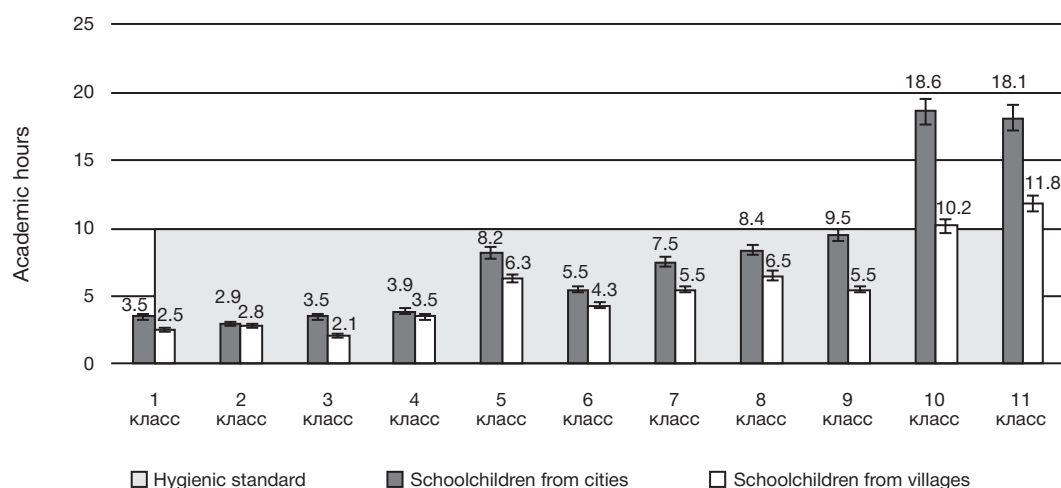


Fig. 2. The volume of a total weekly extracurricular academic load (hours)

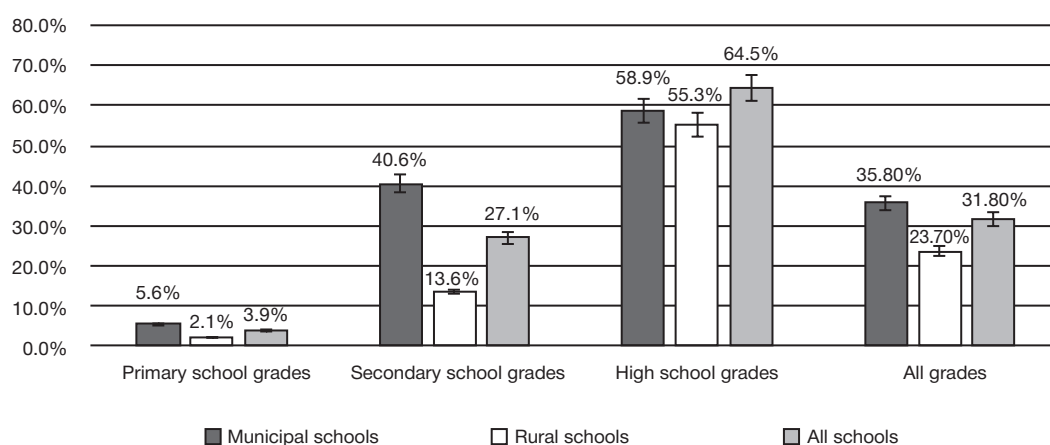


Fig. 3. Share of grades with a schedule not corresponding to hygienic requirements as far as academic load distribution is concerned

Table 1. Indicators of developing a rational schedule (P±σp%)

