RESEARCH ANALYSE OF POTENTIAL CIRCADIAN ASPECTS IN BOXING

[1]Milada KREJČÍ, **[2]Tetsuo HARADA**, **[3]Misako KAWAMATA**

[1]*College of PE and Sport PALESTRA, Czech Republic.*

[2]*Kochi University, Laboratory of Environmental Physiology, Japan.*

[3]*Kochi University, Faculty of Education, Japan.*

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ABSTRACT

There are given in the presented paper outputs of five years long term basic research of the circadian determinants influence on athlete´s performance in the framework of the Czech – Japan joint project W/VSP/161/I. In the paper we present the focus on circadian determinants, which can be important for performance in sport discipline boxing, e.g. on the circadian preferences and habits of boxers in Czech Republic. The main objective of the investigation was to analyse circadian preferences and habits of boxers in context of professional/amateur boxing. The partial goal was to analyse differences between professional and amateur performance of male boxers. In total 91 Czech boxers (37 professional boxers, 54 amateur boxers), in age interval 21- 35 year old, median 26.2 years old, participated in the investigation procedure. The diagnostic method Questionnaire of Circadian Typology "CIT" for adults (Harada, Krejčí - Czech version, 2010) was used. The statistical methods included One-way non-parametric ANOVA SPSS, with using Fisher Exact Test and Mann–Whitney U test. Results demonstrate from the view of chronotype that professional boxers are more evening typed than amateur boxers. Significant differences in the marker "Difficulty fall asleep" were found between professional and amateur boxers. Spent time in night in front of blue light in monitors and displays negatively influenced quality of sleep. Professional boxers tend to adhere to regular eating habits in comparison with amateur boxers. In professional boxers were analysed higher levels of psychological stability and self-control than in amateur boxers. Conclusions presented in the paper can serve background material, for example, to

set up an appropriate intervention program for boxers, whether professional or amateur boxers. Especially is advisable to recommend to boxers to avoid blue light sources in the night before falling asleep, because guides to prolong the sleep cycle and reduce the quality of sleep.

INTRODUCTION

Sleep and physical activities have strong relationships dependent of the biological clock. From the view of chronobiology in sport, athletic performances have been shown to be dependent upon both the quality and the quantity of sleep that has been taken before the competition. The detrimental effects of sleep deprivation are shown by increased lapsing, cognitive slowing, memory impairment, decreased vigilance and sustained attention, and shift in optimum response capability. Its effects on physical performance are manifested as a decline in the ability to perform maximal exercise. Aerobic and anaerobic pathways are both affected, as are fatigue and recovery processes (Davenne, 2009). In connection with biological rhythms being a morning typed person, can be a key to sport productivity in performance and efficiency. (Harada et al 2015, Jančoková, 2013). It is subject to endogenous

determinants, especially circadian rhythms. Its transformation takes place due to exogenous factors, such as the effects of daylight. The effect of light is a very specific factor, as it is the effect of an exogenous factor, which is light, with a direct influence on the endogenous factor, i.e. the circadian rhythm. Sport activity is then considered to be a typical exogenous factor affecting of the circadian rhythm, in different forms from physical activity to mental activity and to activity in relation to social contacts.

There are differences in body temperature among individuals who have different chronotypes. This has been demonstrated by numerous studies that point to the fact that M-types generally have a higher body temperature than E-types. The M-type at the same time reached its temperature peak at earlier values than the E-type. High benefit for athletes in context to the M-type has fact that in M-type person the

body temperature increases even before waking up, when the body temperature is falling to its minimum at a given time. In addition to body temperature, people also differ in other body functions, when M-types have a significantly higher cortisol level than E-types after awakening, and cortisol production is related to the sleep and wake cycle. Its production as such rises within 30 minutes of awakening. For this reason, M-types are more active than E-types right after waking.

