IDENTIFICATION OF CHRONOTYPE AND DIURNAL PERFORMANCE

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The aim of the study was to compare the chronotype and diurnal performance from the point of view of explosive leg – muscle strength of lower limbs. The experimental sample consisted of female and male university students (n = 18) attending various study programmes and study fields at faculties of Matej Bel university in Banská Bystrica during the academic year 2014/2015. The chronotype was identified and assessed by standardised chronotype´s questionnaire (Horne & Ostberg, 1976). The parameter of the diurnal performance (the morning and the evening performance) was the explosive leg – muscle strength of lower limbs. Variations of explosive leg – muscle strength of lower limbs were detected by the vertical jump –countermovement jump (CMJ) by the device Myotest PRO (Myotest, Switzerland). The morning and the evening performance were evaluated as the mean performance of five morning and five evening measurements which were realized during the week. The significant difference in diurnal performance was not detected in the sample ($p < 0.05$). The results of the chronotype´s questionnaire showed that 13 probands tended to be the intermediate chronotype (n = 13), moderate morning chronotype was identified in three probands (n = 3) and the moderate evening chronotype was identified in two probands (n = 2). Definitely morning and definitely evening chronotype were not identified.

INTRODUCTION

The diurnal rhythms and their impact on sport performance is the most explored and examined sphere from the point of view of the sport chronobiology. The diurnal rhythms come within the abmit of circadian rhythms. According to the diurnal rhythms we recognize two phases of the day: the morning phase lasting from 3.00 am to 3.00 pm and evening (afternoon) phase lasting from 3.00 pm to 3.00 am (Jančoková, 2000). The phases are characterized by typical oscillations from the point of view of biochemical and psychological processes, physiological functions and sport performance (Jančoková, 2000). These oscillation caused the division of general population in chronotypes whose organism is more active in specific time of the day. We recognise in general population the morning chronotype (“lark”) which wakes up early in the morning and is more active in the morning and in this type of person is able to reach the maximal physical and psychological performance. People with the morning chronotype usually go sleep earlier in the evening. The second type is the evening chronotype (“owl”) which is obviously more active in the afternoon or in the evening hours. This type finds difficult to wake up early in the morning and people with this chronotype
usually go sleep in the late evening hours (often after midnight). There is also one more chronotype which is presented in the literature – intermediate (neutral) chronotype. This chronotype has balanced performance and other characteristics during the day and there is no preference in any part of the day. This classification can be found in researches made by Horne & Ostberg (1976), Reilly et al. (2007), Harada et al. (2011), Muro et al.

(2011), Roenneberg (2012), Waterhouse & Fukuda & Morita (2012), Pupiš & Pivovarniček & Tonhauserová & Pavlovič (2012); Pupišová (2013); Pupišová & Pupiš & Jančoková & Pivovarniček (2014); Papantoniou et al., (2014).

Many researchers are interested in problem of exogenous rhythms and their oscillations. Schlank & Pupiš (2007) examined that significant better results in speed- strength abilities were achieved by ski jumper at 12.00 pm. Paugschová & Jančoková & Šulej (2009) denoted that soldiers achieved better sport performance (strength – speed preconditions) in the afternoon (at 4.00 pm) and the best sport performance was denoted at 6.00 pm. Rošková & Demjan (2011) denoted that female university students (n = 24) reached better results in psychological and physical performance at 5.00 pm . Gereková (2009) presents that the female biathlonist achieved the best level of speed abilities at 6.00 pm but the best level of the speed abilities were achieved at 9.00 am. Elghoul et al. (2014) examined the impact of the time of the day on dart – throwing performance at 7.00 am and 5.00 pm. The results of the sample consisted of young boys (n – 12, age = 9.8 ± 0.5 years) showed better psychomotor performance at 5.00 pm. The research made by Edwards (2007) showed that the performance in dart – throwing was influenced also by strength and throwing accuracy. Facer & Childs & Brandstaetter (2015) examined the sport performance not only in individual but also in collective sports. Athletes achieved better performance in the evening but the authors present that the most significant predictor of the performance was not the time of day but the „waking“ time. Chin et al. (2015) examined the impact of diurnal variation in cardiovascular performance of the athletes (n = 35). Many endogenous parameters were measured in their study of which results confirmed the impact of time of the day on performance at noon (the highest impact of VO2 max was found at this hour). The authors also present the fact that the athletes should have trainings at hours which relate to VO2max to achieve and reach effectivity in sport performance. Rae & Stephenson & Roden (2015) examined the relationship between the chronotype and sport performance in sample consisted of professional swimmers. The swimmers of the morning chronotypes reached the best performance in the morning and the swimmers of the evening chronotypes achieved better performance in the evening hours.

