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Original Contribution

STUDY ON THE DISPLAY OF CIRCADIAN RHYTHM IN STUDENTS

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ABSTRACT

Purpose: An examination of 400 fresh-year students from the "Paisii Hilendarski" University of Plovdiv was done to determine the individual chronotype of the students and the impact of several paragenetic and social factors such as hour and season of birth, age and education of parents; marital rays were traced in forming their daily and biological rhythm. Results: Results showed preponderance of the intermediary chronotype in both sexes with influence of parental age and birth season on its formation. Conclusion: The good adaptive potential of students regarding the main components of circadian rhythms (sleep-feeding-work-rest) are a foundation for successful construction of inverse cycle under the changing social factors.

Key words: Biorhythms, students, chronotypes, paragenetic and social factors

INTRODUCTION

Many facts related to the possibility that biological objects from cellular to organismal level are able to measure time, to act and be influenced in various ways in time, to synchronize their activities with internal or external rhythmical changes have been revealed in the last decades (1-2). In this sense the trend towards examination of eco-physiological mechanisms of adaptation to new environment and looking for scientifically proven means of correcting the faults caused by various unfavourable factors through studying time organization of bio-systems is completely reasonable "Circadian stresses" are constant companions in the dynamic life of contemporary people and there is an urgent need of confronting these challenges.

More than 300 functions and processes in the human organism have been registered to change in circadian rhythm (3-4). Biological rhythms affect all sides of life, starting with daily fluctuations in the frequency of setting in the act of birth, many physiological mechanisms and regularities of individual development and ending in daily rhythmic of occurrence of cardiovascular "catastrophes" (heart-attacks, brain strokes, etc.), as well as the frequency of advancing death. Many of the normal body functions follow a diurnal pattern of increasing and decreasing, which define circadian rhythms (1-5).

The assessment of the interaction between organism and environmental factors makes it possible to characterize the chronotype of a person, one's chrono-activity and ability for chrono-adaptation. Therefore the possibility of securing human activities in various conditions in maximal regime of labour and rest using the individual chrono-rhythms occurs. Enough quantity of experimental data on display of circadian rhythms in various social and professional groups of people have been gathered for the past years but the interest to students as an original professional group is limited (6-9). Young people studying in universities are exposed to great psycho-emotional, educational, social and daily pressure, which inevitably cause increase on the pressure on the adaptive mechanisms, conserving homeostasis and warning for the occurrence of over-tension and astenization. Young organism is in a constant dynamic equilibrium with the conditions of the environment, securing the normal functional condition of all vital systems. The theory for functional systems, compiled by Anohin P., K. in 1972 (10), underlines the significance of the

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biological and social necessities for the solving of particular tasks with a relevant behaviour activity. In addition to that, the adaptive reactions useful for the organism are realized through dynamic, self-regulating functional systems and one of the ways for clearing out the mechanisms of their organization and activity is inextricably bound to the identification of the individual chronotype and the potential endogenous and exogenous factors, which influence on its development.

In humans, there are certain characteristics related to regulation of biological rhythms by the so-called "indicators of time". Sound signals, colours of environment, motivation situations, relations between the members of the team, etc. can highly influence on the biological rhythms of people. All these can be united in the group of social indicators of time and show well-expressed individual differences. As some authors presume (6, 11, 12) these are related to genetic factors referring to sustainable individual features and can be considered as one of the elements of the constitution of man. Therefore the chrono-biological rate is highly related to the individual and is defined by not only internal regulation (13), but also by the interaction between organism and environment (2, 14- 17). Chronotype of man is defined most commonly depending on when the active phase of the biological rhythm sleep – being awake is observed in the frames of the twenty-four-hour period. The variations in this rhythm allow defining two groups of people – diurnal and nocturnal type. The first group falls asleep early in the evening and wakes up early in the morning. The second group falls asleep late and wakes up late. In addition to that there is a group of people that refer to neither of the mentioned groups and are being defined as an intermediate type (11).

