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***Effect of changes in time zones on the human body  
- jet lag syndrome***

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**Wpływ zmiany stref czasowych na organizm człowieka  
- jet lag syndrome**

Key words: jet leg syndrome, time zone, physiological reaction

Słowa kluczowe: jet lag syndrome, strefa czasowa, reakcja fizjologiczna

The development of intercontinental transport of air transport in particular has created conditions for the development of tourism on the scale previously unimaginable. Transformations can be seen especially in the last hundred years. Each decade results in the development of technology, improving technical solutions and thus

creates the possibility of accelerating the movement of tourists. Also, more and more countries open to travelers seeking new sensations and experiences. With the development of civilization and possibilities of movement followed by the development of aviation medicine and those disciplines that his research focused on human health. One of the problems that occur when air travel a transcontinental is jet leg syndrome.

**The aim** of the publication is to present the phenomenon of jet lag, its causes, methods of elimination, and show that complaints against the rapidly growing aviation market. The development is descriptive. The study used a method based on the analysis of source materials (used in studies of source), also made an analysis of a medical nature

### 1. STATE (PROCESS) TIME ZONE CHANGE

Jet lag syndrome is a process of several symptoms in the human body arise while traveling in the system latitudinal (EW) associated with the change of time zone. The globe is divided into 24 time zones, which correspond to 15 ° longitude. The severity of the team depends on the number of time zones crossed. Also important is the direction of travel. Pretending to the east, and thus in the direction that shortens the day, it is less worn than traveling in a westerly direction, which increases daily. stems from the fact that adaptation to the "long day" is easier for the human body. Jet lag desynchronosis medically termed, is a physiological state resulting from the rapid crossing of time zones which affect the body's circadian rhythm. Plays an important role phenomenon of day and night, that either through the brightness or darkness of human influence. The problem of jet lag affects passengers and tourists, is a particular burden for airline pilots and cabin crew. The rate of movement affects primarily the occurrence syndrome. Earlier, before the jets began to travel movement was stronger and more limited. Propeller planes and trains are slower, even with the use of modern technology and the improvement of transport. It also noted an increase in the number of trips, the frequency of movement, therefore the problem of jet lag affects more and more people. It is worth noting that long-distance travel on the course of the north - south do not cause jet lag syndrome. Exceeding one or two time zones does not cause jet lag. For example, 10-hour flight from Europe to South Africa does not produce the syndrome, but five hours flight from east to west in North America can cause those symptoms. Defeating from six to nine time zones causes the greatest problems. The change to three time zones causes only minor problems.

For the most common symptoms include sleep disturbances. Some people for many days after the return can not recover the balance of sleep and work. The hardest part is the first day. with the weakening arising from lack of sleep appears inability to concentrate resulting in extreme fatigue and tiredness. There are also eating disorders and gastrointestinal disorders. General malaise hampers the normal functioning at work. sometimes there is confusion and some kind of confusion. These symptoms are accompanied by a headache and drowsiness.

The cause of these disorders are disorders of homeostasis. They consist of disorders of physiological processes dependent circadian rhythm (sleep - wakefulness and work of the gastrointestinal tract associated with primary metabolism. Disorder is the secretion of hormones, mainly melatonin and cortisol.

In order to eliminate or alleviate symptoms is indicated acclimatization after arrival, consisting of a gradual adaptation to the existing difference of time. Sometimes, it is recommended that short-acting hypnotics during the flight and taking melatonin. Avoiding bright lights can accelerate the adjustment to the new time zone.

## **2. BIOLOGICAL CIRCADIAN RHYTHM (CYCLE FOR TRANSMISSION OF LIGHT INTENSITY, EXTERNAL SYNCHRONIZERS, PHASE OF SLEEP AND WAKEFULNESS, THE EFFECT OF LIGHT AND MELATONIN ON THE HUMAN BODY)**

In any living organism, including both the simplest single-cell, as well as more complex, such as a human, occurs continuously cyclically recurring certain physiological processes change. They fulfill a dual function in the human body, because in addition to being easy to adapt it to changes in the environment, it is thanks to them it can also predict what changes will come in the future and therefore, pursuant to prepare for them [20].