A condition and level of emotional, physical and mental exhaustion are named as burnout. Sport stereotypes in training process can bring a problem with sportsmen burnout. **As a physiological view point, a high level of burnout may result in a longer duration of sleep as one homeostatic response (Kawamata et al, 2018). In boxing burnout influences purpose, vitality, attitudes and self-concept towards sport and life. It might be negative. Coaches and athletes are prone to likely to burnout due to the sports nature as well as the burnout nature because they are always based on accomplishment** (Hooda, D., Hooda, H. 2016).

The performance of the boxer is limited not only by the functional possibilities of the individual but also by his psychic state and social consequences. Boxers may undergo stable physical training, but they may still experience considerable fluctuations in their performances. This is the area in which the bio-psycho-social aspects of performance play a big role. This should be an integral part of sports training in boxing. As far as training in boxing is concerned, it can be understood how chronotype and circadian knowledge can deepen the effectiveness of the training process. The aim of an athlete coaching is to increase the effectiveness of bio-psycho-social components of sports training, and to stabilize performance at the level of attainment achieved.

Boxing ranks among individual combat sports. From the view of sport psychology it represents an anticipatory kind of individual sport. Concerning that, it can be characerised, that box is the fight of two rivals trying to beat each other through muscular strength, blows, technical, tactical activities and skills according to the rules. Rivals try to use a large amount of very hard and fast properly supervised simple and complex operations of offensive, defensive shots, combination of shots, evasion and dodging, etc. Box, like every other kind of sport is physically

demanding activity, with the aliphatic character and takes great demands on neuromuscular coordination. **Boxing is full-contact kind of sport. Athlete, who wants to be successful in boxing, should have the following characteristics: endurance, speed, stamina, strength, and should be mentally strong.**

The boxing match for every boxer represents a stressful period, not all boxers are able to cope with this stress. Therefore in boxing is a sharp line between professional boxers and amateur boxers. Professional boxers meet with stress management, control from fear of defeat, failure, and, in the case of professional boxers, also from public pressure and fear of failing to meet the expectations of fans. All athletes are supplemented by a possible fear of pain in the case of injury. In the case of professional or amateur boxing, which is considered to be a full contact combat sport, means that the strikes are carried out with maximum force and therefore these blows often hurt. This can be a big problem especially in the case of beginner boxers who do not have enough experiences. A perceived fear of the boxer is in the boxer's inability to use the learned techniques and the capabilities he possesses. Instead, it acts briefly and

schematically, often boxing in a non-technical manner, or does not play at all, or fails physically, even though the match is physically perfectly prepared. It is therefore important that in the sense of success the boxer is fully concentrated and mentally balanced. It should be noted that fear can be felt unconsciously in many boxers (Adámek, 2018).

Amateur boxing can be provided or for competition, or for fitness, or for self-defence as a hobby, even can be provided be provided similarly as hobby-fitness in non-competitive way in nowadays modern sport centres. Even is possible to follow one of the online directories which list boxing gyms and clubs around the world, or to train from home using the free online lessons. **In nowadays box has a very wide range of fitness applications, for example as a part of weight reduction programs and it is called "Hobby box" or "Fit box" when there is realising regular training practice to reduce fat, increase fitness and comprehensive strengthening. Everybody can decide which kind of box he chooses.**

OBJECTIVES AND HYPOTHESES
Objectives
The main objective of the investigation was to analyse circadian preferences and habits

of boxers in context of professional/amateur boxing. The partial goal was to analyse differences between professional and amateur performance of male boxers.

Hypotheses

On the base of the formulate objectives, next two hypotheses are declared.

H1: It is no significant difference in the number of sleep hours between professional boxers and amateur boxers.

H2: Amateur boxers spend significantly more hours on displays in the night than professional boxers.

METHODOLOGY

From the point of view of the methodology we used methods of analysis, synthesis, induction and deduction and applied anchored theory method, as well as causal and operational thinking. Continuously in the process of solving the project, we took into account the hysteresis, where the study of social phenomena emphasizes the importance of historical contexts for the study of current phenomena and their prediction in the future application.