Indicators	Schedule							
	of primary school		of secondary school		of high school		all grades	
	city	village	city	village	city	village	city	village
	n=45	n=30	n=60	n=40	n=64	n=38	n=169	n=108
rationality indicators								
Double-peaked or single-peaked distribution of a total weekly scoring load	85,6 ±0,04	88,3 ±0,06	12,5 ±0,03	10,7 ±0,05	1,6 ±0,04	3,8 ±0,08	33,2 ±0,04	34,3 ±0,04
irrationality indicators								
Maximum total scoring load while warming-up	3,5 ±0,03	3,2 ±0,02	22,1 ±0,05	22,2 ±0,06	36,3 ±0,06	54,1 ±0,08	25,6 ±0,03	30,1 ±0,04
Maximum total scoring load during impaired productivity	2,6 ±0,02	1,7 ±0,02	26,9 ±0,06	33,4 ±0,07	25,4 ±0,05	20,2 ±0,06	11,7 ±0,02	10,4 ±0,03
Maximum total scoring load for the same schedule while warming-up and during impaired productivity	8,3 ±0,04	6,8 ±0,04	38,5 ±0,06	33,7 ±0,07	36,7 ±0,06	21,9 ±0,07	29,5 ±0,03	25,2 ±0,04
TOTAL (%)	100	100	100	100	100	100	100	100

and 54.1±0.08% schedules of high municipal and rural schools, the maximum total scoring load was found during warming-up. In 36.7±0.06% of high municipal school schedules, the maximum total scoring load was additionally found during warming-up. In 36.7±0.06% of high municipal school schedules, the maximum total scoring load was determined both during the warming-up period, and impaired productivity.

A potential reserve of educational process organization health-saving constituent, consisting not only in a hygienically

optimal schedule structure, but also in the intensity rate of lessons, which supports high capacity for work, optimal body functioning, lack of excessive fatigue and harmonious development of schoolchildren [4]. In municipal students, academic activity was first-degree and intense (class 3.1), amounting to 2.9±0.05 points, due to first-degree intense intellectual load (3.3±0.01 points), sensory load (3.2±0.07 points), monotonicity (3.6±0.03 points) and regimen (2.9±0.05 points) of academic work (table 2). In schoolchildren from

**Table 2.** Indicators of intense academic activity in schoolchildren from cities and villages (in points)

Indicators and criteria of intensity	Schoolchildren from cities		Schoolchildren from villages	
	points	intensity class	points	intensity class
1. Intellectual load:				
1.1. Scope of work	3.5±0.05	3.1	2.9±0.03*	3.1
1.2. Comprehension of signals and their assessment	3.8±0.02	3.2	2.6±0.02*	3.1
1.3. Distribution of functions by the degree of a task complexity	2.0±0.05	2	1.8±0.03	2
1.4. Type of the accomplished academic activity	3.8±0.03	3.1	2.5±0.02*	2
Overall estimate of intellectual loads	3.3 ±0.01	3.1	2.5±0.03*	2
2. Sensory load:				
2.1. Duration of focused surveillance (% of time)	3.5±0.05	3.1	3.2±0.02*	3.1
2.2. Density of information messages within 40 minutes of work	3.8±0.02	3.2	3.5±0.02*	3.1
2.3. Size of a differentiation object depending on the font	3.5±0.03	3.1	2.9±0.05*	3.1
2.4. Type and number of training aids used during lessons	3.6±0.05	3.2	2.5±0.03*	2
2.5. Working with optical devices (% of time)	1.0±0.04	1	1.5±0.02	1
2.6. Observation over video terminal screens	3.5±0.04	3.1	3.3±0.05*	3.1
2.7. Load on an auditory analyzer (when it is necessary to perceive speech and use audio materials)	3.3±0.02	3.1	2.5±0.05	2
2.8. Load on the vocal apparatus (% of time)	2.8±0.02	3.1	2.4±0.04	2
Overall estimate of sensory loads	3.2±0.07	3.1	2.7±0.5	3.1
3. Emotional load:				
3.1. Extent of responsibility for the own activity result	3.5±0.05	3.1	2.8±0.03*	3.1
3.2. Risk level to form a negative situation	1.3±0.02	1	1.5±0.03	1
3.3. Extent of responsibility to form a negative situation for other people	1.0±0.02	1	1.1±0.02	1
3.4. Number of conflict situations associated with learning activity per an academic day	1.0±0.02	1	1.3±0.03	1
Overall estimate of emotional loads	1.7±0.05	2	1.7±0.03	2
4. Monotonous load:				
4.1. A number of elements required to implement a simple task	3.7±0.05	3.2	3.5±0.02	3.1
4.2. Duration of simple tasks (in seconds)	3.6±0.04	3.1	2.5±0.03*	3.1
4.3. Time of active actions (% of time)	3.8±0.25	3.2	2.6±0.03*	3.1
4.4. Monotonicity of academic environment (% of time)	3.3±0.02	3.1	3.1±0.02	3.1
Overall estimate of monotonous loads	3.6±0.03	3.2	2.9±0.03	3.1
5. Working regimen				
5.1. Actual duration of academic time considering all types of activity	3.6±0.02	3.2	2.6±0.02*	3.1
5.2. Academic shifts	1.8±0.06	2	1.5±0.01	1
5.3. Availability and duration of regulated breaks	3.5±0.05	3.1	2.5±0.01*	2
Overall estimate of the working regimen	2.9±0.02	1	2.2±0.02	2
Overall indicator of intensity	2.9±0.05	3.1	2.4±0.03*	2