In relation to this, the aim of the current research is to determine the chronotype of freshmen students studying in the "Paisii Hilendarski" University of Plovdiv and the influence of paragenetic and social factors for its formation.

MATERIALS AND METHODS:

The study was carried out on 400 boys and girls, freshmen students of the "Paisii Hilendarski" University of Plovdiv. The initial part of the inquiry form, proposed by the Russian professor Nikolay Reymers (4) allows using a point system to identify the individual circadian rhythm of the studied people. In addition to that, the students were asked to give an objective answer, which reflects their natural preferences and adjustments and not the rhythm enforced by the everyday life with its specific characteristics. The second part of the inquiry allows looking for the impact of some specific paragenetic and social factors on the formation of their daily biological rhythm.

The processing of the data obtained was done through variational statistical analysis (18), using MS Excel. The method of χ^2-testing was used for determination of the extent of interrelation among the non-parametric characteristics used (19).

RESULTS AND DISCUSSION

Most of the contemporary chrono-biologists are studying circadian rhythms, endogenic cycles of their maintenance or biological activity for a period of 24 hours (10, 20). The 24-hour-cycle (day-night / activity – rest) is accepted as a key factor in medical diagnostics and treatment today.

The distribution of the examined students, in accordance with the given responses in the first part of the inquiry is presented in **Figure 1 - 8**. The published results show that the prevailing percentage of the students, regardless of their sex prefer to fall asleep in the interval between 23^{30} - 01 h. They have occasional difficulties waking up early in the morning and wouldn't change this regime in case external factors enforce it (**Figure 1 - 3**). These activities are not dependant on sex as the proportion in percentage does not change, examining boys and girls separately. Despite that a more detailed analysis of the distribution shows that girls tend to have the adjustment to fall asleep earlier, especially if important issues are pending on the next day, while boys have relatively more difficulties waking up early in the morning.

The prevailing feeding regime in most cases (**Figure 4 - 6**) is reduced to one limited breakfast, accompanied by coffee (only 19 % claim they would refuse their morning coffee). The share defining dominant preference for a lighter breakfast consists of girls. About 65 % of the examined students claim they would easily or very easily (**Figure 6**) break their preferences during vacation or holiday. The lack of difficulties when change in the regime of sleep and feeding in most of the students indicates the good adaptation possibilities of the organism.

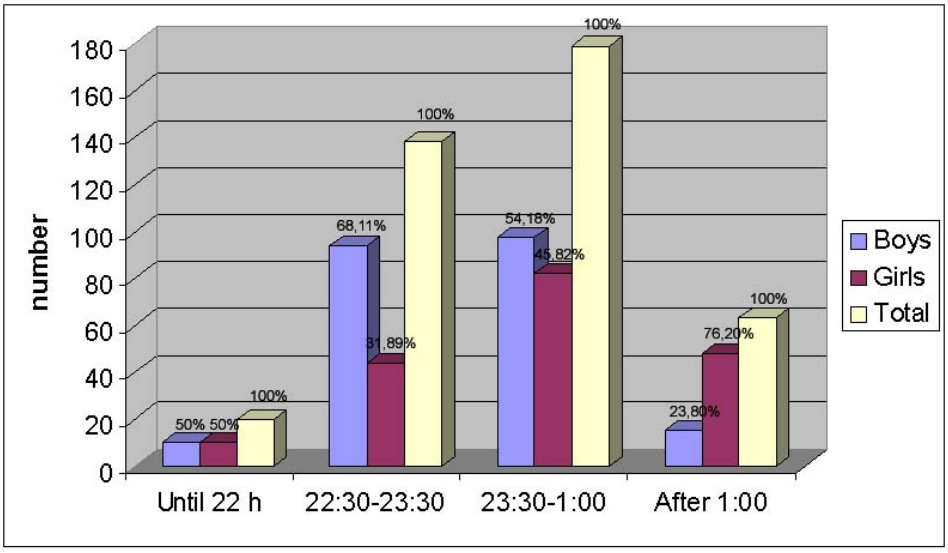

Figure 1. *Results from the statistical processing of the data obtained from the answer of the inquiry question: when do you prefer to go to bed?*

