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EVALUATION OF THE INDICATORS OF THE MUNICH CHRONOTYPE QUESTIONNAIRE IN MEDICAL STUDENTS

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Annotation. The aim of the study was to assess the chronotype in the transition period of 2019 (March-May), taking into account the BMI of medical students living in the city of Vladikavkaz (43°01'00" N 44°41'00" E), North Ossetia-Alania. A voluntary survey of 270 medical students (210 girls, 60 boys) was carried out with the Munich Chronotype Questionnaire (MCTQ). The indices of the entire group were evaluated, separately for boys and girls on weekdays and weekends – the duration of sleep, the time of falling asleep, the middle of sleep, which determines the chronotype, and "social jetlag". Analysis of the data showed significant sex-based differences, the duration of sleep in the mixed group is shorter on weekdays, but for boys it is significantly less than for girls on weekends. The time of falling asleep in the mixed group was shifted to a later time (29 minutes); for girls – by 22 minutes, and for boys – by 51 minutes. In the mixed group, significant differences were found between the duration of sleep on weekdays and weekends (by 29%), the shift in the middle of sleep to the morning hours (by 1 h 36 min). Students have "slightly late" (girls) and "moderately late" defined chronotypes. The prevalence of "late" chronotypes among medical students is accompanied by low resistance to the social environment; a chronic difference between endogenous and external biorhythms leads to an increasing tension of adaptation, which forms dysregulatory disorders, and is a risk factor for the development of pathology of the NEIM system.

Introduction. Organism's adaptation to environmental factors is an evolutionally formed mechanism, which is controlled by several factors, among which the important role is played by photoperiodism. The "day-night" cycle (or the "sleep-wake" cycle) forms endogenic circadian rhythms [6], which regulate the neuroendocrine-immune system (the NEIM system) [5]. Circadian rhythms are projected on the psychophysical performance [9], however, main control is

determined by the central nervous system, which contains all cells of the organism under “tonic control” and contributes to the quality of flexibility (“aftereffect”) in conditions of interaction with the unstable environment [3]. Pacemakers control all cyclic systems of the organism: the suprachiasmatic nucleus (SCN) of the hypothalamus, the pars tuberalis of the hypophysis [10], which regulate circadian and seasonal features of psychophysiological functions’ regulation respectively. Individual setting of the “sleep-wake” cycle, related to social adaptation and rhythm of life, leads to sleep disorders, among which insomnia is prevalent [2], and is accompanied by the desynchronization of performance of the brain’s glymphatic system, which contributes to the main detoxification of the central nervous system’s cells during sleep [8].

Daily routine of modern students is aimed at motivated social adaptation to the learning process. Meanwhile, medical students are in the state of higher psychophysiological stress, because the amount of information, which they learn during 5-6 years of study, corresponds to 3 cycles of higher education at the least. Long-term “overload” corresponds to setting the lifestyle to requirements of the learning process, which is frequently accompanied by the disturbance in “biological clocks” of the circadian rhythmicity and sleep.

In chronobiological observations, circadian cycles are characterized by the chronotype, which is determined using questionnaires [4, 7, 11]. They allow identifying individual features of the circadian cycle and character of adaptation to the daily routine.

The purpose of this study was to evaluate the chronotype in the transition period of 2019 (March-May), taking into account the BMI of medical students living in the city of Vladikavkaz (43°01'00" N 44°41'00" E), North Ossetia-Alania.

Methods and organization. The study was approved by the Ethics Committee of the IBI VSC RAS №7 from 20.02.10 and carried out based on results of voluntary questionnaire of 270 medical students, studying in the North Ossetia Medical Academy (2019), average age – 20,24±1,534 (M±SD), the number of girls was prevalent – 210 people, boys – 60 people. Prevalence of girls was determined by the sex- and age-based structure among students of the medical establishment of higher education. Interpretation of the body mass index (BMI) was carried out according to WHO recommendations. After signing the informed consent, those surveyed answered questions of the Russian version of the Munich Chronotype Questionnaire (MCTQ), which evaluates environmental factors as well [4, 11] without limiting subjective chronotype evaluation. Indicators of the MCTQ were evaluated, integral indicators on weekdays and weekends – the duration of sleep, the time of falling asleep, which is set 2-2,5 hours after melatonin secretion, the middle

of sleep, which determines the chronotype, and the "social jetlag", which is determined by the difference in the middle of sleep on weekdays (WD) and weekends (WE) [12].