\* $p \leq 0,05$  to compare the organization of an academic process in rural and municipal schools

villages, the academic activity was acceptable (class 2); with the overall estimate being  $2.4 \pm 0.03$  points, and first-degree intensity was established based on two criteria only such as sensory load ( $2.7 \pm 0.5$  points) and academic work monotonicity ( $2.9 \pm 0.03$  points).

In municipal students, 6 indicators were estimated as intense second-degree indicators (class 3.2.), including 1 indicator of intellectual load such as 'signal perception and estimation' ( $3.8 \pm 0.02$  points); 2 indicators of sensory load such as 'density of information messages within 40 minutes of work' ( $3.8 \pm 0.02$  points); 'type and number of training aids used during a lesson' ( $3.6 \pm 0.05$  points); 2 indicators of work monotonicity such as 'a number of elements required to implement a simple task' ( $3.7 \pm 0.05$  points) and 'time of active actions' ( $3.8 \pm 0.25$  points); and 1 indicator of academic working

regimen such as 'actual duration of academic time considering all types of activity' ( $3.6 \pm 0.02$  points). In students from villages, no indicators of second-degree intensity were found out.

In the students of the 5<sup>th</sup> grade, the maximum class of academic activity intensity (class 3.2.) was set for algebra ( $3.7 \pm 0.10$  points) due to intense 2-degree (class 3.2.) intellectual load ( $3.8 \pm 0.10$  points), sensory load ( $3.7 \pm 0.12$  points) and intense subject-related academic activity with 1-degree monotonicity ( $3.2 \pm 0.10$  points) (Table 3).

In students of the 10<sup>th</sup> grades, intense second-degree academic activity was also set for literature ( $3.7 \pm 0.10$  points) due to intense 2-degree sensory load ( $3.8 \pm 0.10$  points) and working regimen ( $3.7 \pm 0.10$  points) and intense 1-degree work monotonicity ( $3.3 \pm 0.11$  points); and for algebra ( $3.7 \pm 0.11$  points) due to intense 2-degree sensory load

Table 3. Intensity of academic activity in schoolchildren by school subjects (intensity class/ M±m in points)