Material and procedure

The investigation was realised in total in 91male Czech boxers (37 professional boxers, 54 amateur boxers), in age interval 21- 35 year old, median 26.2 years old. All were trained in the classical type of boxing, see Table 1.

Table 1 Basic characteristics of monitored probands (n=91 males; 37 professional boxers, 54 amateur boxers)

Samples of male probands	Number of probands	Type of boxing	$\bar{x}$ Age years	$\bar{x}$ Body High cm	$\bar{x}$ Body weight kg
Professional boxers	37	Classical	27.1	186.6	91.2
Amateur boxers	54	Classical	25.3	181.4	84.6
All boxers	91	Classical	26.2	184.0	87.9

The number of monitored professional boxers is quite representative. In the Czech Republic the boxing professional sport club base is small compare to the Czech most popular sport clubs base as in ice-hockey and in soccer.

The 37 professional boxers have completed 2 - 3-phase training, used the principle of

intense overload, to reach the development of psycho-physical attributes to maintain the form, including sparing type training. A week before the match, the sparing training was eliminated and the main task of the training was oriented on a training with a coach of combining, speed and coordination of motion, shading and exercises on various intensity. The 54 amateur boxers trained also hard and regularly, but the main difference was that they did not participate in competitions in boxing matches.

METHODS

Diagnostic tool

Questionnaire of Circadian Typology "CIT" for adults (Harada, Krejčí - Czech version, 2010)

The integrated questionnaire is focused on sleep habits and diurnal rhythms, consists of five parts. The validity is being tested and test has a regular valid Czech version.

The integrated questionnaire is very extensive and includes 100 questions and is divided in five integrated parts:

- M - E score Morningness-Eveningness Questionnaire (MEQ) of Torsvall & Åkerstedt (1980)
- Sleep preferences;
- Environmental factors + Time spent on monitors;
- Eating habits;
- Mental health.

Questions on sleep habits asked about sleep onset and offset times and sleep duration. We asked about patterns during weekdays, weekends and holidays, times of earlier limit and later limit for each of the above. With regards to quality of sleep, several questions were asked, that is, subjective sleep onset times, waking up in the middle of the night, difficulty falling asleep, depth of sleep and feeling upon awakening. Questions on eating habits looked into the regularity and timing of meals, food frequency, food groups. Regarding mental health, frequency to feel the following was asked: irritation to other people or objects; easily angered by a small trigger; become suddenly angry and irrational and unable to control these emotions by themselves; and feeling depressed. Possible answers were never, 1–2 times a week, 3–4 times a week, 5–6 times a week and every day.

Statistical analysis

Statistical analyses of the independent variables were provided on the base of

One-way non-parametric ANOVA SPSS. The analysis on M-E scores as a dependant variable were analysed in Fisher Exact Test and Mann–Whitney U test.

Ethical treatment

The study followed the ethical parameters for the conduct of research on human subjects. Before investigation procedure to each of the probands were given an oral explanation about the concepts and objectives of the research and stated in written form that their answers would be used only for academic purposes. After the above explanation, all participants agreed completely with the proposal. The participation of athletes in the research was also with the consent of their sports clubs, and with the approval of the Ethics Commission of the College of PE and Sport Palestra.