As the causes of biological rhythms lists the various factors. According to Bohdan Kielczewski [9] The reason this is innate and is located inside the body, and it controls the environment. On the other hand Baranski [4] draws attention to the existence in the body of the biological clock, which operate environmental stimuli, reaching him through the central nervous system and sense organs.

Generally, the cause of the biological rhythms, they are divided into two groups:

- 1) 1). Rhythms internal (endogenous) formed in the body, thanks to some internal stimuli and pursuit of the body to maintain balance and stability (breathing, heart rate), which by their automatism can more easily adapt to different stimuli from the environment,
- 2) The rhythms of external (exogenous) are formed through the body affecting the environmental and social factors, which in turn operate external synchronizers, such as light, temperature, pressure or humidity. For these rhythms are not also affect other external causes such as mealtimes, sleep, or work [16].

Almost every living organism occurs several types of biological rhythms, the rhythm namely annual, monthly - lasting 28 days and circadian rhythm also called daily activity, including interval 24 hours [17].

Each biorhythm is characterized by the following features:

- Cyclicity, which means that the nature of changes in the characteristics of the course is repeatable,
- Duration (in humans ranging from milliseconds to years)
- The difference between the minimum and maximum intensity of the characteristic [22].

Due to the duration of biological rhythms (from the ongoing shortest) we have:

- 1) micro-rhythms (pulsations enzyme systems),
- 2) meso rhythms (rhythm associated with cell division, pulse newborn or adult human, breathing, speech, etc.),
- 3) macro rhythms (daily, weekly, seasonal, annual, lunar, etc.) [6].

In adapting to ongoing changes in our bodies helps us to endogenous mechanism, known as the biological clock, which in combination with the Zeitgeber, or synchronizing external factor, produces biological rhythms in the human body, while subordinating them to the era of astronomy. [10] This also means that these rhythms do not arise naturally as a consequence of changes in lighting, which we perceive as day and night [19].

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Among the most common external synchronizers, affecting the internal rhythms and forming, together with the mechanism of endogenous circadian rhythm, which can be divided into the phase of sleep and wakefulness are mentioned:

- Light-dark cycle
- A cycle noise-silence
- A cycle of ambient temperature: the higher-lower
- A cycle feeding-fasting
- A cycle of professional activity-rest after work [22]

The circadian rhythm is an endogenous rhythm, based on automatism. It is regulated depending on the intensification of certain processes occurring in the body or phenomena in phase mode (bright time of the day) or lowering phase of sleep (dark time of the day). Remain subject to it: cell division, body temperature, duration of sleep and wakefulness, mood and mental capacity. This rhythm determines the time of Earth's rotation around its axis. [16].

Circadian periodicity, regulated by the suprachiasmatic nucleus (SCN) of the hypothalamus (located above the optic chiasm), the main biological clock, it takes but not exactly 24, and approximately about 24.2 hours. Through the external light cycle (day) darkness (night) however, it is synchronized to exactly 24 hours thanks to connections of the retina of the hypothalamus (Fig. 1) [12,13].

The main clock is located in the suprachiasmatic nucleus (SCN) has a dual function. On the one hand controls for synchronization of the sleep-wake cycle, on the other hand affects arousal, REM sleep and sleep consolidation.

Light, in turn, through a mechanism containing retinal ganglion cells, connected directly with the suprachiasmatic nucleus (SCN) on the road: the retina-the hypothalamus inhibits the oscillation.

Oscillation in the suprachiasmatic nucleus (SCN) also removes melatonin produced in the pineal gland, only during sleep, which indirectly also occurs Circadian information. In addition to this, along with the nervous, melatonin from the pineal gland may also act directly on the same sleep-wake cycle, and therefore the amount of light in collaboration with the circadian system can change its properties [18].