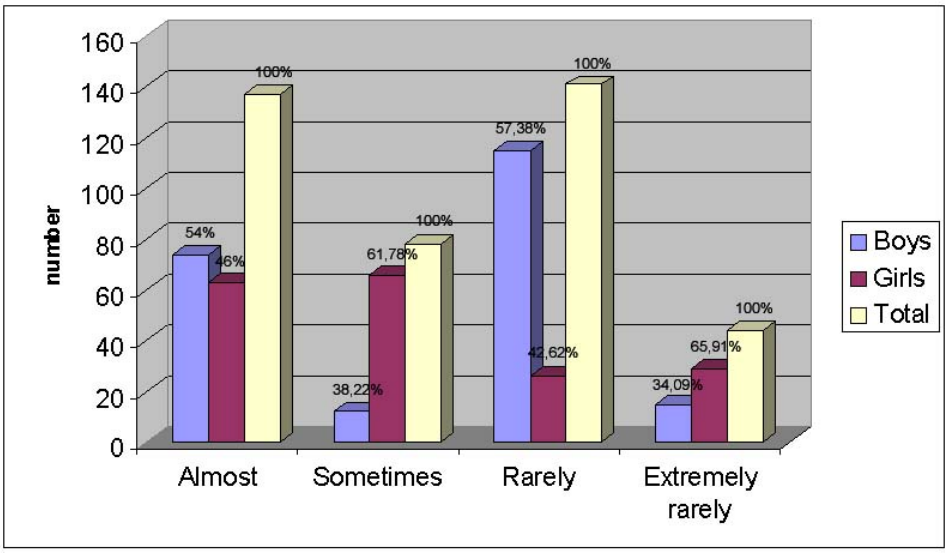

Figure 2. *Results from the statistical proceeding of the data obtained from the answer of the inquiry question: is it hard to get up early?*

The commented table data provides reasoning to expect a higher percentage of boys and girls of intermediate and diurnal type even during this initial review of the obtained results. The distribution presented in **Figure 7**, which shows an increasing irritability and aggression in the second half of the 24-hour-period, is related to the decreasing work efficiency and increasing tiredness.

Students show moderate ability for exact determination of a section of time with no watch. The "Ashoff rule" is well-known in chrono-biology long ago as well as the main conclusion of it – light determines circadian fluctuations in organism, a conclusion, which has been experimented and proved many times. The results from **Fig. 8** can be related to data obtained from studies in extreme conditions (big closed and dark spaces, caves, specially constructed bunkers), demonstrating that in these conditions the regime sleep – being awake becomes longer than 24 hours, extending the duration of the phase of being awake. Therefore the daily rhythm sleep – being awake turns into a rhythm with a certain free period. This fact enables some specialists (10, 21, 22) to suggest that natural "biological" day exceeds 24 hours. It is accustomed to 24 hours in result of the time indicators, related to the rotation of Earth around its axis (23). The results of our examination support this position.