RESULTS AND DISCUSSION

In the Figure 1 are demonstrated results of the so called M-E score in the investigated samples of professional boxers and amateur boxers. There was not detected the significant difference between professional boxers and amateur boxers. Figure 1 declares more predominant trend toward morning-type M, which is generally positive finding. It can be said that regular training practice of the monitored boxers leads to the desired circadian rhythms of sleep and wakefulness. According the Czech – Japan study presented by Wada, Krejčí, Harada et al. (2009), there can be another possibility why Czech athletes are morning-typed. Authors report that very severe bedtime discipline performed in general in the Czech Republic seems to play an important role in the morning-type circadian typology of Czech analysed groups of children and adults. A further limitation is that the M-E questionnaire may be limited in detecting the M-E preferences of boxers. The mental and physical health of the analysed athletes seems to be influenced by the mental health social circumstances in regards to angry and depressed mood. This question remains to be solved in future investigation.
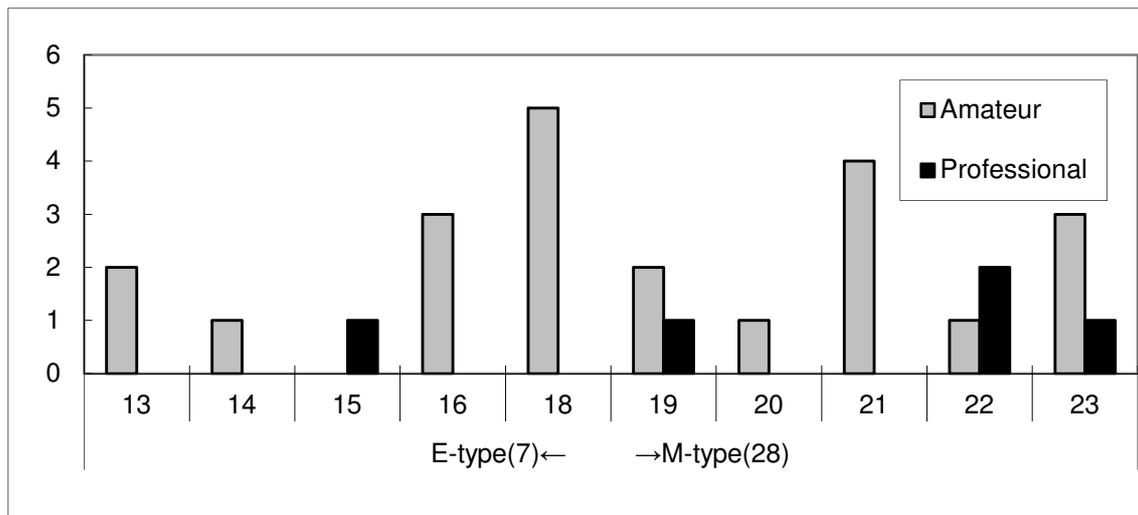
Figure 1 Analysis of M - E score in samples of amateur boxers and professional boxers (n=91 males; 37 professional boxers, 54 amateur boxers) U-test: z=-1.10, p<0.284

Notice: M – Morning type; E – Evening type

Results demonstrate significant differences in the marker "Difficulty fall asleep" between professional and amateur boxers, when in professional boxers were analysed significantly worse results than in amateur boxers, see Figure 2. The presented figure clearly shows that the sample of professional boxers had troubles of falling asleep. The observed difference in troubles of falling asleep between the sample of professional and amateur boxers is significant (p = 0.007). This result is inconsistent with the hypothesis H1: "It is no significant difference in the number of sleep hours between professional boxers and amateur boxers". To the found significant difference between the investigated professional and amateur boxers in the in the marker "Difficulty fall asleep" to sleep we can discuss, that higher training load in 2-3 phase training several time per weekdays of the professional boxers correspondents with muscle fatigue and nervous system excitation after such training in the evening.
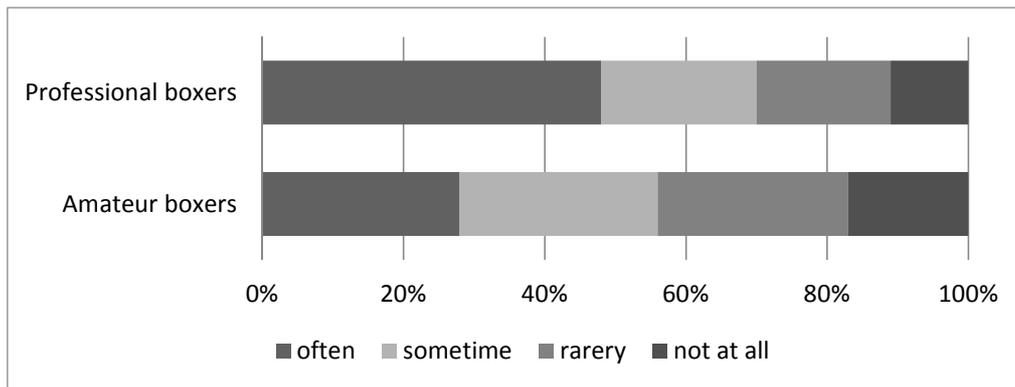
Figure 2 Differences in the marker "Difficulty fall asleep" between professional and amateur boxers (n=91 males; 37 professional boxers, 54 amateur boxers) Fisher's exact test: p<0.006