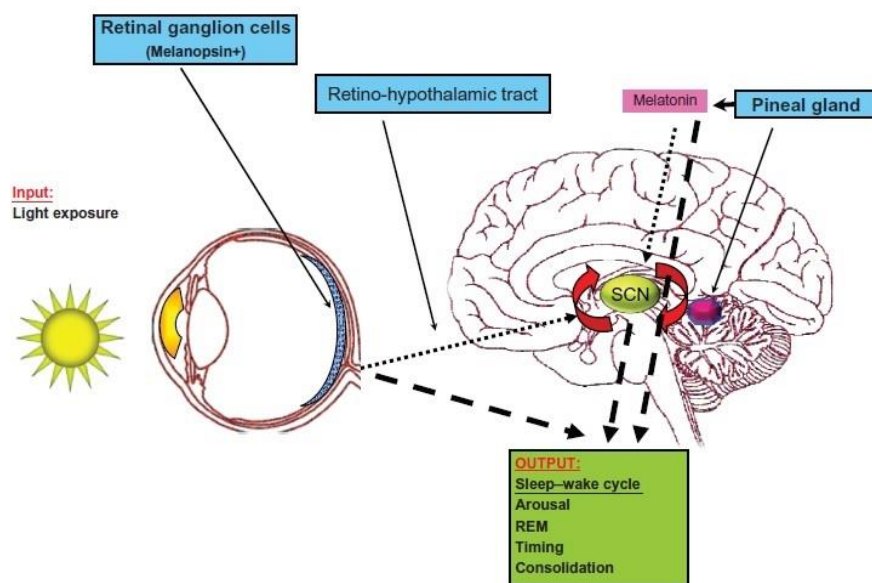


Figure 1. Cycle for transmission of light intensity [Source: 18]

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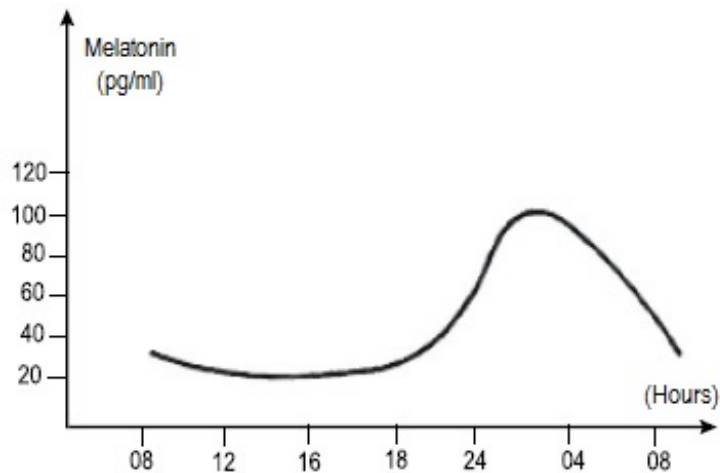


Figure 2 Diurnal secretion of melatonin [Source: 7]

The rhythm of melatonin secreted (fig. 2) in the body is a circadian rhythm, the internal clock is created by biological and is conditioned by cycling lighting during the day [7].

Profile of circadian melatonin secretion is not constant, but is repeated in individuals and, together with the rhythm of locomotor activity, characterized by a clearly among other circadian rhythms.

Adequate knowledge of the rhythm of melatonin can help create new methods in the treatment of sleep disorders. For if it is administered at a certain time, it helps if the clock biological [20], which is extremely important for those in certain occupations.

The problem occurs because when the body does not get the information from the environment by alternately occurring after a day and a night, or a mismatch between the internal clock and the external synchronism, for example, in the case of persons working on the night shift, in which the conversion occurs in daily activity, when the instead of sleep at night, followed by psychomotor activity and vice versa. Then decide for conditional genetic cycles, which are usually longer than the astronomical day. As demonstrated by research conducted among cavers, polar explorers and people who are blind, then the day may be extended up to approximately 25 hours [21]. Such rhythms can be described as drifting or slow-running (free running) [2].

