

PSYCHOBEHAVIOURAL IMPLICATIONS OF THE CIRCADIAN RHYTHM DISORDER

Angela BLOGUȚ*, Izabella PETRE**

*"Vasile Goldiș" Western University of Arad, Arad, Romania

**Victor Babeș University of Medicine and Pharmacy, Faculty of Medicine, Timișoara, Romania

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Abstract: *Circadian rhythm is a cycle of biochemical, physiological or behavioural processes of approx. 24 hours, belonging to living entities, including plants, animals. Many studies showed the removal from any time measurement source, internal "time" seems to operate for a long day of approx. 25 hours. When biological time is desynchronized to that of the society, dysfunctionalities start appearing at physical, mental and behavioural level which shall influence sleep, hormone secretions, body temperature etc. The desynchronizations arisen due to the disorder of circadian rhythm may be an aggravating factor for the appearance of chronic diseases, from high blood pressure, to diabetes mellitus, depression and even cancer.*

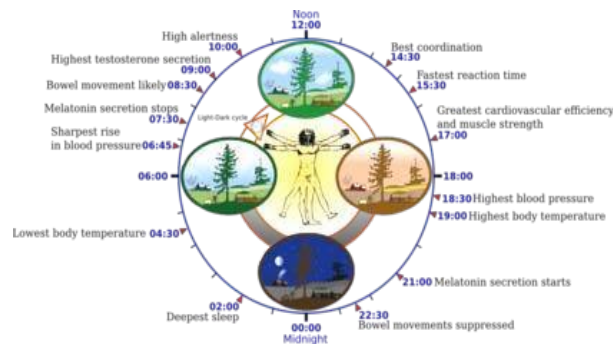
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Circadian rhythm is involved in days related temporization but it also is an element in the body physiological and behavioural adaptation, to passing to a new season. Recent measurements performed by Harvard professors showed that such rhythm has 24 hours and 11 minutes, the internal duration of a day being the same for the young, and for the elderly. Many of the functions of the body have a circadian rhythm, from sleep-awake cycle, to the vital signs of the body. As science becomes more and more exact in its measurements, more and more circadian rhythms are recognized; therefore, they recently discovered that bones growth takes place according to circadian rhythm. The human body represents a miraculous universal biological oscillator, subordinated to endogenous stimuli (genetic signals of pace-makers) and environmental factors (zeitgeber – time synchronizers), biorhythms depend upon. Bioperiodicity is a fundamental property of the living matter. The common element of time course is represented by biological rhythms, as all biological functions develop with time. The period of a biological rhythm is well profiled, which reflects the individual, hereditary character, and therefore, transmissible to following generations. The human being is born as such, not only with spatial biological structure, but also temporal.

Physiologically speaking, recent studies showed that circadian rhythm consists of a set of interconnected proteins which have the capacity to generate their own rhythm. Cell physiology is object of an internal "watch" with the length of 24 hours, which consists of interconnected molecular loops. This human biological clock is genetically printed, there existing in our brains a type of "heart stimulator" placed inside the suprachiasmatic nuclei being deeply influenced by factors like light, temperature of the surrounding environment, sleep, social contact, physical activity, and even regular table intervals. Neurotransmitters, neuromodulators and neuropeptides are those controlling the operation of the "circadian watch". Neurobiology of time (chronobiology), with biological infradian

rhythms – more than 24 hours, circadian - 24 hours, and ultradian – below 24 hours is often reminded in biorhythm disorders, major role disorders in the etiology of psychic or other morbidities. In practical activity, chronobiology is used as treatment guide and as source of additional information. Leaving from the idea that all the functions of the body are object of regulate temporal cycles for “opening” (maximum activity) and “for closure” (minimum activity), the use of chronobiology allows depending on the moment the cure of an organ, by administration of remedies during the hours of maximum activity. Our body has a number of 3 regulating times: epiphysis – regulated for 24 hours – endogen rhythm; hypothalamus – regulated adjusted per cycle light / dark; cortex – regulated adjusted per social rhythms.