This regime may have an adverse impact on sleep. Especially professional boxers in the Czech Republic use to have training in the later evening. It can be an important difference in comparison with training timetable of the amateur boxers. During the day, the level of cortisol is gradually decreasing and the lowest is late in the evening, which allows by long-term physical exercises to exhaustion. Training exercises wake up the body and activates the sympathetic nervous system, which is responsible for increased cardiac activity. It is also responsible for the overall preparation of the body for exercise - it limits the flow of blood through the internal organs and improves the blood circulation of the muscles. It is inappropriate to do so a few hours before go to bed. And not just lie down and fall asleep, but sleep well all night and wake up in the morning full of energy.

Finally, the poor quality of sleep is due the mental stress of the expected matches that are associated with fear of failure and fear of injury, which are in professional boxers, unfortunately, quite common. The amateur boxers are not facing to that, so probably therefore the quality of sleep in amateur boxers is significantly better than in professional boxers, see Figure 3, Figure 4.
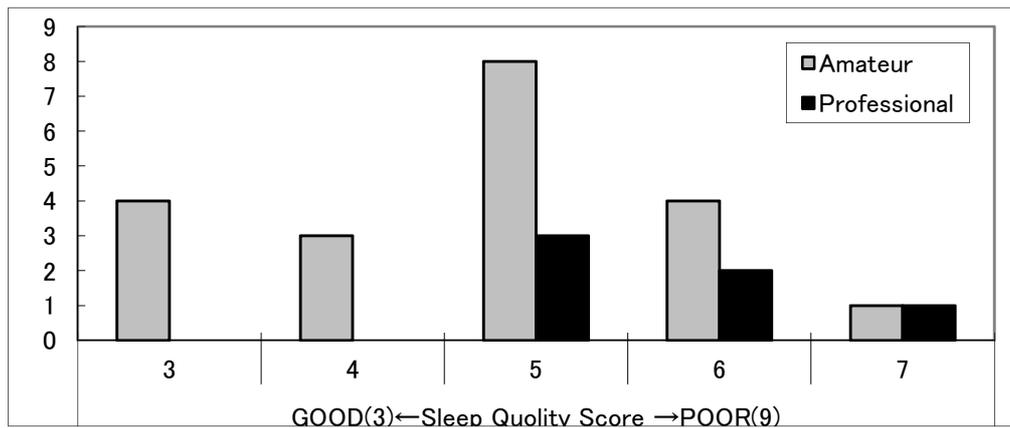
Figure 3 Displaying of sleep quality in professional boxers and in amateur boxers (n=91 males; 37 professional boxers, 54 amateur boxers) U-test: z=-1.69, p<0.108
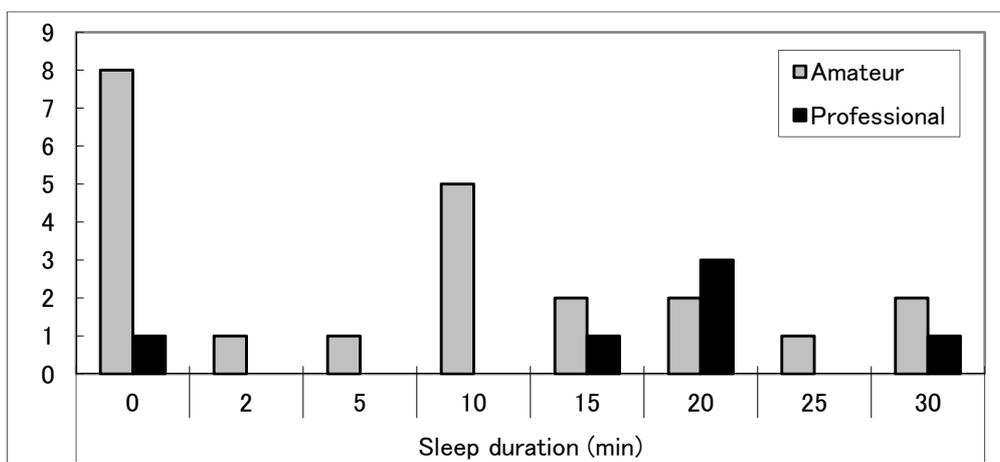
Figure 4 Length of time to fall asleep in minutes of amateur boxers and professional boxers (n=91 males; 37 professional boxers, 54 amateur boxers) U-test: z =-1.66, p<0.112

