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INJURIES AND TEAM SPORTS

PLANNING STRATEGIES FOR TEAM TRAVEL

4.2 Planning Strategies for Team Travel

Planning Strategies for Team Travel

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The team sports physician must adapt his knowledge to the new demands imposed by the globalization of professional sports. One of the demands of this kind of globalization is planning long-distance travel, which involves long flight times and crossing different time zones. This can be a source of different health problems, which is why we must adopt sufficient preventive measures to ensure that the athlete's performance capabilities are not affected.

The trigger for these changes in the athlete's performance after a long journey has a twofold origin. On the one hand, the means of transportation, in this case an airplane, where the hypoxic conditions in the cabin, transmission of infectious diseases, fear and anxiety aroused among some team members, and possible venous thromboembolism episodes (VTE), should be well controlled in order to mitigate their effects to the greatest extent possible. And on the other hand, we have jet lag, resulting from crossing several time zones, which disrupts our internal clocks and alters some of the rhythms of our body such as the sleep-wake cycle, which has significant impact on sports performance. Given the limited text space that we have, we will focus on two fundamental aspects: jet lag and preventive measures of venous thromboembolism episodes for long distance trips.

Jet lag

Globalization in the world of sports has contributed to the creation of supranational leagues, which has forced teams to make long journeys and cross different time zones in a short time span. Basketball or soccer leagues are a good example of this: Russian teams participate in competitions that are sometimes located more than 6-8 hours away from their place of origin. This causes alterations in the internal rhythms of our body, which affect athletes' performance.

The disruption of the body's homeostasis that occurs when we make a journey across different time zones is what we call jet lag (Waterhouse, Reilly, & Atjinson, 1997). This desynchronization between our endogenous rhythms and the exogenous rhythms of the new time zone (for example, the light/dark cycle) provokes a series of disorders such as: difficulty achieving and maintaining sleep (60-70%), difficulty concentrating, irritability, fatigue, time-space-distance disorientation, dizziness, loss of appetite, lack of motivation and gastrointestinal disorders. The prevalence of these symptoms will depend on each individual, the type of activity to be performed and the time of day: sleep-related problems will prevail in the morning, while at noon the difficulty will be concentrating (Waterhouse, Nevill, Edwards, Godfrey, & Reilly, 2003).

In addition to these organic symptoms, there is also an impact on sports performance both in training quality and performance during the competition. It is difficult to know the exact incidence of this desynchronization on sports performance capabilities, just as it is difficult to assess the influence of physical exercise on biological clocks (Edwards, Lindsay & Waterhouse, 2005).

Another aspect that should be added to the disruption of the internal clock is the fatigue caused by long trips,

> because of the conditions of the structure of the cabin in which passengers are seated (seats with reduced space or tourist syndrome, immobility), and because of environmental conditions (dry cabin air that tends to produce a certain degree of dehydration), bureaucratic customs procedures, materials and luggage inspections, etc. (Gorostiaga Ayestarán and Olivé Vilás, 2007, p. 49).

The science that studies the structuring of biological cycles and their manifestations in life is chronobiology. The father of clinical chronobiology and human biorhythmology is J. Aschoff, who in 1959 published several works after submitting different individuals to cosmoclimatic isolation. He is the one who introduced the term zeitgeber to refer to those environmental elements that man uses to delimit and periodize his biological rhythms. Biological rhythms are not imposed by the environment, but are adjusted by it; is the so-called exogenous synchronization (light/dark, presence of food, etc.). (Gorostiaga Ayestarán, E. and Olivé Vilás, R.,2007)

Chronobiology divides the population into three large groups of rhythm personalities or chronotypes: a) morning people, who get up and go to bed early (in Anglo-Saxon literature they are called "larks"); b) evening people, who go to bed and get up late (in English language literature they are called "owls") and c) those who are indifferent. Between the first two chronotypes there is a difference of approximately 65 minutes in the appearance of peak body temperature rhythm. Morning people secrete more adrenaline in the morning than evening people. In addition, frequency, mode and rhythm of activity differ by several hours between the two groups.

Athletes over age 50 tend to be morning people more often than young athletes. This is important when designing training programs and workloads. Circadian rhythms show a higher amplitude in trained individuals than in sedentary individuals. (Gorostiaga Ayestarán and Olivé Vilás, 2007, p. 49).

We do not know all of the exogenous factors that influence the human internal clock, but one of the most important of them is the light/dark cycle, which is capable of affecting all the others. Light stimulates the retinohypothalamic tract and directly acts on the CNS (central nervous system), and especially on the pineal gland, thus inhibiting the secretion of melatonin. Light must be relatively intense (bright) and long-lasting in order to be a regulating factor. (Gorostiaga Ayestarán, E. and Olivé Vilás, R.,2007)

> Ingesting a certain food group constitutes another factor; for example, consuming high doses of protein in the morning should increase the concentration of thyroxine, which would favor the synthesis and discharge of norepinephrine (neurotransmitter) and dopamine, which in turn would activate the CNS. Conversely, meals with a high concentration of carbohydrates facilitate the increase of tryptophan concentration in plasma, and thus the synthesis and discharge of serotonin, a neurotransmitter that has a prominent role in the regulation of sleep and is a precursor of melatonin. (Gorostiaga Ayestarán and Olivé Vilás, 2007, p. 49).