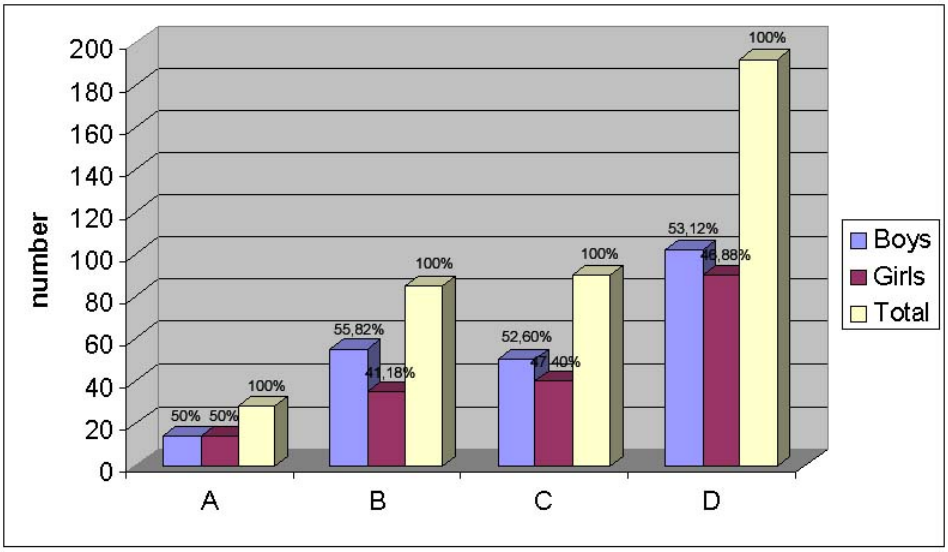

Figure 3. *Results from the statistical proceeding of the data obtained from the answer of the inquiry question: if you have important work in the morning, do you go to bed earlier in the evening?*

Legend: A *– "I go to bed more than 2 hours earlier", B – "I go to bed more than 1 hour earlier", C – "I go to bed less than 1 hour earlier", D – "As usual"*

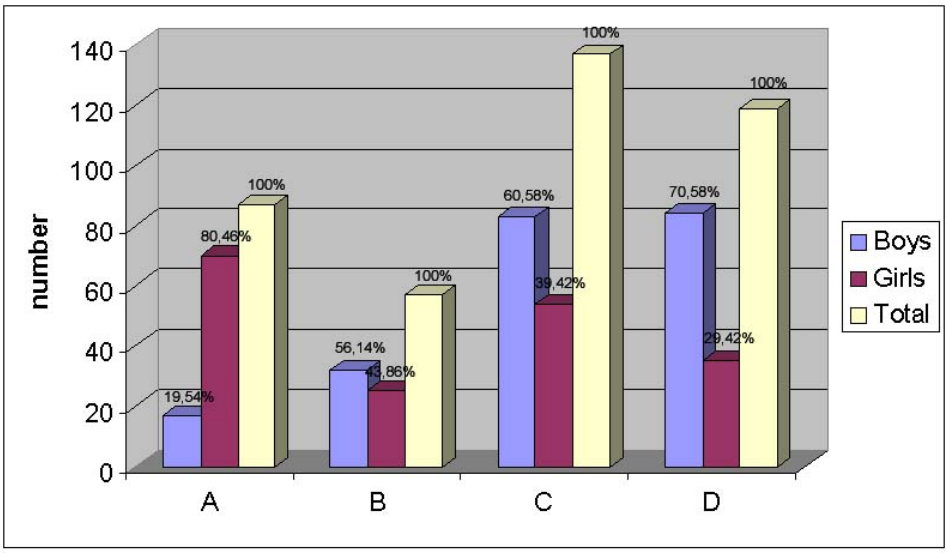

Figure 4. *Results from the statistical proceeding of the data obtained from the answer of the inquiry question: what breakfast do you prefer up to 1 hour after getting up?*

Legend: A *– "Solid", B – "Abundant, but not very rich in calories", C – "Only a sandwich, an egg, a glass of milk", D – "Only a cup of coffee or tea"*

Information on the individual chronotype of the examined students was obtained by passing the answers of the inquiry through a standard point system. The summarized results are presented in **Fig. 9**. The distribution in percentage verifies the stated assumption for orientation towards the diurnal and intermediary type. Over 50 % of the boys and girls show characteristics of the intermediary chronotype, twice less are those displaying features of the diurnal circadian type and the smallest part of the examined students can be classified as nocturnal type. No significant sex differences can be found tracing the internal distribution in the groups. This is an extra argument in support of the assumption that chronotype is not dependent on sex.

The second part of the inquiry studied the influence of some paragenetic and social factors on forming the daily biological rhythm. The aim was to determine a relation between the circadian rhythm and:

- a) season of birth;
- b) hour of birth;
- c) age of parents;
- d) education of parents;
- e) marital rays.