In vivo, the cells of the nervous system must synchronize not only the day-night cycle, but also coordinate amongst them in order to coordinate circadian behaviour. The lack of coordination may allow peripheral oscillators to anticipate and to quickly respond not only in case of signals transmitted by the CNS, but also to behaviour related physiological signals. More and more evidence shows that the ability to react to larger or smaller perturbations of the light/dark cycle is important in order to preserve healthy metabolic function. The imbalance of the biological clock may lead to much more than sleeping problems, the negative impact on the health condition and general welfare of the body and normal processes in the body, leading to the deregulation of the levels of hormones, obesity, depression, diabetes etc.



Implications for the circadian rhythm for certain diseases

Recent studies showed that circadian rhythm is involved in the incidence of certain heart and cerebral-vascular events, like myocardial infarction, sudden cardiac death or heart attack. They are intensively studying pathophysiology and the mechanisms which determine such variations, as well as the effect of various drugs for such circadian rhythms. They also noticed that circadian rhythm may lead to a series of changes as related to body tolerance and to the way cancer tumours respond to anti-cancer agents. It is possible for the circadian rhythm to have implications as well for cancer development, therefore, they have been initiating and performing medical tests which showed by now the effectiveness of the principle of chronotherapy, that is, treatment based on circadian rhythm. Chronotherapy has presenting by now potential for the improvement of treatment options for cancer, as well as for the development of new anticancer agents.

There are diseases, amongst which depressions, with seasonal pattern, exacerbating during colder periods of the year. Circadian rhythm is perturbed, more serious symptoms appearing in the morning, with a slight improvement in the afternoon and evening. Specialists drew the conclusion that most of the symptoms of depression are tightly related to circadian rhythm, like variations of the disposition during a day, deregulations at the level of awake-sleep cycle and periodical recurrences of the disease. As well, there

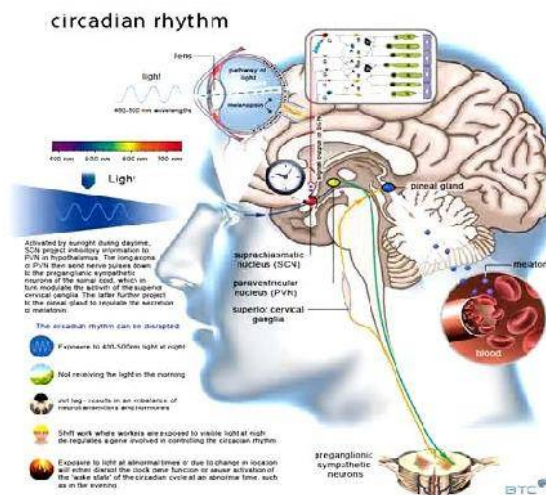
appear for depressive persons frequent deregulations of the circadian rhythm at the level of the body temperature or endocrine and metabolic parameters (secretion of cortisol, thyroid-stimulating hormone, melatonin and monoamine), much more often than in case of healthy individuals. They are also added sleep related issues: depressive patients with melancholic symptoms wake up earlier and undergo aggravation of their state of spirit in the morning. The abnormalities of the circadian rhythm noticed in case of depressive people suggest a possible degradation at physiological level of the circadian system. As well, in case of people with Alzheimer the rest-activity rhythm is deeply affected and correlated with the seriousness level of dementia, their affectation being more serious in case of patients being administered sedatives. Anxiety is a dangerous condition which may appear amongst the flight crew, in case of long time overloads. It is expressed by unrest, mistrust, concern related to what can happen, reactions which lead to strongly generalized fear. An anxious person shall react weakly, which may be easily noticed by another experimented person (a flight trainer or a cabin mate) due to the following signs:

- physical discomfort - expressed by sweat, nervous agitation, dryness of the mouth, heavy breath, palpitations and growth of heart frequency;
- improper conduct like laughing or singing during improper situations, careful self-control, over-cooperation, quick emotional changes, impulsivity or extreme passivity;
- changes of the state of soul, from welfare to depression;
- irrational conduct to other persons, useless fury, irritable and gross behaviour etc;
- tiredness - extreme and deep tiresome which may come from exposure to overloads for long periods of time;
- incorrect reasoning, weak focus or focus on one element only, detrimental to the other, incapacity to ordinate priorities, omission of points from the algorithm of operations (like the omission of the use of the flap at final closure or incapacity to perform routine control of the cabin).