Figure 4 shows the length of time of asleep in minutes. From the Figure 4 is clear the fact that professional boxers need longer time to asleep. It correlates significantly with longer time to fall asleep in professional boxers comparing to the sample of amateur boxers.

In fact, Figure 4 confirms significantly worse sleep quality in the monitored samples of professional boxers comparing

to the sample amateur boxers. As it was already discussed, this negative trend may affect the intensity of training, it can also be nervousness from the expecting match in the professional boxers. A large share of it may also be, for example, adjusting the weight, which may represent adjustments as well as weight 10-15 kg per month, which in our opinion has a big negative impact on the psyche and on the problem

with falling asleep. Again we stress, that this problematics would deserve a more detailed scientific research. However, scientific studies regarding sleep and diet of boxers, is possible to see as very unique in the international scientific journals. This is important for psychological state and mental health to investigate in boxers a potential poorer ability to concentration, level of confusion in the sample of professional boxers versus amateur boxers due to the numerous possible head injuries in the classical boxing, especial in professional competitive boxing.

Statistical correlation results brought the next fact, that negative influence on the quality of is manifested due using of computers or other displays with blue lights in late evening and in nights in the sample of professional boxers and in the sample of amateur boxers as well. Statistical analyses of data has clearly shown that not computer activities, but especially TV watching until late night (over midnight) is the main accelerator guiding to worse quality of sleep, see Figure 5 and Figure 6.
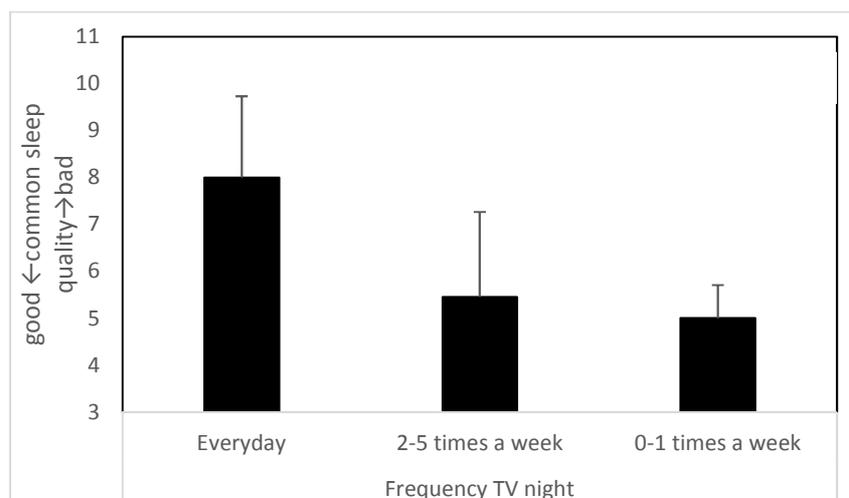
Figure 5 Sleep quality in the context of frequency night TV using in analysed samples of probands (n=91 males; 37 professional boxers, 54 amateur boxers) Kruscal-Wallis test: χ^2value=4.86, p<0.088