Subject	Indicator of intensity	Grades							
		Grade 5	Grade 6	Grade 7	Grade 8	Grade 9	Grade 10	Grade 11	
Russian	Intellectual load	3.2	3.1	2	2	2	3.1	3.2	
		3.7±0.10	2.8±0.10	2.4±0.12	2.1±0.10	2.2±0.10	3.3±0.11	3.8±0.10	
	Sensory load	2	2	3.1	2	2	3.1	3.1	
		2.4±0.11	1.9±0.10	3.3±0.10	1.8±0.12	1.7±0.10	2.8±0.12	2.9±0.10	
	Emotional load	3.1	2	2	2	2	2	3.1	
		3.5±0.13	1.7±0.10	2.1±0.11	1.9±0.11	2.4±0.12	2.3±0.10	2.8±0.12	
	Monotonicity	3.1	3.1	2	2	2	3.1	3.2	
		2.8±0.10	3.4±0.12	1.8±0.11	2.1±0.10	1.9±0.12	3.4±0.10	3.8±0.11	
	Working regimen	3.1	2	2	2	3.1	3.1	3.2	
		3.4±0.12	2.4±0.10	2.1±0.11	1.7±0.12	2.9±0.11	3.8±0.12	3.9±0.10	
	Overall estimate	3.1	2	2	2	2	3.1	3.2	
		3.2±0.11	2.3±0.10	2.2±0.11	1.9±0.10	2.1±0.11	3.1±0.10	3.7±0.11	
	Literature	Intellectual load	2	3.1	2	2	2	2	2
			2.3±0.11	3.0±0.11	1.9±0.10	1.8±0.11	2.3±0.10	1.9±0.12	2.4±0.10
Sensory load		3.1	3.1	3.1	3.1	3.1	3.2	3.2	
		3.3±0.11	3.1±0.10	2.8±0.10	3.0±0.11	3.3±0.12	3.8±0.10	3.9±0.11	
Emotional load		2	2	2	2	2	2	3.1	
		2.3±0.10	1.8±0.12	1.8±0.10	1.6±0.12	2.1±0.11	2.0±0.10	3.3±0.12	
Monotonicity		3.1	2	2	2	2	3.1	3.1	
		2.9±0.10	2.3±0.10	1.8±0.11	2.2±0.11	1.7±0.10	2.7±0.12	3.1±0.11	
Working regimen		2	2	2	2	2	3.2	3.2	
		2.1±0.11	1.8±0.10	1.6±0.12	1.9±0.12	1.7±0.12	3.7±0.10	3.8±0.10	
Overall estimate		3.1	2	2	2	2	3.2	3.2	
		2.6±0.10	2.4±0.11	1.9±0.10	2.1±0.11	2.2±0.11	3.7±0.10	3.8±0.11	
Algebra		Intellectual load	3.2	3.2	3.1	3.1	3.1	3.1	3.1
			3.8±0.10	3.5±0.11	2.8±0.12	2.6±0.10	3.3±0.11	3.3±0.11	3.4±0.10
	Sensory load	3.2	3.2	3.1	3.1	3.1	3.2	3.1	
		3.7±0.12	3.6±0.10	3.8±0.11	2.7±0.10	3.0±0.12	3.7±0.12	3.4±0.11	
	Emotional load	2	2	2	2	2	2	3.2	
		1.9±0.12	1.8±0.10	1.7±0.12	2.1±0.10	2.0±0.12	2.4±0.11	3.8±0.10	
	Monotonicity	3.1	2	2	2	2	2	3.2	
		3.2±0.10	2.1±0.12	1.9±0.12	1.6±0.11	2.1±0.12	2.3±0.12	3.7±0.12	
	Working regimen	2	2	2	2	2	3.1	3.2	
		1.9±0.10	2.1±0.11	1.7±0.10	1.8±0.12	1.6±0.12	3.3±0.12	3.7±0.10	
	Overall estimate	3.2	3.1	3.1	3.1	3.1	3.2	3.2	
		3.7±0.10	2.7±0.11	2.6±0.12	2.8±0.10	2.6±0.10	3.7±0.11	3.6±0.11	
	Geometry	Intellectual load	3.2	3.1	2	2	2	3.1	3.1
			3.8±0.10	3.4±0.11	2.2±0.10	1.8±0.12	1.7±0.10	2.8±0.10	3.4±0.12
Sensory load		3.1	3.1	3.1	3.1	3.1	3.1	3.2	
		2.8±0.12	2.9±0.11	2.6±0.10	3.1±0.12	3.3±0.10	3.2±0.12	3.8±0.10	
Emotional load		2	2	2	2	2	2	3.2	
		2.2±0.10	1.8±0.11	2.3±0.10	1.8±0.11	1.7±0.10	2.1±0.12	3.8±0.10	
Monotonicity		2	2	2	2	2	3.1	3.1	
		1.8±0.11	1.9±0.10	1.6±0.12	1.8±0.10	1.7±0.11	3.4±0.10	3.3±0.10	
Working regimen		2	2	2	2	2	3.1	3.2	
		2.3±0.10	2.1±0.10	1.9±0.12	2.1±0.11	1.9±0.10	3.4±0.10	3.7±0.12	
Overall estimate		3.1	3.1	2	2	2	3.1	3.2	
		2.8±0.10	2.6±0.11	2.1±0.11	2.0±0.10	2.1±0.11	2.9±0.10	3.7±0.11	

Table 3 cont.