A person in such status may undergo personality changes, a labile behaviour and improper attitude to the people around him/her which leads to low results. Manifestations may start with stomach- and headaches, tendency to drink, smoke and eat in excess. All this lead to premises of accidents. Anxiety is a dangerous disease for a pilot and it is extremely important for it to be lowered before the flight. It is recommended to consult the specialty physician, but, the best antidote is to remove the cause (if identified), as much as possible, and profound relaxation.

Circadian rhythm influences as well the metabolism. More than that, circadian rhythm and metabolism are closely related molecularly. Daily variations between awake/feeding /anabolism and sleep/post/catabolism are coordinated by the internal "clock" from the hypothalamus, connected, in its turn, to surrounding light. There are, in case of metabolism, secondary "clocks", represented by the liver, pancreas and adipose tissues, synchronized with the main clock, but unlike it, they are depending on the times of the meals, especially when it takes place during the rest period. Such clocks control metabolic processes. Metabolism and circadian rhythm are interconnected, and when deregulations appear at the level of the circadian rhythm, dysfunctions may appear as well at the level of the metabolism and the other way round. In case of dysfunctions of the circadian rhythm with an impact on metabolism, it is very possible for obesity to be enabled especially in case of persons working in shifts and where desynchronization appears. They presently develop the so-called approaches based on chrono-therapy which consist of following diets or using pharmaceutical remedies or natural synchronizers (like the daylight or meal time) in order to re-establish the normal circadian rhythm and to fight against metabolic risks.

The meta-analysis of the studies which regarded the administration of certain drugs taking into account the circadian rhythm of patients, concluded that some drugs have higher beneficial effects if administered in the evening (it is the case of corticosteroids, receptor blockants, ranitidine), while in the morning, we recommend the drugs inhibiting the production of gastric acid. In case of other drugs, there is no significant difference of effects depending on the moment of administration (for example, drugs inhaled for asthma). Other medicines have also been considered, but scientific evidence has not been enough in order to draw generalized conclusions. Additionally, there is a need for additional studies which shall catch the long time effect of drug administration depending on the circadian rhythm.



Implications of the circadian rhythm on the behaviour

Many institutions or companies assume work in shifts (emergency hospitals, production factories) which assume night shifts as well and/or which assume the change of shifts every few days. Under such conditions, the question arises as related to the changes occurring at the level of the circadian rhythm and its implications for the health of the persons working in shifts. The difference between night sleep and day sleep is that the latter is generally shorter by one hour, one hour and a half than the night sleep, therefore REM sleep being affected and the second step of the sleep. As related to circadian rhythm, the night shift is exposed to the lowest level of alert and energy state. Statistics show that generally the highest disasters due to human errors occurred during nightshifts (Chernobyl, explosion of the chemical factory from Bhopal, oil leakage from Exxon Valdez, Three Mile Island). The effects at the level of the health condition are reflected in chronic tiresome state, sleep disorders or express sleep. Universally, it is considered that a night shift which includes from four to seven nights is to be avoided as the individual may suffer due to lags it undergoes during each and every night shift, and when he/she starts settling into the night shift, they change again their schedule, making them experiment the worst of both systems.

“Jet Lag” disorder appears when the individual travels in an area with a time belt very different from that he/she is used to and consists of a conflict between the internal biological clock and the external clock of the concerned area. Travelling to the East is usually more difficult than to the West as it is easier to postpone sleep than to try to sleep before the time you are used to. Desynchronization between the rhythms of the body and the environment is connected to the transmeridian flights, and involve factors relates to age, flight direction, and number of time areas. Due to the work nature of plane pilots and

flight crews, which many times cross several time areas and light and dark regions in one single day, spending more hours both day and night, they are often impossible to keep a sleep schedule, which correspond to a normal human rhythm, this situation may easily lead to tiresome, sleep disorders, change in the state of spirit, stomach lesions and intestinal symptoms, as well as other health issues.

The studies performed related to circadian rhythm chronic perturbation for a group of flight attendants as compared to a group of professors, found that a travel to large differences of time belt during normal sleep hours led to the affection of both groups, with the specification that the group of flight attendants slept more than the group of professors, and their sleep was more disordered. Therefore, they concluded that the passengers after one flight recover in 1-2 weeks, but the members of the crew with higher exposure or sometimes continuous exposure present chronic perturbation signs of the circadian rhythm with possible harmful effects on their health. Such studies measured more psychological variables, including anxiety, tiresome and performance, besides physical and medical (skin temperature and heart rhythm), all this being correlated per age categories. The psychometric evaluation showed that circadian rhythm desynchronization affected all pilots, consistent effects being found as related to flight direction. Certain results showed as well variability related to age, with more accentuated influence in younger pilots.

