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[1]Gumarova L., [2]Germaine Cornelissen, [1]Ablayhanova N.

[1]al-Farabi Kazakh National University, Almaty, Kazakhstan,
[2]Halberg Chronobiology Center, University of Minnesota, Minneapolis, USA
*e-mail: Lyazzat.Gumarova@kaznu.kz, corne001@umn.edu, Nurzhanat.Ablaihanova@kaznu.kz

Circasepran rhytyms of motion activity

Abstract: In this study the circaseptan rhythms of the motion activity of practically healthy people with an average level of locomotor activity were analyzed, engaged in mental work, of different ages and sex. We compared data of peoples, who have usual working week (5 working days per week) and a person who worked seven days per week, at the same pace, to determine the influence of the social factor. The statistically significant circaseptan rhythms with period between 6.4 and 7.0 days were found, with the internal, endogenous rhythm being in most cases more significant in relation to the external rhythm, which should be taken into account, for example, in the formulation of optimal individual schedule.

Key words: circaseptan rhythms, week, social factors, motion activity, people, period.

Introduction

In a wide range of biological rhythms, weekly rhythms, occupying an important place in our daily life, at first sight look like exogenous rhythms, passively responding to environment cycles, in this case, social cycles. Nevertheless, the scientific literature data presented that indicate the endogeneity of these cycles. So, for example, one of the founders of chronobiology, Jurgen Aschoff, styduing scientists of antiquity, who study biological weekly rhythms [1], mentioned Hippocrates, Aristotle and Galen. However, even before the ancient Greeks, before Hippocrates and Galen, the famous scientist of the East, Abu Ali Hussein ibn Abdallah ibn Sina, or Avicenna (980-1032), discovered that the week was an important unit of biological time. He showed that, as a rule, the duration of diseases, for example, with pneumonia until the era of access to sulfonamides and antibiotics, took 7 days before finding out whether the patient would survive or die. The studies of Hobart Reiman [2], Kurt P. Richter [3], and Eric Ask-Upmark [4], give incontrovertible proofs about the importance of the week in human pathology, circaseptan rhythms of the physiological functions of a healthy person are also known [5; 6].

About weekly variations in biology are oflen viewed as no more than a response to the social week. Whereas the social schedule can be a strong synchronizer of circaseptan rhythms, much evidence has accumulated illustrating that this component has a dual aspect, being partly endogenous while also responding not just to the social week but also to circaseptans in geomagnetics.

Materials and methods

In this study, we analyzed the circaseptan rhythms of the motion activity of practically healthy people with an average level of locomotor activity, engaged in mental work, of different ages and sex. We compared data of peoples, who have usual working week (5 working days per week) and a person who worked seven days per week, at the same pace, to determine the influence of the social factor. As the method of investigation, automated multi-day wrist actigraphy (AMI, New-York, USA) was chosen, as a parameter, ZCM (zero crossing mode) was used, which is the count of the number of times the accelerometer signal crosses 0 for each time period. The data were recorded every minute on the continuation of a long time interval (6-7 months). For the analysis of the methods of spectral analysis were used [7-9].

Results and their discussion

An analysis of a two-year, continuous record of a 51-year-old man (TK) working standard five days a week showed a highly significant weekly rhythm ($p < 0.001$) with the following characteristics: period 7.001 days [6.995; 7.008], the amplitude of 8.4592, the acrophase -0.52233 (Table 1).

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Table 1 – Chronostructure of ZCM circadian rhythms

No.	The cipher of the participant of the experiment, sex, age	Period, days	Frequency	Amplitude	Acrophase
1	FH, male, 93 years old	6.878 [6.858; 6.898]	0,006058	4.796	-0.75291
2	TK, male, 51 years old	7.001 [6.995; 7.008]	0.142834	8.4592	-0.52233
3	ZT, female, 42 years old	7.886 [7.854; 7.918]	0.005283	4.2042	-0.2973
		6.934 [6.844; 7.02]	0.006009	1.6821	-0.53751
		6.451 [6,43; 6.472]	0.006459	4.259	-0.01379
4	RK, male, 16 years old	7.097 [7.043; 7.156]	0.005871	23.596	-0.39953
		6.635 [6.601; 6.669]	0.006279	27.803	-0.72364

In other participants of the experiment, the motor activity showed the most pronounced (with maximum amplitude) rhythms with a period slightly shorter than 7 days, while also revealing a statistically significant component almost equal to the astronomical week.