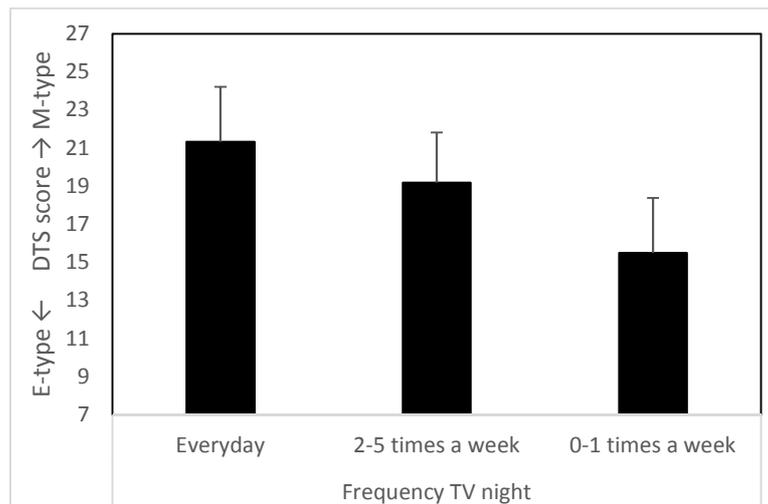
Figure 6 M-E score in the context of frequency night TV using in analysed samples of probands (n=91 males; 37 professional boxers, 54 amateur boxers) Kruscal-Wallis test: χ^2value=5.56, p=0.062

Figure 5 clearly shows that longer using of blue light displays especially as TV caused the sleep quality to the lower level, how it was analysed in both analysed samples - professional boxers or amateur boxers. There are no significant differences between the examined samples. Also M-E score is shifting to the evening type depending on the frequency of night TV using in analysed samples of probands (Figure 6). The mentioned results confirm the Hypothesis H2: Amateur boxers spend significantly more hours on displays in the night than professional boxers. The declared results correspond with findings from previous studies in young athletes of the authors Harada, Krejčí, Wada et al 2016). As follows from the results of this study are similar correlations in adult athletes in the age range 25-35 years. The whole problematic deserves further continual investigation.

In the presented survey also eating habits were analysed. The significant difference between the investigated samples of boxers was found in milk products consumption when in amateur boxers the milk products consumption is significantly different than in boxers-competitors.

Other partial interesting findings represent the facts that professional boxers tend to adhere to regular eating habits in comparison with amateur boxers and that in emotionally stressed situations professional boxers are mentally more stable than amateur boxers.

Figure 7 shows the use of milk and milk products in the diet of investigated samples of boxers.
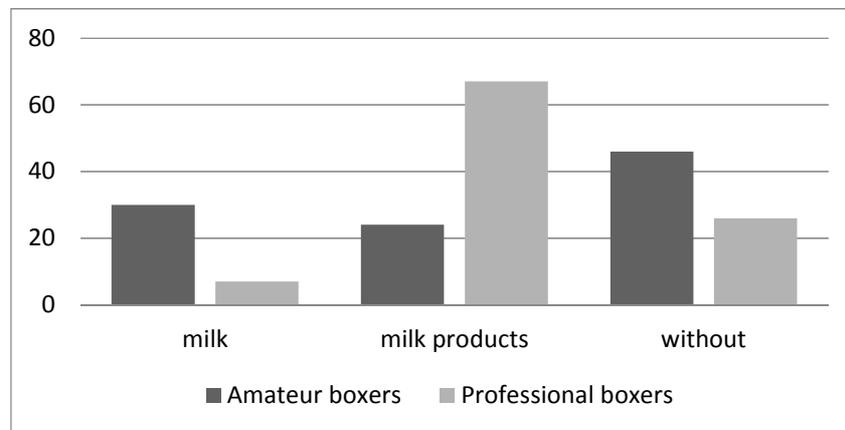
Figure 7 Milk consumption in samples of amateur boxers and professional boxers (n=91 males; 37 professional boxers, 54 amateur boxers) Fisher's exact test: p<0.011