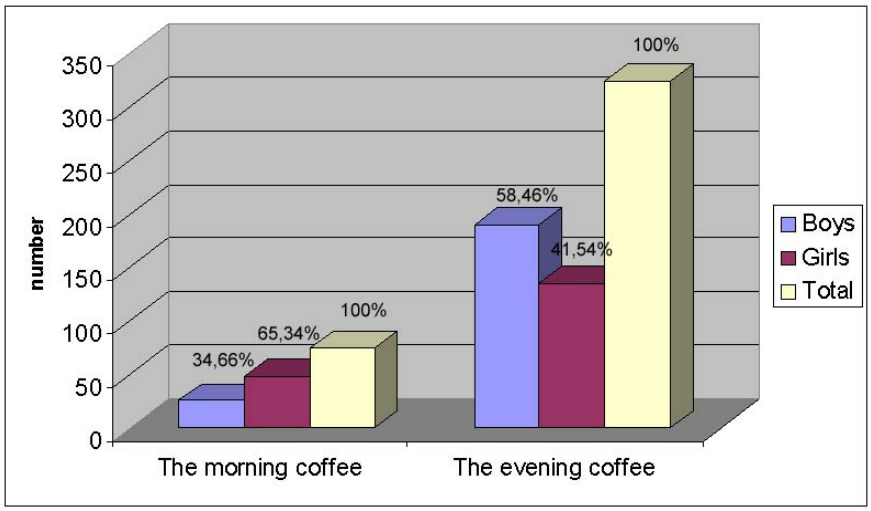

Figure 5. *Results from the statistical proceeding of the data obtained from the answer of the inquiry question: what would you easier give up?*

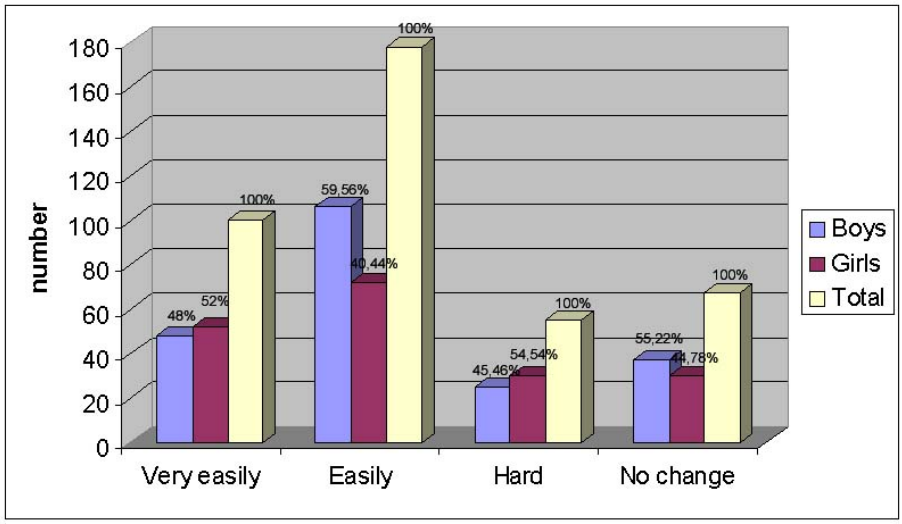

Figure 6. *Results from the statistical proceeding of the data obtained from the answer of the inquiry question: during vacation (holiday) would you easily break your feeding habits?*