Travel through several time zones results in a similar situation as in the case of those working the night shift, in which the environmental synchronizers no longer interact with individual biological rhythm. He can not, therefore, immediately adapt to the sudden change of external synchronizers, which causes short-term desync or a mismatch between the organism and the environment. Light is in fact considered as the strongest synchronizer of biological rhythms [15].

It is generally believed that the light has a greater effect on the circadian rhythm, rather than temperature [8]. What's more, it affects two possible ways. Phase can either accelerate rhythm, in the case where the light stimulus occurs during the second half of the night, or delay, in turn, when the stimulus will work in the first half of the night [14].

In addition, the light stimulus must be sufficiently severe or last long enough. Very well is visible in the case of the circadian rhythm of melatonin. When in fact the night, a man is exposed to the light, almost immediately is reduced or even halted production of melatonin in the body, which in turn can result in the phase shift of its circadian rhythm [1].

### **3. TIME ZONES AND THEIR IMPACT ON BIOLOGICAL RHYTHMS CROSSING**

In the world we distinguish 24 time zones, located at 15 degrees longitude, thus differing from each other by one hour. The division start from the zero meridian runs through Greenwich, England town, which was subject to Western European Time-GMT (Greenwich Mean Time). Moving east of this meridian we are in time zones earlier than GMT, while driving west will force us later time from Greenwich.

For the proper functioning of physical and mental human, it is necessary to synchronize the circadian rhythm, particularly phases of sleep and wakefulness, the environmental cycle: day-night [10].

Changing the time zone while shifting biological rhythm in relation to the local Zeitgeber, resulting malaise, sleep disturbances, loss of the possibility of effective thinking, annoyance and general fatigue, persisting even through the first week after arrival until the biological rhythm is not flush with the external Zeitgeber [3]. The situation is further complicated by the fact that each of the functions of the body working at its circadian rhythm, and, what is more, has a separate time to systematize the relationship, both with internal rhythms and with the cycle of environmental day-night. This means, moreover, that even a small physiological change can affect the whole process and the differences in the time it needs each passenger traveling by plane to adapt to local conditions. It is especially difficult for the elderly, in whom temporal organization of physiological processes is incomplete, so they are significantly exposed to prolonged internal desynchronization caused by a sudden change in the time zone [11].

Physiological problems often associated with the crossing several time zones can affect anyone, whether younger or older. If, however, people traveling privately, to visit family or friends or see and experience new places, usually can not afford to regeneration, whereas in the case of business travel, this is often impossible. An example would be soldiers, seafarers or pilots who may simply not have time to adapt to the new conditions, which is nevertheless necessary for effective action [15]. The same situation can also be applied to athletes traveling around the world, which happens to achieve poor results in the competition, just the discomfort associated with the change of time zones - psychophysical disorders [24]. Therefore, it may be helpful here knowledge of circadian rhythms, as research shows, periods of

greater efficiency of operation, are synonymous with greater exercise capacity, and hence, achieving better results in sport [16].

Blecharz [5] believes that the body reacts in a different way in the case of flights along the parallels (on the east-west or west-east) and meridians (the north-south direction). In the first case we are dealing with desynchronization of circadian rhythms, while in the second, they remain unchanged in relation to the place of permanent residence, and you need to turn to acclimate to the new thermal conditions.

**How to prevent jet lag?**

Josephine Arendt [2] in order to avoid the disadvantages associated with the change of time zone, it is proposed procedure according to the following scheme (Fig. 3).