METHODOLOGY

The standardised questionnaire was used for the chronotype´s identification (Horne & Ostberg, 1976) which contains of 19 closed questions. Each answer in the questionnaire (A, B, C, D and in some cases E) has specific number of points (Horne & Ostberg, 1976). Firstly we counted points according to answers when we assessed somebody´s questionnaire and then we assigned concrete chronotype according to stated scale which consists from five following possibilities (Horne & Ostberg, 1976):

•Definitely morning chronotype – 70- 86 points
•Moderate morning chronotype – 59- 69 points
•Intermediate chronotype – 42- 58 points
•Moderate evening chronotype – 31- 41 points
•Definitely evening chronotype – 16- 30 points

The indicator of the diurnal performance was the explosive leg – muscle strength of lower limbs. Its morning and evening changes were examined by vertical jump – countermovement jump (CMJ) by the device Myotest PRO (Myotest, Switzerland). According to producer´s agreement (Myotest, Switzerland) the result of one measurement was the mean height from five realized countermovement jumps in cm with accuracy 0.1 cm. According to producer´s agreement (Myotest, Switzerland). The morning and the evening performance of each student are assessed and evaluated as the mean performance from five morning and five evening measurements during five days. The statistical significance of differences between the morning and the evening performance of each proband was determined by Wilcoxon signed – rank test on the level $\alpha = 0.05$. The statistical analysis was realized by the software IBM® SPSS® Statistics V19 (Statistical Package for the Social Sciences). We used arithmetic mean (x) and standard deviation (SD) from the point of view of descriptive statistics.

RESULTS

According to the questionnaire we identified the intermediate chronotype in 13 students. The moderate morning chronotype was identified in 3 students and the moderate evening chronotype was identified in 2 respondents. The significant difference was not examined and denoted (p >

0.05) in countermovement jumps´ test. Based on the results we can state that in 13 cases exists the relationship between identified chronotype and balanced diurnal performance.

Table 1 Physical and age characteristics of examined respondents with results of identified chronotype and diurnal performance

N	G/S	DA	H (cm)	W (kg)	CH	MP (cm)	EP (cm)	W test
1	f	19,7	170	57,3	v	27,2±0,8	27,0±1,2	T = 3, n = 4, p > 0,05
2	f	22,6	164	52,2	v	22,7±0,2	23,2±1,0	T = 3, n = 4, p > 0,05
3	f	19,6	176	57,2	v	22,8±2,6	25,0±1,8	T = 3, n = 5, p > 0,05
4	f	21,9	166	56,2	v	26,0±0,9	26,2±1,1	T = 3, n = 5, p > 0,05
5	f	20,1	176	47,1	v	24,8±2,6	25,4±2,4	T = 1, n = 5, p > 0,05
6	f	20,4	166	66,1	v	20,7±1,5	21,8±1,4	T = 0, n = 4, p > 0,05
7	f	20,3	157	49,6	mv	23,4±0,6	23,3±0,8	T = 4, n = 4, p > 0,05
8	f	19,9	171	56,9	v	27,7±0,8	27,7±1,2	T = 7,5, n = 5, p > 0,05
9	f	19,5	163	54,9	v	24,3±0,4	23,6±0,8	T = 1, n = 4, p > 0,05
10	f	19,9	162	74,1	mv	22,3±1,0	23,0±0,4	T = 0, n = 5, p > 0,05
11	f	22,0	157	51,7	mr	24,7±1,9	25,3±2,0	T = 0, n = 4, p > 0,05
12	f	21,4	168	54,4	v	27,1±1,1	27,2±2,6	T = 6,5, n = 5, p > 0,05
13	f	23,2	171	59,3	mr	26,5±0,8	25,7±0,8	T = 2, n = 5, p > 0,05
14	m	20,1	180	81,6	v	31,2±1,0	32,9±2,1	T = 1, n = 4, p > 0,05
15	m	24,1	181	80,5	mr	22,7±0,2	23,2±1,0	T = 3, n = 4, p > 0,05
16	m	18,9	172	60,6	v	36,6±1,9	36,3±1,5	T = 4, n = 4, p > 0,05
17	m	24,0	181	91,0	v	34,5±1,5	34,8±2,5	T = 4, n = 4, p > 0,05
18	m	20,0	181	69,4	v	42,0±1,7	41,5±1,6	T = 6, n = 5, p > 0,05

Legend:
N – number of the respondent; **G/S** – gender/sex[f – female, m – male]; **DA** – decimal age; **H** – height; **W** – weight ; **CH** – identified chronotype [n – intermediate, mm – moderate morning, me – moderate evening]; **MP** a **EP** – the mean diurnal [the mean morning x±SD and the mean evening x±SD] performance from the point of view of explosive leg – muscle strength of lower limbs in countermovement jump test; **W test** – evaluation of difference of diurnal performance [morning – evening] by Wilcoxon Signed – Rank test