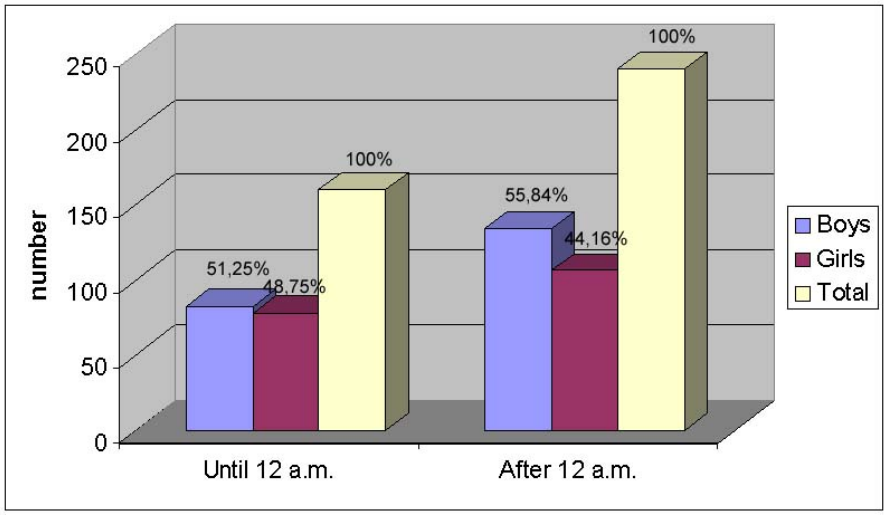

Figure 7. *Results from the statistical proceeding of the data obtained from the answer of the inquiry question: what time do slight irritations or quarrels at home or in school happen?*

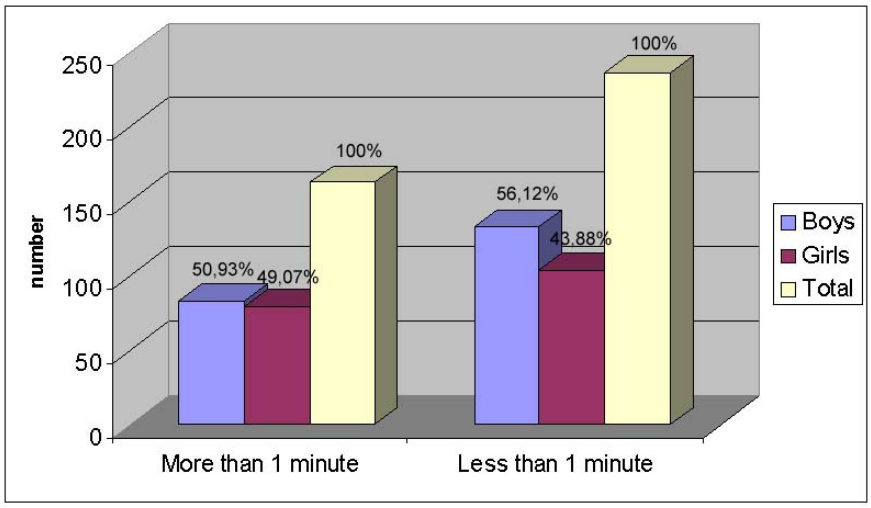

Figure 8. *Results from the statistical proceeding of the data obtained from the answer of the inquiry question: how exact can you determinate of a section of 1 minute without a watch?*

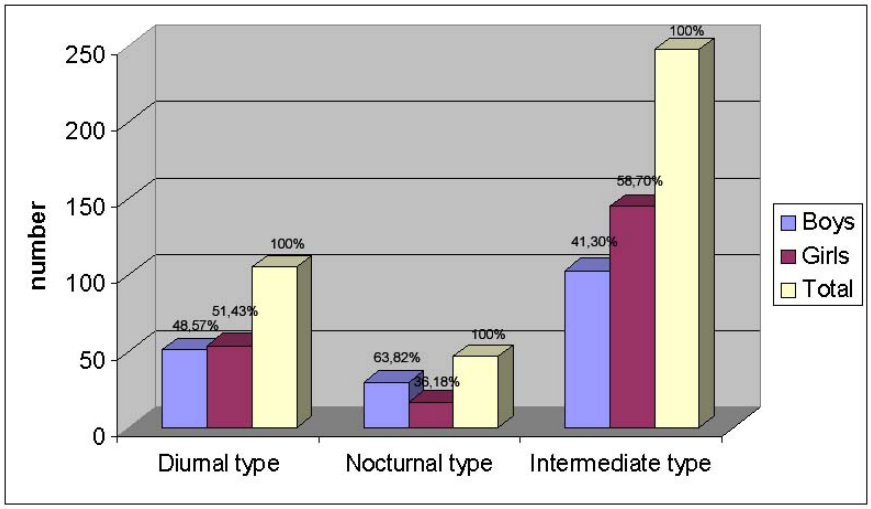

Figure 9. *Statistical distribution of the data from the obtained results for individual chronotypes in the examined students*