The pilots or flight crew suffering from chronic circadian rhythm disorder may experiment one or more of the following symptoms: difficulty to stay asleep, and late in night insomnia, growth of dormancy during the day, general lack of energy in the morning, growth of energy in the evening or late in night, difficulties in staying focused, alert, growth of negative states. The most concerning symptom is, of course, tiresome. Tiresome itself is a very dangerous condition for each and every airplane pilot. Pilots' tiresome is usually characterized by:

- lack of awareness – radio calls or checks remained without answer;
- diminished motor skills - delayed reactions in case of weather reports when flying during rain
- obvious exhaustion – sensation of headache, drowsiness or eyes half open;
- diminished sight - focusing difficulties;
- slow reactions;
- short memory issues - incapacity to withhold long enough an authorization in order to repeat it or to accurately write it;
- focusing channelling - fixing attention on unimportant aspect and neglect of the others, important for the flight;
- easily distracted, or the opposite, impossibility to distract attention from one element, however, both extremes are dangerous and indicate tiresome;
- weak flight qualities – difficulties in focusing on on-board apparatuses, fixation on one of them and neglecting the others, diminished motor skills, weak coordination eye-hand, drowsiness;
- great mistakes, weakly reasoning, weak decisions or indecision;
- abnormal states of soul - from depressions to strange joy, diminished standards.

The activity of the airplane staff is developed in aerial environment, in a hostile and unpredictable space, adverse to the human being, highly complexity as related to the low survival possibilities in case of emergency or catastrophe. Chronic circadian rhythm disorders assume an additional cause leading to premature wear of aviators. As consequence of the flight activities development, this wear is also transposed in alterations of the structures and functions of the body, with direct effect on human reaction speed under conditions lacking of oxygen and low atmospheric pressures, factors

reducing, significantly, life duration as well. High psychic and physical wear leads to alterations of the spine and directly affects professional performances in case of emergency. Physical and chemical effects generated by flight conditions at high altitudes accelerate the biological ageing process and reduce the effort capacity. Dosimetric study of radiations during the flight, performed by international profile bodies, concluded that the level of radiations increases dramatically once with altitude, that the level of radiations doubles every 1.500 m altitude, and that the flight at altitudes of more than 11.000-12.000 meters represents very high risk. Morality amongst the navigating staff increased, during the latest years, by 32%, due to stomach, testicular, brain cancer, especially due to irradiation. Other professional diseases specific to flight staff are: premature ageing, discopathies, stomach diseases, heart, lung, blood diseases, andropause and menopause at premature ages, high stress, reduction of visual and hearing acuity, varied types of cancer of internal organs, breast cancer, leukaemia, premature births or infertility.

Effective management of such overloads starts with the recognition of its existence and the adoption of defence techniques in order to face usual requirements from life, related to profession, the way to reason and to act behaviourally (cognitive/behavioural techniques, relaxation, time organization). The identification of professional, extraprofessional and individual risks must be followed by the implementation of preventive measures categories, to avoid /reduce risk factors, to prevent mental, psychosomatic and behavioural disorders, to preserve the state of comfort and security as well as physical and mental health.

CONCLUSIONS

The human individual needs to face multiple temporal and other constraints: professional, familial, social in general, biological etc. There appear, in such background, temporal conflicts amongst the biological time, psychological time, social time and technical professional economical times, between work time and extraprofessional time. In case the individual does not succeed in adapting in relation to various temporal constraints, he/she does not find proper strategies to various fix times, often little or at all modifiable, like those imposed by work, they act as temporal aggressors leading to intra and interpersonal imbalances, with psychosomatic, psychic and/ or behavioural manifestations. In relation to the complex system of temporal constraints different in nature and depending on the limits of adaptive capacities of the human body, there may appear inadaptation / disadaptation, phenomena which, in case of excessive types of the lack of intra- and extra-temporal compliance, may lead to serious, irreversible disorders of the security and health state as prove of the harmful character of such type of constraints.

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