Statistical processing was carried out using descriptive methods of variation statistics with the use of the IBM SPSS 23 software. Values of questionnaire indicators were presented as the mean value and standard deviation (M±SD). Significance of differences in examined indicators between groups was evaluated using the t-test, the Pearson coefficient was used to evaluate correlations.

Results and discussion. Sleep characteristics in the MCTQ evaluation are divided into indicators on WD, which assess "social clock", and into indicators on WE, which reflect internal endogenic "biological clock" of the organism [11].

Table 1

Indicators of the Munich questionnaire in medical students (descriptive statistics)

Questions	Total		Girls		Boys		
	Freq.	%	Freq.	%	Freq.	%	
WD							
I go to bed at... (h:min)	21:00-0:00	96	36,1	68	32,7	28	48,3
	0:00-1:40	148	53,6	125	60,1	23	39,7
	2:00-3:00	22	8,3	15	7,2	7	12,1
Time needed to fall asleep (min)	0-25	194	72,9	157	75,5	37	63,8
	30-59	68	25,6	49	23,6	19	32,8
	60-120	4	1,5	2	1	2	3,4
I wake up at... (h:min)	06:00-06:50	41	15,5	31	15	10	17,2
	7:00-7:50	179	67,5	148	71,5	31	53,4
	8:00-9:00	45	17	28	13,5	17	29,3
WE							
I go to bed at... (h:min)	20:00-0:00	69	26,1	58	28	11	19,3
	0:00-1:50	142	53,8	115	55,6	27	47,4
	2:00-3:00	48	18,4	32	15,5	16	28,1
	4:00-4:30	5	1,9	2	0,9	3	5,3
Time needed to fall asleep (min)	0-25	185	70,1	143	69,1	42	73,7
	30-59	72	27,3	58	28	14	24,6
	60-150	7	2,7	6	2,9	1	1,8
I wake up at... (h:min)	5:00-5:50	2	0,8	2	1	-	-
	06:00-06:30	8	3,1	6	2,9	2	3,5
	7:00-7:50	13	5,0	6	2,9	7	12,3
	8:00-8:40	32	12,2	26	12,7	6	10,5
	9:00-9:30	52	19,8	39	19,0	13	22,8
	10:00-14:00	155	59,1	126	61,5	29	50,9
Additional characteristics							
BMI	19-24,9	233	86,3	196	93,3	37	61,7
	25-29,9	31	11,5	12	5,7	19	31,7
	30-34,9	6	2,2	2	1,0	4	6,6
BMI mean value (M±SD)		21,39	3,276	20,83	3,017	23,36 ^{*d}	3,42
Working hours	Day	236	87,7	185	88,1	51	86,4
	Night (d)	33	12,3	25	11,9	8	13,6

Note: *d – comparison of mean values between boys and girls; * – p<0,0001

Frequency indicators of the questionnaire data of surveyed ones demonstrate differences on WD and WE (Table 1). The bedtime period on WD occurred after midnight (63,9%), the time of waking up was registered after 7 O'clock in the morning (84,5%), which indicates a formation of the socially dependent chronotype, which preserved with some variations on weekends (Table 1).

Questionnaire analysis revealed significant sex-based differences, when at the same time sex-based differences in schoolchildren are not yet revealed [4]. The duration of sleep in the mixed group is shorter on WD, but for boys it is significantly less than for girls on WE. The time of falling asleep in the mixed group shifted to a later time (29 minutes); for girls – by 22 minutes, and for boys – by 51 minutes. Significant differences between the duration of sleep on WD and WE (by 29%) were revealed in the mixed group, which also favors the forming “jetlag” by the shift of the middle of sleep to morning hours (by 1 h 36 min) (Table 2) [1].