DISCUSSION and CONCLUSION

The questionnaire´s results have shown that our sample of university students tend to be the intermediate chronotypes. This fact can be argued and reasoned by the existence of the precondition that the university students have not got stated and organized exact schedule of activities. Of course, their lives is influenced by school which is on the other hand organized variously- The lectures and seminars are stated in various time of the day – in the morning hours, in the afternoon and even in the evening hours. Each day is specific and different from the point of view of time requirements. It can be stated that the exact hour of the sleep of university students is not determined and specified and it is changed according to mentioned demands of the study, leisure time and university “night” life. The dominance of the intermediate chronotype was confirmed by the study made by Vančová et al. (2013) a Vančová & Palovičová (2013) in which they identified the chronotypes to female university students (n = 62) from which 77.4 % tended to be the intermediate chronotype. The present study has shown that no proband tends to be the definitely morning or the definitely evening chronotype.

Biss & Hasher (2012) present that the definitely morning chronotype is very unique and rare among university students. Werner et al. (2009) present in the research that the chronotype can be changed and it unstable up to the time when the human – being becomes self – depended and has regular work and own home. The varying chronotype is specific and characteristic manly for pubescence and adolescence up to 26 year. The results of the research made by Hagenauer & Ku & Lee (2011) agreed with the previous arguments and statements.

Barbosa & Albuquerque (2008) were dealing with problem of chronotypes´ relationship with diurnal performance. They divided students

according to chronotypes and they examined training effect on long-term explicit memory of undergraduates who were classified as morning, intermediate, or evening chronotypes. The students who trained in the afternoon achieved better performance. The authors presented that the long-term explicit memory performance was not affected or depended by chronotype or time –of- day. Brown, Neft & LaJambe (2008) divided young in three groups according to the identified chronotypes: the morning chronotypes, the intermediate chronotypes and the evening chronotypes. The athletes´ performance was examined in the morning from 5 am to 7am and in the afternoon from 4.30 pm to 6 pm. The authors did not detect any significant difference in athletes´ performance according to chronotype´s typology from the point of view of time- of – day and they stated that the results of athletes were influenced by training and time- stereotypes. Atkinson et al. (2005) presented very interesting results. The professional cyclists who tended to be the morning chronotypes achieved significant better performance in the evening. Also Pivovarniček et al. (2012, 2013) present detections related to balanced diurnal performance of young soccer players in the morning and in the evening. The authors state that there is the existence of time – training stereotypes which is presented also in researches made by in Pivovarniček (2009a,b,c). Our university students were not interested in sport and were not active and that is why there is no evidence to predicate the existence of created time – training stereotype what was confirmed in their balanced diurnal performance from the point of view of the explosive leg – muscle strength. Mentioned detections in our sample of university students showed the existence of the relationship between identified chronotype and diurnal performance.

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ABSTRAKT

IDENTIFIKÁCIA CHRONOTYPU A DIURNALNEJ VÝKONNOSTI

Kľúčové slová*:* vertikálny výskok z miesta, večerný chronotyp, večerný výkon, ranný výkon

Predložená štúdia prezentuje výsledky výskumu, cieľom ktorého bolo zistenie vzťahu medzi identifikovaným chronotypom a diurnálnou výkonnosťou u vysokoškolských študentov. Výskumný súbor tvorili študenti I. a II. stupňa vysokoškolského štúdia rôznych študijných programov a študijných odborov na fakultách Univerzity Mateja Bela v Banskej Bystrici (n = 18) v akademickom roku 2014/2015. Chronotyp bol identifikovaný dotazníkom (Horne – Ostberg, 1976). Rozdiely diurnálnej výkonnosti (ráno – večer) boli zisťované prostredníctvom Wilcoxonovho testu v parametri explozívnej sily dolných končatín v teste vertikálny skok s protipohybom (CMJ), meraný zariadením Myotest PRO (Myotest, Švajčiarsko). Ranná a večerná výkonnosť bola vyhodnocovaná ako priemerná výkonnosť piatich ranných a piatich večerných meraní. Štatistická analýza bola realizovaná pomocou softwaru IBM® SPSS® Statistics V19. Výsledky identifikácie štatistickej analýzy diurnálnej výkonnosti a chronotypu ukázali, že u najväčšej skupiny probandov bola zistená vyrovnaná diurnálna výkonnosť ($p > 0,05$) a rovnako sme u väčšiny probandov identifikovali vyrovnaný chronotyp (n = 13). Traja probandi (n = 3) inklinovali k viac rannému chronotypu a dvom probandom (n =2) bol dotazníkom identifikovaný viac večerný chronotyp. Rozhodne ranný a rozhodne večerný chronotyp nebol identifikovaný u žiadneho z probandov (n=0).

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