Subject 3 (ZT) had three statistically significant rhythms with a weekly periodicity, of which the highest and most significant amplitude was for a cycle with a period of 6.45 [6.43; 6.47] days, i.e., shorter than a week, although the period close to the week at 6.93 days [6.84; 7.02] is also statistically significant and reflects the contribution of the social factor to the analyzed biological rhythm. The youngest participant in the experiment had the highest rates of motor activity and the highest amplitude, i.e. for him the differences in the days of the week were most pronounced (Table 1, Figure 1).

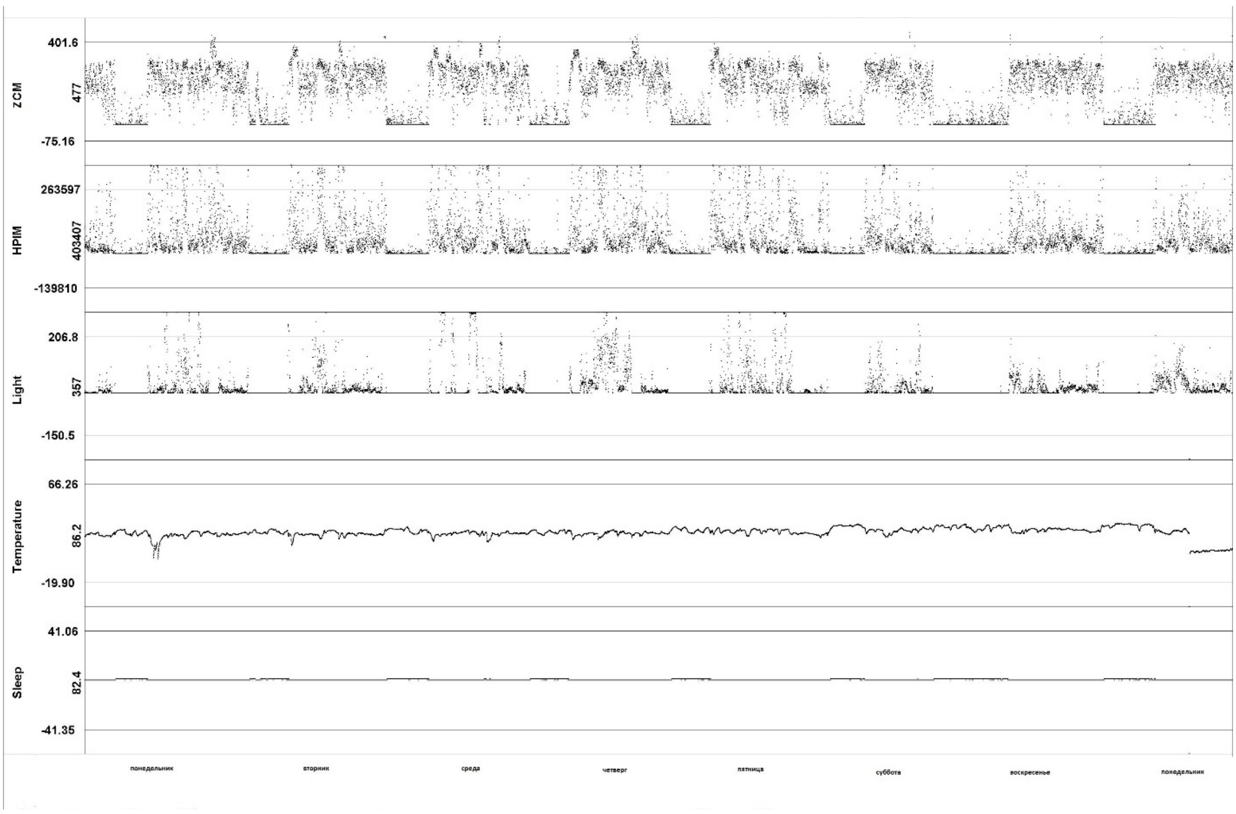

Figure 1 – Chronogram of motor activity during the week of one of the participants in the experiment (RK)

Subject 1 (FH) was the only one of the analyzed groups that worked without weekends, and not during the experiment only, but also for many decades, despite its advanced age. His biological week was predictable differ from the calendar week (somewhat shorter), but the other two participants having a training (RK) and working (ZT) schedule have also biological week, shorter than the astronomical one. The amplitude of the cycle for women and old man were low. Probably, the woman' motion activity at the weekend is related to household chores.

Changes as a function of age in the relative circaseptan-to-circadian prominence indicated a resurgence of the about-weekly variation in the elderly, Figure 2 [10]. The question may be raised whether this is a common feature of non-photic cycles, since a similar trend with age is found for the relative prominence of transyears versus the 1-year synchronized variation in blood pressure and heart rate [11].

