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SEX AND AGE CHARACTERISTICS OF DAILY ACTIVITY OF DISTANCE LEARNING STUDENTS IN NORTHERN CLIMATE

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ПОЛОВОЗРАСТНЫЕ ОСОБЕННОСТИ СУТОЧНОЙ АКТИВНОСТИ СТУДЕНТОВ НА СЕВЕРЕ ПРИ ДИСТАНЦИОННОМ ОБУЧЕНИИ

Abstract. The purpose of the work is to study the time preferences of students performing daily tasks during distance learning and to determine if such preferences depend on sex and the year of study. In the absence of social regulation, the daytime and nighttime activity of students corresponded to the distribution of chronotypes that typifies a northern region, with arrhythmic and evening types prevailing but the morning bi-rhythmic stereotype having a minimal representation. With no 'master timer' in distance learning, students demonstrated pronounced sex differences in the daily dynamics of performance. Young females had maximum performance during the day and minimum performance at night, which corresponds to the most common type. Young males were observed to have several ascents in their performance during the 24-hour period. First-year and second-year students' learning behavior was less synchronized with the day-night cycle. The wavelet analysis found insignificant four to five hourly rhythmic fluctuations that occurred in the evening hours, during the period of students' high educational performance.

Key words: performance rhythms; distance learning; north; wavelet-analysis.

Аннотация. Цель работы – исследовать временные предпочтения выполнения ежедневных заданий студентами при дистанционном обучении с учетом пола и курса обучения. Присутствие дневной и вечерней активности студентов при отсутствии социальной регламентации соответствует распределению хронотипов, характерному для северного региона, где преобладают аритмичный и вечерний типы при минимальном представителе утренняя биоритмологического стереотипа. При отсутствии социального задатчика времени при дистанционном обучении у студентов наблюдаются выраженные межполовые различия суточной динамики работоспособности. Девушки демонстрируют классический тип с максимальными значениями днем и минимальными ночью, у юношей наблюдается кривая с несколькими подъемами активности. Студенты младших курсов менее синхронизированы с циклом день–ночь. При проведении вейвлет-анализа обнаруживаются незначимые ритмические колебания с периодом 4–5 часов, которые возникают в вечерние часы, в период высокой учебной продуктивности студентов.

Ключевые слова: ритмы работоспособности; дистанционное обучение; север; вейвлет-анализ.

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Introduction

Students' adaptation to studying at the university has always been challenging. The new social role implies that a student needs to develop new behavioral repertoire and seek opportunities to establish oneself in the new status. This process of gaining a foothold in the unfamiliar environment takes a long time, and it causes students anxiety and stress. Students' activity decreases, and they may fail to adopt new behaviors and perform usual activities [7].

The adaptation process includes biological, social and psychological levels. The biological level is associated with acclimatization or with the genotype and selection of useful traits (distance runner, sprinter). The social level is associated with the socialization and the interiorization of new group norms. The psychological level of adaptation is realized through decision making, manifestations of activity and expected results of actions [2; 5; 14].

The daily dynamics of human performance is rather pronounced. As a rule, humans are highly capable in the daytime but their performance declines at night. At the 'warm-up' phase, the performance is unstable and changes in waves; hence one can observe the instability of work actions and slight increases/decreases in the quantitative and qualitative characteristics of labor productivity. At the phase of sustainable performance, the productivity is stably high. At the phase of decreasing performance (fatigue), there appear tiredness, low motivation, a lack of interest in the current work, disturbance of the general sense of well-being, bad mood, erroneous actions, and the general deterioration of labor productivity [1; 16].

Distance learning at the university is generating considerable interest [4; 9; 12], and it seems relevant to study the dynamics of mental performance in the absence of a 'master timer', such as a class schedule or a lesson plan, in distance learning. The *purpose of this work* is to study the time preferences of students performing daily tasks during distance learning and to determine if such preferences depend on sex and the year of study.

Participants, Materials and Procedure

Male and female students enrolled in the Khanty-Mansiysk State Medical Academy, Khanty-Mansiysk, Russia, participated in the study. The students could choose the time of study and rest themselves, with no actual class schedule. The activity of distance learning students in time was investigated. Upon receipt of the students' responses to daily tasks, the time of file arrival to the professor's computer was recorded.