Table 1. *Results from the statistical proceeding of the data obtained from the answer of the inquiry questions concerning the impact of some paragenetic and social factors on the circadian rhythm – boys.*

Factors	χ^2	***P***
Season of birth	5.98	P>0.05 Sex dependence
Our of birth	11.20	P>0.05 Sex dependence
Age of the mother in the moment of marriage	8.69	P>0.05
Age of the father in the moment of marriage	7.99	P>0.05
Marital rays	9.87	P>0.05
Education of parents	12.66	P>0.05

The second part of the inquiry studied the influence of some paragenetic and social factors on forming the daily biological rhythm. The aim was to determine a relation between the circadian rhythm and:

- a) season of birth;
- b) hour of birth;
- c) age of parents;
- d) education of parents;
- e) marital rays.

The season of birth is a factor which determines the formation of the biological type as the extent of this dependence is higher in boys (χ^2 = 5, 98) in comparison to girls (χ^2

= 9, 90), (**Table 1, 2**). Their birth in winter, with its short days and long nights is defining for the confirmation of nocturnal chronotype in both girls and boys. The examined students of diurnal type were born mainly during the winter or one of the intermediate seasons. For boys autumn and winter combine, when days gradually decrease, while for girls – mainly winter and spring when day begins to expand. In both cases the shortened day is a prerequisite for a higher activity in the morning hours of the day.

Table 2. *Results from the statistical proceeding of the data obtained from the answer of the inquiry questions concerning the impact of some paragenetic and social factors on the circadian rhythm - girls*

Factors	χ^2	***P***
Season of birth	9.90	P>0.05
Our of birth	11.90	P>0.05
Age of the mother in the moment of marriage	1.80	P>0.05
Age of the father in the moment of marriage	2.50	P>0.05
Marital rays	17.00	P>0.01
Education of parents	11.22	P>0.05

The intermediate types were born mainly in the intermediate seasons, when the balancing of day and night duration begins. Conditions for a relatively constant activity in the greater part of the day are created. For boys autumn is of forming significance, while for girls this is spring.

The correlation between circadian rhythm and hour of birth is less expressed (**Tables 1, 2**). From the given exact answers of this question is seen that the students of diurnal type were born mostly during the second half of the day (from 12 to 24 h). The examined students of intermediate circadian type show greatest hour variety but there is a visible concentration of the cases in the interval between 6 – 18 h.

The influence of the age of the parents at the moment of the contracting of the marriage on the formation of chronotype is very strong, especially in girls (**Tables 1, 2**). Defining for the confirmation of diurnal type is the equal, young age of the parents (20 – 25 years). The examined students of confirmed nocturnal type are not related to mothers over 25 years and fathers less than 20 years of age. The intermediate type is expressed in cases of coinciding age of the parents or when the mother is about 5 years younger than the father.

Marital rays, or the extent of remoteness of the parental pair and especially the education of the parents have very low influence on the confirmation of the individual circadian rhythm. No dependence between chronotype and sex of the examined students has been found.

CONCLUSIONS

The following conclusions can be derived from the conducted examination:

- The inquiry responses of the students from both sexes determine dominant display of intermediate type and rarest display of nocturnal chronological type.
- The daily rhythm is not dependant on sex. The season of birth and age of the parents but not the marital rays have a significant influence on its confirmation.
- Students show great adaptive possibilities for the main components of the circadian rhythm – sleep – feeding – work – rest. In this sense a successful development of an inverse cycle in changing conditions of the social environment can be prognosticated.

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