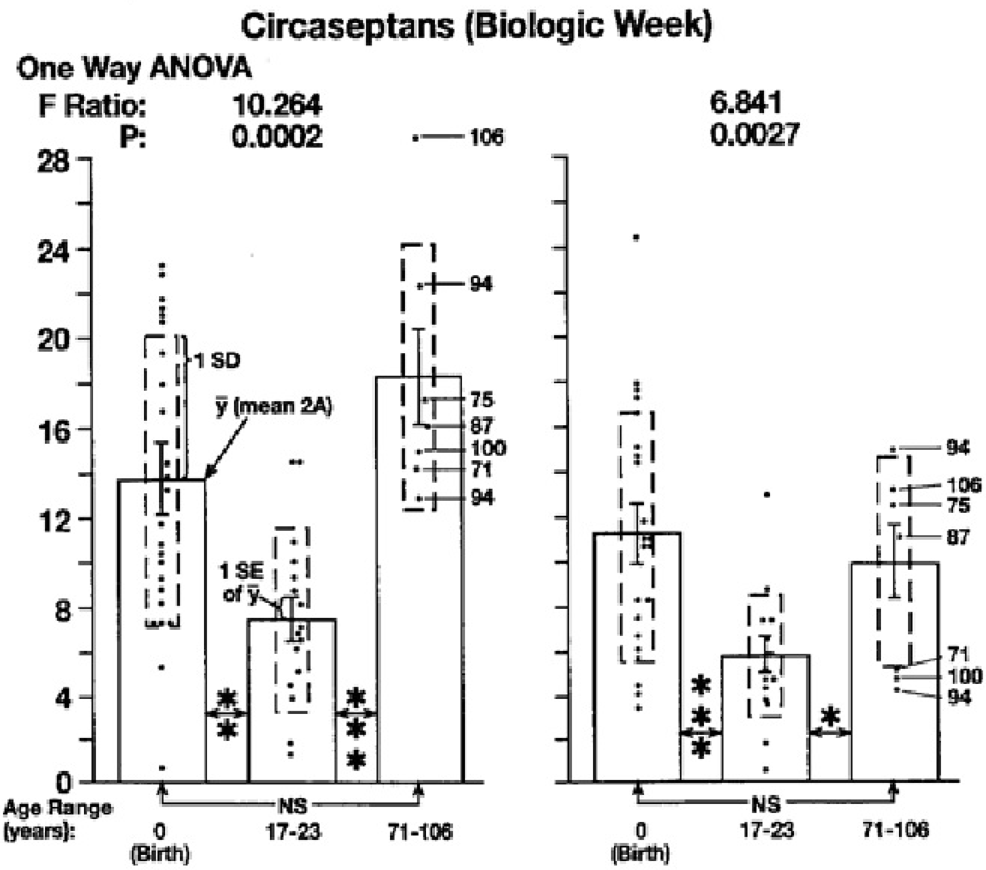

Figure 2 – Double amplitude of systolic (left) and diastolic (right) blood pressure is statistically significantly larger in the young and elderly than in mid-adulthood

Earlier, other authors [5; 6] showed a drift of the acrophase of the week, as well as the duration of the circadian rhythm cycle of 17-ketosteroid in the urine of a clinically healthy person. Data on urinary excretion of urinary hormones were collected daily for 10 years, periodically the cycle duration was synchronized exactly with the week, with a peak on Wednesdays or Thursdays. Periodically, the circaseptan acrophase of testosterone began to shift, and the period lasted longer than a week for several years, then the rhythm was characterized by a shorter period, the statistically most significant rhythm had a shorter period than exactly 1 week. The authors explain the periodic changes in the length of the cycles due to the influence of heliophysical factors.

A significant contribution of heliomagnetic factors to weekly rhythms of heart rate dynamics on some people was also reported earlier in the scientific literature [12]. The shortening of the cycle observed in our experiment is associated with the endogenous circadian component, as well as the influence of external physical factors. Absolute domination of external heliophysical factors excludes the absence of other circadian frequencies in the spectrum of participant 1 (TK), except for a cycle of exactly 7 days. The influence of age and sex was manifested in the amplitude of the cycle, but not in its period.

Thus, in the dynamics of motion activity a statistically significant circaseptan rhythm was found, with the internal, endogenous rhythm being in most cases more significant in relation to the external rhythm, which should be taken into account, for example, in the formulation of optimal individual schedule.

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