http://dx.doi.org/10.35630/2199-885X/2021/11/1.20

# CHARACTERISTICS OF HUMAN MOTOR ACTIVITY DURING SLEEP IN YOUNG ADULTS (18–21 YEARS) USING INFORMATION-ANALYTICAL SYSTEM

*Received 05 December 2020;*
*Received in revised form 17 January 2021;*
*Accepted 21 January 2021*

***Alexey Gorbunov*[1], *Yuri Gromov*[1], *Dmitry Parshin*[2]✉, *Vladimir Egorov*[1], *Egor Dolgov*[1], *Darya Grechukha*[1]**

[1] *Tambov State Technical University, Tambov, Russia*
[2] *Astrakhan State Medical University, Astrakhan, Russia*

✉ *parshin.doc@gmail.com*

**ABSTRACT** — The study of human motor activity during sleep in the period of adolescence/early adulthood was carried out. The study involved 35 healthy people — 18 women (51.5%) and 17 men (49.5%) aged 18 to 21 years. The data was obtained and processed with the employment of an original information-analytical system developed by the authors. When analyzing the data, we identified and used the following parameters: the number of movements, the maximum value of jerk and the coefficient of motor activity. For the number of movements, the average value was 9.6 and 10.2 for men and women, respectively. For the maximum value of jerk, the average value was 26.4 g/s and 24.3 g/s for men and women, respectively. For the coefficient of physical activity, the average value was 10.3% and 12.7% for men and for women, respectively. Thus, the results of the study are fundamental for understanding the adolescent period of postnatal human ontogenesis, indicate sexual dimorphism, and can also be used in research and practice in the field of physiology, neurology, neurosurgery, psychiatry and functional diagnostics with account of the specific age interval, as well as for prognosis.

**KEYWORDS** — motor activity in sleep; ontogenetic development, adolescence/young adulthood; information-analytical system.

## INTRODUCTION

Currently, despite the intensive development of methods and tools for clinical observation, insufficient attention is paid to the organization and conducting preventive and screening diagnostic studies. However, the development of such technologies makes it possible to identify diseases at an early stage of their onset and, what is extremely important, to predict a patient's condition. Today, one of the most challenging and poorly studied issues in terms of development of medical diagnostics is the dynamic analysis of physiological and pathological conditions. Improvement of diagnostic methods inevitably requires to introduce new information parameters into research [1, 2, 3]. As such information parameters, we introduced and studied: the number of movements, the maximum value of jerk and the coefficient of motor activity.

*Purpose of the study is* to investigate motor activity during sleep in young adults (human ontogenesis of the period of young adulthood).

## MATERIAL AND RESEARCH METHODS

The study involved 35 people — 17 women (51.5%) and 18 men (49.5%) aged 18–21 years (average age 19.6 years). All participants were students of the Tambov State Technical University, practically healthy people who gave informed consent to participate in the study. The study was carried out during the period of night sleep. The information-analytical system (IAS) developed by us [5] performed the monitoring from the moment of going to bed, followed by falling asleep until the moment of awakening with the IAS turning off. The IAS device was fixed on the wrist of the subdominant hemisphere (in right-handers — on the left hand, in left-handers — on the right hand). The duration of an experiment was 8 hours. The motor activity in each participant was recorded using the IAS for three consecutive nights. On completion of the experiment, the data on the motor activity of each individual was saved in the memory of the IAS device. Then, using special software, the obtained data were processed and presented for subsequent analysis of the following parameters:

1. Number of movements: the largest number of hand movements out of the total number of movements along each axis for the entire study period (dimensionless value);
2. Maximum value of jerk: the maximum value of the modules of the acceleration rate changes during data recording (g / s);
3. Coefficient of motor activity (CMA): the ratio of the number of files with significant motor activity to the total number of files (%).

## RESEARCH RESULTS AND THEIR DISCUSSION

The findings of the study are as follows. The average value for the number of movements was 9.6 and 10.2 for men and women, respectively; the maximum values for men were from 4 to 19, while those for women were from 5 to 22. For the maximum value of jerk, the average value was 26.4 g/s for men and 24.3 g/s for women; the maximum values were from 13 to 40 g/s for men and from 8 to 38 g/s for women. For the coefficient of motor activity, the average values were 10.3% and 12.7% for men and women, respectively; while the maximum values were from 4.3 to 19.3% for men and from 3.9 to 23.0% for women.

Fig. 1 shows the histogram of indicators of the motor activity in a selected study subject.