Table 2

Main characteristics of sleep of medical students (M±SD)

Sleep characteristics		n	WD	WE
Duration	All	270	6 h 55 min ± 1 h 21 min	8 h 55 min ± 1 h 47 min *
	Girls	210	6 h 52 min ± 1 h 18 min	9 h 3 min ± 1 h 49 min*
	Boys	60	7 h 3 min ± 1 h 27 min	8 h 25 min ± 1 h 29 min *,**(0,024)
Middle	All	270	3 h 46 min ± 46 min	5 h 22 min ± 1 h 26 min *
	Girls	210	3 h 46 min ± 43 min	5 h 22 min ± 1 h 21 min *
	Boys	60	3 h 50 min ± 0 h 58 min	slightly late chronotype [12] 5 h 40 min ± 1 h 43 min * moderately late chronotype [12]
Time of falling asleep	All	270	0 h 34 min ± 1 h 9 min	1 h 3 min ± 1 h 32 min *
	Girls	210	0 h 37 min ± 1 h 7 min	0 h 59 min ± 1 h 29 min *
	Boys	60	0 h 28 min ± 1 h 19 min	1 h 19 min ± 1 h 44 min *
“Jetlag”	All	270	1 h 51 min ± 2 h 4 min	
	Girls	210	2 h 8 min ± 1 h 56 min	
	Boys	60	1 h 11 min ± 2 h 4 min**(0,003)	

Note: *p<0,0001 – between WD and WE, **p< – between girls and boys

It is known, that difference between the duration of sleep on WD and WE increases the risk of development of excessive weight and obesity, but despite the fact that the BMI was higher in boys (Table 1), “jetlag” was more profound in girls (Table 2). According to literature data, the “later” chronotype is, which is judged based on the middle of sleep, the more frequent are associations related to using stimulators (smoking, alcohol) and antidepressants [12].

The correlation analysis revealed the significant dependence of the sleep duration on the time of falling asleep, the middle of sleep and “social jetlag” (Table 3). However, while the correlation strength between the sleep duration and the time of falling asleep is decreased on weekends, in case of “jetlag” the correlation strength is increased. Correlations between the time of going asleep on weekdays

and weekends are not significantly changed, but in case of “jetlag”, they are decreased. Significant correlations with the BMI were not revealed.

Table 3

Sleep indicators correlations according to Pearson (R, p)

Indicator	Sex	Time of falling asleep	Middle of sleep	“Social jetlag”
Sleep duration on WD		on WD	on WD	
	Girls	-,789 ^{**} , 0,000	-,659 ^{**} , 0,000	-,404 ^{**} , 0,000
	Boys	-,836 ^{**} , 0,000	-,724 ^{**} , 0,000	-
	All	-,802 ^{**} , 0,000	-,671 ^{**} , 0,000	-,245 ^{**} , 0,000
Sleep duration on WE		on WE	on WE	
	Girls	-,497 ^{**} , 0,000		-,762 ^{**} , 0,000
	Boys	-,456 ^{**} , 0,000	-	-
	All	-,489 ^{**} , 0,000		-,537 ^{**} , 0,000
Time of falling asleep on WD			on WD	
	Girls		,840 ^{**} , 0,000	,346 ^{**} , 0,000
	Boys		,847 ^{**} , 0,000	-
	All		,923 ^{**} , 0,000	,192 ^{**} , 0,002
Time of falling asleep on WE			on WE	
	Girls		0,798 ^{**} , 0,000	-,215 ^{**} , 0,002
	Boys		,923 ^{**} , 0,000	-
	All		,830 ^{**} , 0,000	-,167 ^{**} , 0,007
Middle of sleep on WD			Girls	,328 ^{**} , 0,007
			Boys	-
			All	,135 [*] , 0,029
Middle of sleep on WE			Girls	,224 ^{**} , 0,001

Note: * – correlation is significant on the level of 0,05 (bilateral); ** – correlation is significant on the level of 0,01 (bilateral)

Prevalence of “late” chronotypes among medical students is accompanied by low tolerance to environmental factors, including the social environment, because chronic differences between endogenic and external biorhythms lead to increasing adaptation stress [4, 12], which affects academic progress, and consequently – state of the NEIM system.

Conclusion. The formation of the constantly active, socially dependent late chronotype and the “social jetlag” in the young age leads to the formation of desynchronosis – misalignment of interaction between the NEIM system’s performance and the “day-night” cycle. In this case, “external” desynchronosis is accompanied by a decrease in the duration of sleep, which leads to disturbance in sleep’s qualitative characteristics. In case of cycle’s shift, the peak melatonin secretion occurs later, preconditions of accumulating excess weight form, which is significant in earlier implementation of genetically determined disturbances of metabolism and vascular blood flow. Exclusion of such risk factor by following sleep hygiene is one of means of prevention of diseases of the cardiovascular and endocrine systems, as well as depressive states.

Conflict of interest. The authors declare no conflict of interest.

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