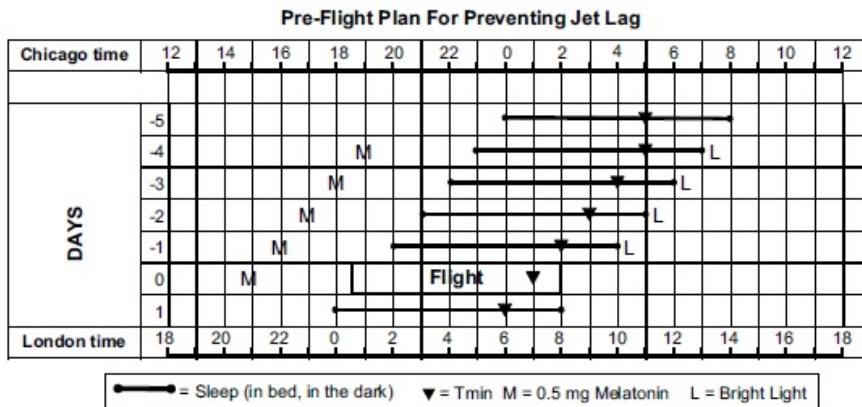


Figure 3: The plan to prevent debt team time [Source: 2]

The above chart is to present the way of conduct aimed at counteracting the effects associated with the "team of temporary debt", for example flight eastward from Chicago-London, for 6 zones.

- Day -5 (ie, 5 days before the scheduled departure) shows the distribution of bedtime and its minimum (T min.) For young people,
- Day -4: 5 hours before the founded time to sleep, to move the phase is administered 0.5 mg of melatonin, and sends the wake of bright light pulses,
- Every other day schedule is shifted by one hour earlier,
- The first night after arrival minimum sleep time should already be shifted to the range allocated for sleep.

Flight, as is the case with most flights to Europe to the United States, afternoon begins and ends in the morning. As the clock should be shifted, the light access is only possible after T min, thus helping resynchronization.



#### **4. CHARACTERISTICS AND DEVELOPMENT OF THE AVIATION MARKET IN THE WORLD IN THE CONTEXT OF JET LAG SYNDROME**

In 2012, there was an increase in passenger service in relation to 2011 of 6.72%. Number of passengers increased to nearly 3 billion. It is worth noting that since 2009, despite the economic crisis, the growth of air traffic continues to grow. According to IATA transport of passengers increased by 5.3% compared to 2011. Growth in 2011 was higher compared to 2010, was 5.9%. Number of foreign travel has grown faster than domestic travel, respectively, 5.4% and 4.1%. The largest increase in traffic recorded Middle East countries. The greatest growth of domestic traffic recorded while China (9.5%) and Brazil (8.6%). The supply of airline seats has increased by 3.9%. Average global rate of filling the plane (load factor) increased by 0.75% and amounted to 79.1%.

In terms of transport performance largest region in 2012 were Asia-Pacific region, up to 30% of the total (tab.1).

Table 1. The development of air services market in 2012, in relation to 2011 [23, p.11]

	Transport of passengers in terms of km (in%)	The supply of seats per km (in%)	Load factor (w %)
International transport	6	4	78,9
National transport	4	3,8	79,5
Total	5,3	3,9	79,1
Africa	7,2	6,5	67,7
Asia and the Pacific	6	5,2	77,5
Europe	5,1	2,9	79,6
South America	9,5	7,5	76,1
Near East	15,2	12,4	77,5
North America	1,1	0,1	82,9

The biggest carriers are Delta Air Lines, Southwest Airlines and Lufthansa. Statement of the largest transport companies with the number of passengers is presented in table 2.

Table 2: The biggest air carriers in the world in 2012. [Source: 23, p 11]

O.n	the carrier	Number of total in millions
1	Delta Air Lines	164,5
2	Southwest Airlines	133,9
3	Lufthansa Group	103
4	United Continental	93,5
5	China Southern	86,4
6	American Airlines	86,3
7	Ryanair	79,6
8	Air France - KLM	77,4
9	Lufthansa	74,7
10	China Eastern	73
11	Air China Group	72,4
12	Latam Group	64,9
13	easyJet	59,2
14	SkyWest	58,8
15	IAG Group	54,6

Great importance to destinations, as previously indicated they to a great extent determine the presence of symptoms of jet lag. Among the 15 largest airports in the world, all except Djakarta in Indonesia are located in the northern hemisphere (tab. 3).