Biological rhythms

What do we mean by biological rhythm? It is the biological change that occurs over time, in the form of a periodic wave, and which is repeatable. These biological rhythms are closely related to environmental factors.

The human body presents a series of rhythms called endogenous rhythms, which are characterized by variable periodicity. Those with a duration of 20 to 28 hours are called circadian (appear near the end of the day), rhythms of less than 20 hours are called infradian, and those which have a duration longer than 28 hours are called ultradian.

Physiological parameters in a circadian rhythm are influenced by changes in human behavior and in the environment in which the athlete develops. One example of this is the behavior of human society, which has its peak activity period during the day, when temperature and luminosity levels are higher.

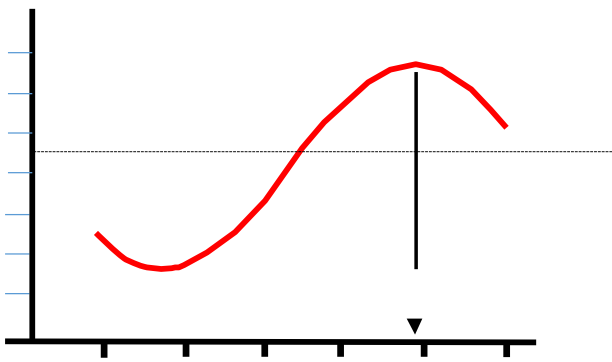
These exogenous factors are able to interrelate with physiological rhythms and modulate them, but they cannot condition them completely, while endogenous factors, commonly referred to as the biological clock, are capable of modifying them. We can see that biological rhythms are maintained during the first few days when an individual is placed in an isolation chamber and deprived of sleep, in the initial period of time zone changes or in people who start working night shifts. It takes several days for the individual to completely adapt to the new environment (Minors & Waterhouse, 1981).

Where is an individual's endogenous clock located?

The endogenous clock is found at the level of the suprachiasmatic nucleus of the anterior hypothalamus (CNS), near the optic chiasm. Were it not for the constant adjustment ensured by a series of factors called general modulators (zeitgebers), which are directly or indirectly influenced by environmental factors, its periodicity would be greater than 24 hours (Minors & Waterhouse, 1981). Mammals provide an example of this with their own cycles of light/dark, availability/unavailability of food, activity/inactivity and social influences alone or in combination, which would be able to modulate the biological clock.

Central temperature

Figure 1: Circadian rhythm of rectal temperature with the terms used to describe biological rhythms



Source: Retrieved from Reilly (1995)

Body temperature fluctuates during the day: it increases before waking up and reaches its peak value towards 6 o'clock in the afternoon, and then decreases until 4 o'clock in the morning, the lowest body temperature point (Figure 1). It seems like these changes are related to changes in the daily secretion of noradrenaline.

The main factors that influence temperature are sleep and exercise.

The core temperature of the body (rectal temperature) and the surface temperature (skin) do not show rhythmic changes when doing exercise (Reilly & Brooks, 1986).

Heart rate, blood pressure and respiratory rate

Resting heart rate tends to fluctuate throughout the day: it reaches its peak value at 3 o'clock in the afternoon, with a daily range of variation between 5 and 15%. The same happens with other parameters of heart function, such as: ejection volume, cardiac work, blood pressure and blood flow. Ejection fraction and blood pressure are influenced by external factors such as posture, sleep, diet and physical activity.

It is demonstrated that blood pressure has a neuroendocrine regulation role associated with sleep. A drop in blood pressure occurs after lunch, followed by a peak in the afternoon. This phenomenon appears more clearly in patients who take naps and in those who experience a greater pressure drop after eating (the elderly) (Zulch & Hossmann, 1967).

Blood pressure and heart rate show a rhythmic oscillation throughout the day, but it is difficult to identify these variations when they are subject to the influence of physical exercise (Callard et al., 2001, Descheneset al., 1998).

Two indicators of airway resistance, such as forced expiratory volume and peak expiratory flow, vary throughout the day and reach their minimum level between 3 and 8 o'clock in the morning.

Gastric and urinary function

The gastric emptying rate of solid foods is 50% faster after breakfast than after dinner (8 p.m.). But we do not know if the emptying of isotonic drinks is faster in the morning or in the afternoon during exercise.

Urinary function presents a peak of elimination of electrolytes in the afternoon (4 p.m.) (Robertson, Hodgkinson & Marshall, 1977).