Subject	Indicator of intensity	Grades						
		Grade 5	Grade 6	Grade 7	Grade 8	Grade 9	Grade 10	Grade 11
Biology	Intellectual load	2	2	2	2	2	2	2
		1.8±0.10	1.6±0.11	1.7±0.10	1.7±0.11	2.4±0.11	2.2±0.12	2.2±0.11
	Sensory load	3.1	2	2	2	2	3.1	3.1
		3.3±0.12	2.1±0.12	1.8±0.12	1.9±0.11	1.7±0.10	2.8±0.11	3.4±0.10
	Emotional load	2	2	2	2	2	2	3.1
		2.4±0.12	1.7±0.10	1.9±0.10	1.6±0.11	2.2±0.12	2.1±0.11	3.2±0.10
	Monotonicity	2	2	2	2	2	2	2
		2.3±0.10	1.6±0.10	1.7±0.11	2.0±0.10	2.2±0.10	2.3±0.12	2.4±0.10
Working regimen	2	2	2	2	2	3.1	3.1	
	1.9±0.12	2.0±0.12	1.7±0.10	1.7±0.12	1.9±0.12	2.9±0.10	3.3±0.10	
Overall estimate	2	2	2	2	2	3.1	3.1	
	2.3±0.12	1.8±0.11	1.7±0.11	1.8±0.10	2.1±0.10	2.6±0.11	2.9±0.10	
Chemistry	Intellectual load	3.1	3.1	2	2	2	3.1	3.1
		3.0±0.12	2.9±0.10	1.7±0.12	1.8±0.10	1.6±0.11	2.9±0.10	3.2±0.10
	Sensory load	2	2	2	2	2	3.1	3.1
		1.9±0.10	1.7±0.11	1.7±0.12	1.6±0.10	1.8±0.11	3.3±0.12	3.4±0.10
	Emotional load	2	2	2	2	2	2	3.1
		1.8±0.10	1.6±0.11	1.6±0.10	1.7±0.12	1.7±0.10	1.8±0.11	3.4±0.12
	Monotonicity	3.1	2	2	2	2	2	3.1
		2.9±0.11	2.4±0.11	1.9±0.12	2.2±0.10	1.8±0.11	2.1±0.11	3.1±0.10
Working regimen	2	2	2	2	2	3.1	3.1	
	2.4±0.10	1.9±0.11	1.9±0.10	2.1±0.12	1.8±0.12	3.2±0.11	3.4±0.10	
Overall estimate	3.1	2	2	2	2	3.1	3.1	
	2.8±0.10	2.1±0.11	1.8±0.11	1.9±0.10	1.7±0.11	2.7±0.12	3.3±0.11	
History	Intellectual load	2	2	2	2	2	3.1	3.1
		2.3±0.10	2.2±0.11	2.3±0.12	2.1±0.10	2.4±0.10	2.7±0.12	3.1±0.12
	Sensory load	3.1	3.1	3.1	3.1	3.1	3.1	3.2
		3.3±0.12	3.2±0.10	3.2±0.11	3.1±0.10	3.1±0.12	3.4±0.10	3.8±0.10
	Emotional load	2	2	2	2	2	2	3.1
		1.8±0.10	1.7±0.10	1.7±0.12	1.6±0.10	1.7±0.11	1.9±0.10	3.1±0.10
	Monotonicity	2	2	2	2	2	2	2
		1.6±0.10	1.7±0.11	1.6±0.11	1.8±0.10	1.8±0.12	1.6±0.12	1.9±0.10
Working regimen	2	2	2	2	2	3.1	3.2	
	1.9±0.10	1.8±0.10	1.8±0.12	1.7±0.12	1.6±0.10	2.8±0.10	3.7±0.10	
Overall estimate	2	2	2	2	2	3.1	3.1	
	2.2±0.10	2.2±0.11	2.1±0.11	2.1±0.10	2.1±0.12	2.6±0.11	3.1±0.10	
Foreign language	Intellectual load	3.1	3.1	3.1	3.1	2	3.1	2
		2.8±0.10	2.8±0.11	2.9±0.10	3.1±0.10	2.4±0.10	2.6±0.11	2.5±0.10
	Sensory load	3.1	3.1	3.1	3.1	3.1	3.1	3.1
		3.3±0.12	2.7±0.10	2.8±0.12	3.3±0.11	2.9±0.10	2.9±0.11	3.4±0.10
	Emotional load	3.1	3.1	3.1	3.1	3.1	3.1	3.1
		2.1±0.10	2.2±0.11	2.1±0.11	2.3±0.10	3.1±0.10	3.3±0.11	3.3±0.10
	Monotonicity	3.1	3.1	3.1	3.1	3.1	3.1	3.1
		3.1±0.11	2.9±0.12	2.8±0.10	2.8±0.11	3.2±0.12	3.2±0.10	3.3±0.10
Working regimen	3.2	3.1	3.1	3.1	3.1	3.2	3.2	
	3.8±0.10	3.5±0.10	3.4±0.10	2.9±0.10	3.1±0.10	3.8±0.12	3.8±0.11	
Overall estimate	3.1	3.1	3.1	3.1	3.1	3.1	3.2	
	3.0±0.11	2.8±0.11	2.8±0.10	2.9±0.10	2.9±0.11	3.2±0.11	3.3±0.10	