The Figure 6 demonstrates that from the sample of amateur boxers just 30% are drinking milk and 70= don´t use to drink milk regularly do not. In the case of milk products the situation in in the sample of amateur boxers even worse. Only 24% use to consume milk products regularly. According Harada et al (2016) investigation, milk seems to be an important resource for taking tryptophan at athletes' breakfast. Taking milk at breakfast might be effective to the promote serotonin synthesis in the morning which could improve mental health directly and become "inner zeitgeber" for circadian clocks. Results of the scientific research of Harada show that tryptophan intake at breakfast has been known to be effective on promoting better mental health and morning-typed life through serotonin and melatonin synthesis. Cow milk is an important supplying of protein resources for human infants and sports athletes because it is easy to be taken and possible for vegetarians. Cow's milk has long been thought as a relaxation agent with sleep-inducing substances (Guesdon et al., 2006). In contrast, in the Figure 7 we can see that only 7% of the professional boxers used to drink milk regularly! This difference between the monitored samples is significant (p < 0.01). This phenomenon is difficult to explain because it can be

predictable that professional boxers drink milk as much or perhaps more than amateur boxers. Quite satisfactory is the result, 67%, was found in the consumption of milk products in the sample of professional boxers. They use to consume milk products 2 -3 times daily, especially morning and evening, i.e. in breakfast and in the dinner. Professional boxers prefer in particular cottage cheese, cream cheese and whey, what are product very rich in protein. This phenomenon might deserve further exploration for athletes in the Czech Republic. Research focused on milk consumption of athletes in relation to the optimization of circadian rhythms was properly analysed already by the research team of Kochi University headed by Professor Harada (Harada et al. 2013-2015). Results of the scientific research team of Professor Harada declare that tryptophan intake at breakfast has been known to be effective on promoting better mental health and morning-typed life through serotonin and melatonin synthesis. For Japanese students, milk seems to be an important resource for taking tryptophan at breakfast because of limited meal time in the morning. Taking milk at breakfast might be effective to the promote serotonin synthesis in the morning which could improve mental health directly and become "inner zeitgeber" for circadian clocks.

CONCLUSIONS

We can conclude that new insights in the circadian problematic of male athletes, particularly in boxing serve good background material for appropriate effective interventions in training program of professional and amateur boxers. Especially is advisable to recommend to boxers to avoid blue light sources in the night before falling asleep, because guides to prolong the sleep cycle and reduce the quality of sleep. The goal of the present research study has been realised.

The Hypothesis H1: "It is no significant difference in the number of sleep hours between professional boxers and amateur boxers" was not confirmed.

The Hypothesis H2: "Amateur boxers spend significantly more hours on displays in the night than professional boxers" has been confirmed.

The research had the appropriate level. Quite surprising it seems the less quality sleep in professional boxers. Amateur boxers sleep significantly better in the quality of sleep compared to the professional boxers, and it is not just about

the marker "Length of sleep" but also about the marker "Speed of falling asleep". The professional boxers are exposed to higher stress than amateur boxers. But they have control ability and manage it as possible. Also frequent use of computers or other IT devices with blue lights screen over the midnight leading to the worse quality and length of sleep in amateur boxers and in professional boxers as well.

In conclusion, this study shows there are three main focuses – try to shift the diurnal rhythm from the evening type to the morning type, to keep regular sleep and eating habits including nutritional factor such as Tryptophan and Vitamin B6, and especially the neglected factor of light exposition on morning sunlight.

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