In total, the arrival time of 1,374 files was analyzed, of which 386 were the completed tasks turned in by young males, and 988 by young females. The turned-in tasks belonged to the following courses:

- first-year course of *anatomy*, 200 by male students, 446 by female students, 646 in total;
- second-year course of *normal physiology* the students', 43 by male students, 192 by female students, 235 in total;
- third-year course of *operative surgery*, 82 by male students, 185 by female students, 267 in total;
- fifth-year course of *hospital therapy* (5 and 6 courses), 50 by male students, 104 by female students, 154 in total;
- sixth-year course of *hospital therapy*, 11 by male students, 61 by female students, 72 in total;

The students' responses were divided by sex and the year of study and entered into the database with time accuracy of one hour. The absolute number of responses was converted into relative indicators for comparison (conventional units). The study continued from 19 March to 30 April 2020.

Wavelet analysis was used to test the hypothesis of multiple cycles [13]. A wavelet is a mathematical function that allows analyzing frequency components of collected data. Signals are analyzed in the plane of wavelet coefficients (scale – time – level). The obtained wavelet spectrograms fundamentally differ from regular Fourier spectra in that they give a clear reference of a signal spectrum to time [6]. In this study, the periods of constant and insertion rhythms, their energy (amplitude) and significance were analyzed.

Results

First to sixth-year medical students demonstrated sex differences of a qualitative nature in the daily learning activity (Fig. 1). The observation of the female students' behavior produced a fairly smooth daily

curve, with a decrease in the nighttime, minimum activity around 7–8 am, a non-stepped increase in the daytime, and maximum activity from 4 pm to 10 pm.

To compare, the male students had periods of activity interrupted by episodes of inactivity. The surges in activity occurred at 11 am, 1 pm, 5 pm, 9 pm, and 11 pm. It should be noted that there were surges of night activity at 3–4 am.

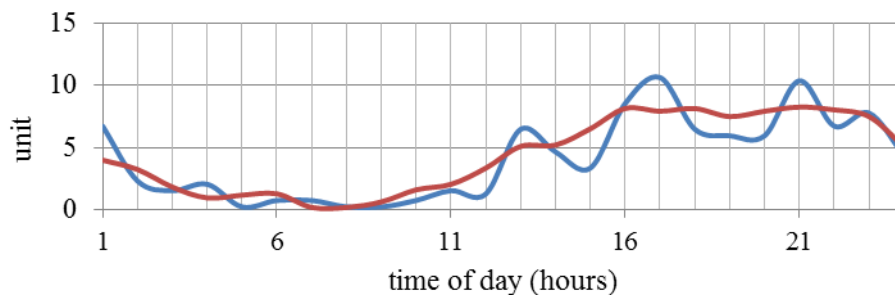


Fig. 1. Daily activity of first to sixth-year students in distance learning: — male; — female

The learning activity of junior and senior students by sex is shown in Figure 2 for females and Figure 3 for males. The both senior and junior female students demonstrated a noticeable activity completing educational tasks at night. The junior female students were highly active throughout the day till the evening, while the senior female students most often turned in the completed tasks at 11 am, 2 pm, 7 pm and 9 pm.

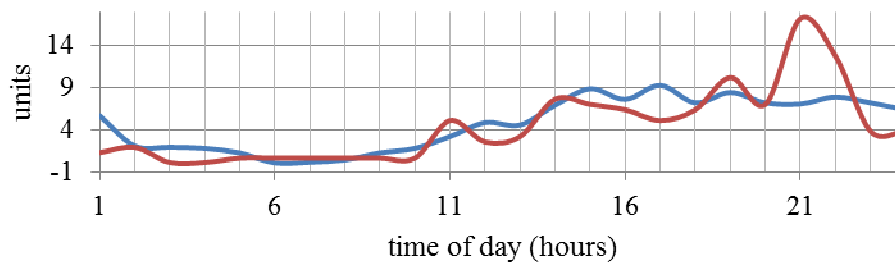


Fig. 2. Daily activity of first to third-year female students and fourth to sixth-year female students in distance learning: — senior; — junior

The curve of the educational activity fluctuations in Figure 3 indicates that the senior male students mostly belong to arrhythmic and evening chronotypes. They demonstrated the inactivity in early morning hours, the eagerness to learn awakening around 10 am, leisurely work with breaks during the day, and going to bed around 11 pm. The junior male students were not synchronized to the day cycle, which was manifested by noticeable night activity and fluctuations in learning activity from 6 am midnight.