■ – intense –1 and 2-degree academic activity (class 3.1., 3.2)

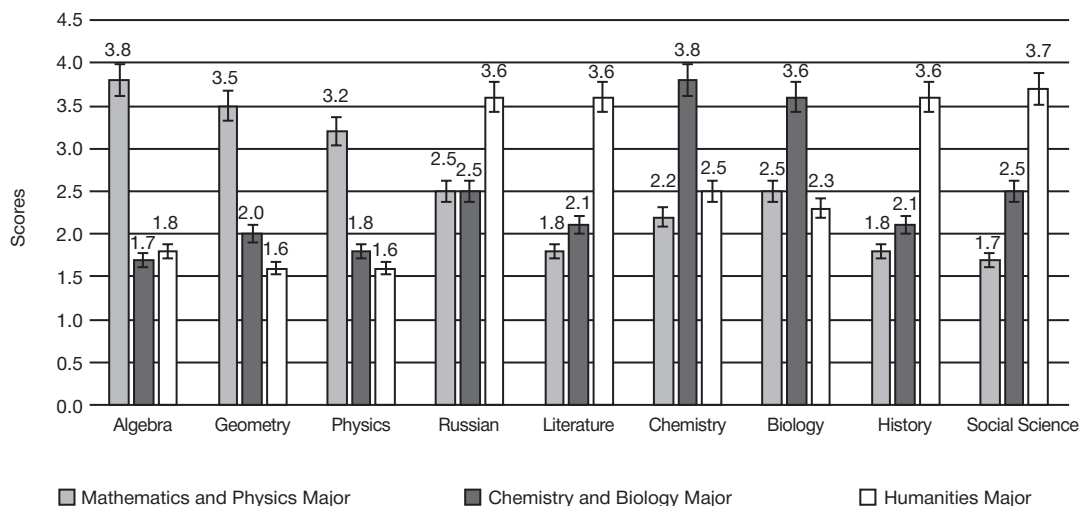


Fig. 4. Intensity of school subjects depending on specialization

Table 4. Correction factors to rank the difficulty of the subjects studied in high school

School subjects	Score (ranked by difficulty) in accordance with the Sanitary Rules and Regulations 1.2.3685–21)	Specialization-based correction factors			Score (ranked by difficulty) based on correction factors		
		Mathematics and Physics Major	Chemistry and Biology Major	Humanities Major	Mathematics and Physics Major	Chemistry and Biology Major	Humanities Major
Physics	13	1.0	0.50	0.50	13	7	7
Geometry	8	1.0	0.46	0.46	8	4	4
Algebra	7	1.0	0.45	0.45	7	3	3
Chemistry	12	0.54	1.0	0.54	6	12	6
Biology	7	0.71	1.0	0.71	5	7	5
Russian	6	0.70	0.70	1.0	4	4	6
Literature	7	0.50	0.50	1.0	4	4	7
History	10	0.5	0.5	1.0	5	5	10
Social science	5	0.48	0.48	2.0	2	2	10

( $3.7 \pm 0.12$  points) and intense 1-degree intellectual load ( $3.3 \pm 0.11$  points) and working regimen ( $3.3 \pm 0.12$  points).