This shows that the vast majority of travel between airports has run east - west. Therefore, passengers are exposed to the occurrence of symptoms of jet lag.

Table 3. Biggest airports in the world in 2012 [source: 23, p 12]

O.n	Airport	passengers (in millions)	Growth (in%)
1	Atlanta	95,5	6,92
2	Pekin	81,9	10,88
3	Londyn Hethrow	70	6,31
4	Tokio	67,7	5,8
5	Chicago	67	0,64
6	Los Angeles	63,7	8,1
7	Paryż	61,6	5,92
8	Dallas	58,6	2,96
9	Jakarta	57,7	12,03
10	Dubai	57,6	22,26
11	Franfurt	57,5	8,51
12	Hong Kong	56	11,22

O.n	Airport	passengers (in millions)	Growth (in%)
13	Denver	53,1	1,81
14	Bangkok	53	10,63
15	Singapur	51,1	9,97

According to forecasts of the development of the largest producers of an aircraft (Airbus Industrie and Boeing Corporation), it is assumed that air transport is the wave of falling, but the coming years are expected to bring some improvement. Over the next 20 years the world economy will grow at a rate of 3.2% per annum, and air traffic during this time will be increased by 5% [23].

Based on these data, it is noted that the jet leg ailments will become deeper. The more that comes out every year traveling long distances. This also applies to Polish tourists who are increasingly interested in exotic travel.

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#### **ABSTRACT**

Jet lag syndrome, seemingly imperceptible - a significant ailment while traveling in the system transcontinental east - west. The problem, according to the analysis of air traffic will grow in the coming years. Discomfort, lack of sleep, fatigue and weariness flight affect the normal operation of airline passengers. Looking at the types of tourism, you will see that every segment of the community is affected by this problem. Suffer athletes taking part in the competition. In this case it is necessary acclimatization and adaptation to the optimal conditions for the new time zone.

Tourists also explore implementing the program in the first days are not fully focused on watched attractions. business segment, realizing short-term travel passes like trouble. The employees and stewards airlines should be approached with greater concern for passengers. Also, not all tourists are aware of emerging problems, which is why it is also important publishing and promotion. Education passengers and potential visitors should begin before boarding an aircraft. Such operations can significantly alleviate the psychological burden on air travel and have a positive impact on the health of travelers psychophysical.

### **STRESZCZENIE**

Jet lag syndrome, pozornie niedostrzegalny - stanowi znaczącą dolegliwość podczas podróży międzykontynentalnych w układzie wschód - zachód. Problem, jak wynika z analiz ruchu lotniczego, będzie w najbliższych latach wzrastał. Odczuwany dyskomfort, brak snu, zmęczenie i znużenie lotem wpływają na normalne funkcjonowanie pasażerów linii lotniczych. Przyglądając się rodzajom turystyki, widać, iż każdy segment podróży dotknięty jest tym problemem. Cierpią sportowcy biorący udział w zawodach. W tym przypadku konieczna jest aklimatyzacja i przystosowanie do optymalnych warunków nowej strefy czasowej. Turyści realizujący program zwiedzania również w pierwszych dniach nie są w pełni skoncentrowani na oglądanych atrakcjach. segment biznesowy, realizujący podróże krótkoterminowe przechodzi podobne kłopoty. Pracownicy i stewardzi linii lotniczych powinni z większą troską podchodzić do pasażerów. Również nie wszyscy turyści są świadomi pojawiających się problemów, dlatego ważna jest również działalność wydawnicza i promocyjna. Edukacja pasażerów i potencjalnych turystów powinna zacząć się jeszcze przed wejściem na pokład samolotu. Takie czynności znacznie mogą złagodzić obciążenia psychiczne dotyczące podróży lotniczych oraz pozytywnie wpłynąć na zdrowie psychofizyczne podróżnych

*Artykuł zawiera 27370 znaków ze spacjami + grafika*