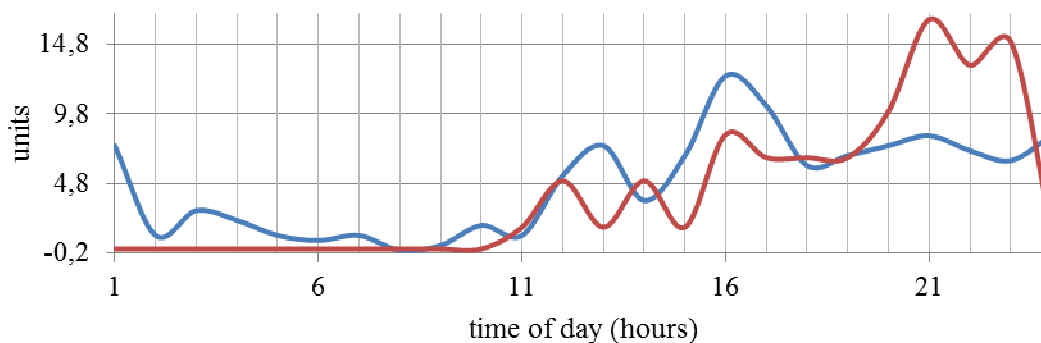


Fig. 3. Daily activity of first to third-year male students and fourth to sixth-year male students in distance learning: — senior; — junior

The wavelet analysis detected insignificant rhythmic fluctuations with a period of 5.4 hours ($p = 0.285$) for female students and 4.3 hours ($p = 0.182$) for male students. They occurred in the evening hours during the period of high performance.

Discussion

The ability to maintain physical and mental performance is especially relevant during the period of high information load on students. The typical performance curve (Fig. 4) implies the lowest activity around 3–4 am [8]; the performance progressively increases reaching a maximum at 11 am and is followed by a noon abatement; another rise in activity happens around 8–9 pm followed by a night decline.

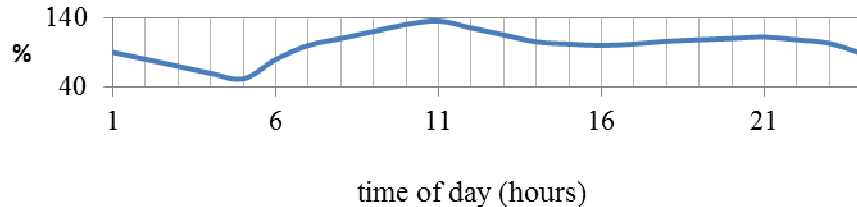


Fig. 4. Daily fluctuations in performance according to Lifanov [8]

The obtained performance curves partially agree with Glybin's [3] hypothesis (Fig. 5), according to which the human performance rhythm is determined by a single wave process with five physiological rises (5 am, 11 am, 4 pm, 8 pm, and 12 am) and the equal number of recessions (2 am, 9 am, 2 pm, 6 pm, 10 pm hours). The wavelet analysis in this study also indicated the presence of intraday cyclicity with a period of four to six hours.

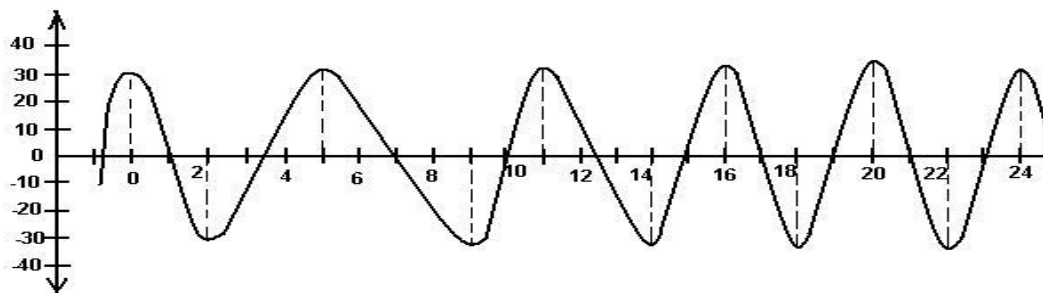


Fig. 5. Daily physiological performance rhythms [3]

In the absence of social regulation, the daytime and nighttime activity of students corresponded to the distribution of chronotypes that typifies a northern region, with arrhythmic and evening types prevailing but the morning biorhythmic stereotype having a minimal representation.

Conclusion

To summarize, with no 'master timer' in distance learning, students demonstrated pronounced sex differences in the daily dynamics of performance. Young females had maximum performance during the day and minimum performance at night, which corresponds to the most common type. Young males were observed to have several ascents in their performance during the 24-hour period. First-year and second-year students' learning behavior was less synchronized with the day-night cycle. The distribution of activity corresponds to the arrhythmic and evening chronotypes. The wavelet analysis found insignificant four to five hour rhythmic fluctuations that occurred in the evening hours, during the period of students' high educational performance.

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