In students of the 11<sup>th</sup> grades, intense 2-degree academic activity was observed for 5 subjects such as the Russian language ( $3.7 \pm 0.11$  points), literature ( $3.8 \pm 0.11$  points), algebra ( $3.6 \pm 0.11$  points), geometry ( $3.7 \pm 0.11$  points) and a foreign language ( $3.3 \pm 0.10$  points). As far as the examined subjects for the 11<sup>th</sup> grade students go, intense academic activity for every indicator such as intellectual, sensory, emotional loads, monotonicity and academic labor regimen corresponded to class 3 only (which is intense). This shows an increased risk of unfavorable effect produced by a highly intense academic process on the organisms of the 11<sup>th</sup> grade students.

The obtained data partially correspond to the scale measuring the difficulty of school subjects. This is probably because the rate of the subject difficulty is universal and is not associated with the rate of difficulty for teaching depending on specialization, as high school teachers in general educational institutions note that it's the specialization that defines the degree of subject difficulty. Thus, classes specializing in chemistry and biology offer a more difficult course of biology as compared to classes specializing in mathematics and physics. This assumption was confirmed in the comparative analysis of subject-associated academic activity intensity depending on specialization (Fig. 4). Thus, intensity of major subjects was 1.6–2.2 times higher than the one of the same subjects in non-major classes.

Considering the above, an important hygienic issue of scientific justification of a differentiated approach defining difficulties of subjects depending on specialization in high school is becoming obvious. Therefore, it is suggested that correction factors need to be used, taking into account the frequency in difference between the subject intensity depending on specialization. This will enable more rational practical development of a schedule, considering a real difficulty of subjects depending on specialization (Table 4).

## DISCUSSION

In many studies, the problem of students' health preservation is associated with academic loads, their rational distribution and occurrence of new risk factors such as use of electronic training aids [1–4].

The data about the correspondence of academic loads within a week to hygienic standards basically do not correspond to the published data of other authors [5]. This is probably because in this study a differentiated approach was used to estimate a weekly academic load during and after class time, but not their overall estimate. If a number of hours didn't exceed the permissible levels during class time, then the academic load in high school students analyzed after class exceeded the regulated scope by a factor of 1.5. According to published data, a high academic load after class can be explained by active and deep study of certain subjects and

active attendance of extracurricular activities by a significant number of high school students [6–7].

The problem of non-rational distribution of a weekly academic load depending on subject difficulty corresponds to other authors' data, whereas systematic publications of these results denote immediacy of the issue [8–10].

The issue of academic process intensification has been increasingly focused lately. It is believed to be an important factor resulting in development of fatigue, stress-induced functional disturbances of organs and systems, disturbed physical development and chronic pathology in senior schoolchildren [11–16]. The academic process established intensity is significantly dependent on intellectual, sensory and emotional loads. The academic process intensity is higher in municipal students than in those from villages. Intensity data about the entire academic process and separate subjects are compliant with data of other researchers [7]. In this research, it was attempted to compare subject difficulties and the academic process intensity for the first time. It is known that students of the 10<sup>th</sup> grades start specializing in certain subjects, and

in classes with different specialization the same subjects are studied with different intensity. This hypothesis was reflected in the cited data and determined the perspective of studying the real difficulty of subjects in high school and scientific justification of school subject scoring correction.

## CONCLUSION

Organization of an academic process in modern educational institutions is characterized by increased duration of extracurricular activity, especially among high school students, non-rational development of schedules without taking into account the dynamics of the physiological curve of working capacity, high intensity of academic activity due to intellectual and sensory loads against the background of monotonous and non-rational organizational regimen of academic activity. The mentioned facts can be risk factors of fatigue development and augmentation in students, whereas the fatigue itself can be predictor of health deterioration, especially when digital educational environment is being implemented actively.

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