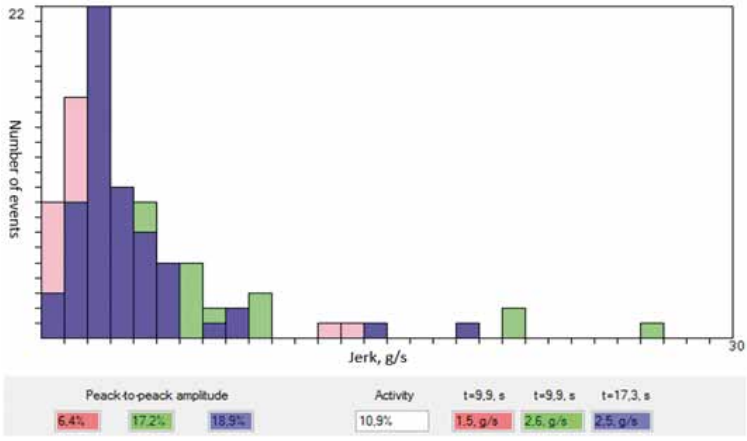


*Fig. 1. Motor activity histogram*

Fig. 2 shows graphs of motor activity along three axes in a selected study subject.

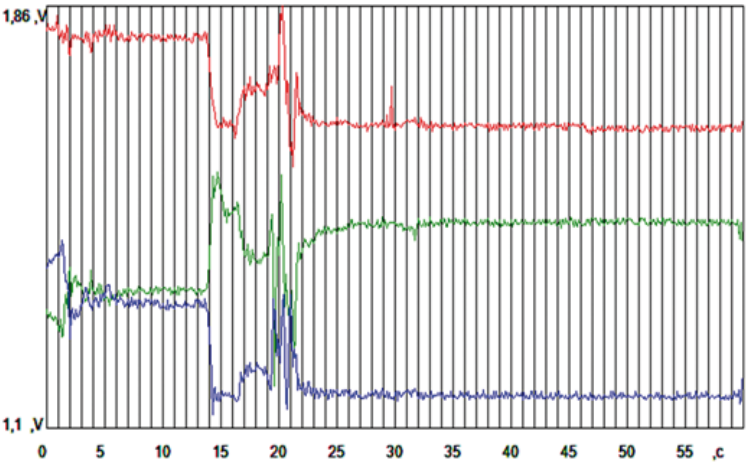


*Fig 2. Three-axis motor activity graphs*

This study makes it possible to form the regulatory framework of healthy people in the period of young adulthood (18–21 years of age). This will help to assess normal motor activity in order to subsequently use the obtained values for the analysis and diagnosis of patients with hyperkinetic movements and tremor in various pathological conditions.

Our research offers simplification and greater accessibility of clinical analysis and interpretation of patient's data when rendering diagnostic and/or therapeutic medical care or medical services in various conditions.

Our findings show that there is a slight deviation in the parameters of the motor activity in healthy people. This deviation can be explained by individual physiological characteristics, by the influence of certain external factors, and by sexual dimorphism.

The results of the research are practically applicable; they have scientific novelty and originality due to the use of an innovative technique, which enables to register and analyze the motor activity [4, 5].

## CONCLUSION

We intend to employ the information-analytical system for further researches on the following directions:

— Searching for further system upgrades to improve diagnostics and treatment;

— Improving data accuracy and this will result in a better quality of future research.

## REFERENCES

1. **A. Marquez, M. Dunn, J. Ciriaco and F. Farahmand,** "iSeiz: A low-cost real-time seizure detection system utilizing cloud computing" 2017 IEEE Global Humanitarian Technology Conference (GHTC), San Jose, CA, 2017, pp. 1–7, DOI: 10.1109/GHTC.2017.8239249

2. **Aadland E, Ylvisåker E** (2015) Reliability of the Actigraph GT3X+ Accelerometer in Adults under Free-Living Conditions. PLOS ONE 10(8): e0134606. https://doi.org/10.1371/journal.pone.0134606.

3. **Gorzelniak L, Dias A, Bakhirev A, Knoll A, Horsch A.** Does the low power mode of the actigraph GT3X+ accelerometer influence the device output in sleep research in healthy subjects? Stud Health Technol Inform. 2013;192:1172. PMID: 23920946.

4. **Gorbunov A., Gromov Yu., Dolgov E., Tugolukov E., Neprokin A.** Accelerometric Studies of Night-time Motor Activity with Essential Tremor. Paper presented at: 2nd International Conference on Control Systems, Mathematical Modeling, Automation and Energy Efficiency (SUMMA); November, 10–13, 2020; Lipetsk; C. 642–645. IEEE Catalog Number: CFP20OND-ART ISBN: 978-1-7281-8840-9. (In Russ.)

5. **Gorbunov A.V., Egorov S.A., Egorov A.S.** Device for recording human motor activity // Patent of the Russian Federation No. 168584 dated 09.02.2017, eLIBRARY ID: 38293187 (In Russ.)

6. **Gorbunov A.V., Egorov S.A., Egorov A.S.** A method for diagnosing epilepsy and a device for its implementation // Patent of the Russian Federation No. 2640138 dated 26.12.2017 (In Russ.).