Hormone secretion and subjective mood

> Both cortisol and growth hormone (GH) present secretion peaks at night during sleep. Both hormones are influenced by the quality of sleep and this is, in turn, is influenced by physical exercise.
>
> The peaks in catecholamine levels appear at noon (12 p.m.). Variations of this rhythm can be observed through changes in the individual's excitability levels. (Gorostiaga Ayestarán and Olivé Vilás, 2007, p. 52).

Melatonin has a circadian rhythm: its peak appears around 9 p.m., and then it decreases until 8 a.m. Darkness promotes the secretion of melatonin, and one of its effects is vasodilation, which supposedly induces heat loss, as well as the delay of other functions that would prepare us for sleep.

Melatonin is an internal "modulator" that acts similarly to light, but the other way around. Light stimuli tend to slow the secretion of melatonin.

We know that the secretion of melatonin is influenced by exercise, but whether it produces a stimulating or inhibiting effect remains unclear. The studies conducted seem to show that the state of wakefulness and a good mood are produced upon awakening. This good mood and excitement is important for sports performance, for the predisposition to physical work, group work and the cohesion of the team (Atkinson, Greeves & Cable, 1995).

Athletic performance

> Circadian rhythms are believed to have some kind of relationship with physical performance, because many of the parameters that determine athletic performance present a synchronism with the circadian rhythm of internal body temperature. (Gorostiaga Ayestarán and Olivé Vilás, 2007, p. 54).
>
> Therefore, peak strength of the muscles in the back, legs and arms, anaerobic power, the long and vertical jump and

> endurance capacity all present their maximum peak at 6 p.m. The same applies to flexibility.

> If we analyze what time of day peak performance is attained in different competitions, we will see that most sports records have been beaten in the early afternoon, when body temperature is at its highest. (Gorostiaga Ayestarán and Olivé Vilás, 2007, p. 54).

We need to be cautious when asserting that this is all due to circadian rhythms, as other factors must also be taken into account, such as environmental factors (wind speed, temperature, altitude, etc.), which can have a significant impact (Drust, Waterhouse, Atkinson, Edwards & Reilly, 2005).

Psychomotor performance

Reaction time reaches its maximum peak in the afternoon, coinciding with maximum body temperature. This could be explained by the fact that the increase in body temperature facilitates nerve transmission (Winget, De Roshia & Holley, 1985).

For exercises in which balance is an essential aspect, such as that of the unstable plate and the balance beam, the best results are achieved in the morning (Atkinson, Todd, Reilly & Waterhouse, 2005).

> There is an inverse relationship between speed and accuracy of execution. Therefore, athletes who practice high precision sports (shooting, golf, etc.) are expected to achieve poorer performance in the early afternoon. (Gorostiaga Ayestarán and Olivé Vilás, 2007, p. 55).

As concerns recent memory and mental calculation, higher performance is achieved in the early morning than in the afternoon. However, this strongly depends on the characteristics of the task to be performed (Winget et al., 1985). Long-term memory or "retention memory" (data that must be retained for a period of 1 week or more) is 8% more effective when studying or presenting data in the time slot from 3:00 p.m. to 9:00 p.m.

It should be noted that there is significant individual variability in the daily rhythms of the previously analyzed variables (different chronotypes). Moreover, with age, the amplitude and length of daily rhythms is reduced. It is not clear whether this difference observed over time is due to the internal clock's aging process or to the changes in sleep rhythm that occur with age.

Effects of time change on athletic performance

There are a number of factors that can help predict the greater or lesser impact that this time change may have on athletic performance:

- Flight direction: the time needed to adapt one's physical condition to the time change is approximately one day for each hour of time difference (Reilly, 1982). In general, we can say that when we travel east, it is more difficult to fall asleep at the local time; conversely, when we travel west, those who wake up early are the ones who experience difficulties.
- Individual variability: in one same individual, how the different endogenous cycles adapt to the time change varies, and they do not all adapt at the same time. For example, it would appear that the sleep-wake cycle is the first to adapt, followed by body temperature (Lemmer, Kern, Nold & Lohrer, 2002). It is harder for women and the elderly to adapt than men and young people (Moline et al., 1992). Evening people adapt better to trips towards the west than morning perople do to trips towards the east (Baehr, Revelle & Eastman, 2000). Individuals who are in better physical shape and less anxious adapt better than those who are in worse physical condition and more anxious (Van Someren, Lijzenga, Mirmiran & Swaab, 1997).

A previous experience or the season of the year may also have an impact. Indeed, it is easier to adapt to the time change when traveling in summer time.

Bearing in mind circadian rhythms can prove helpful when planning tasks that require faculties such as endurance, mental agility and physical strength. This benefit can reach 10% of sports performance. We must bear in mind that a 10% decrease in sports performance occurs after a night's sleep of less than

3 hours, after consuming alcohol up to the legal limit or after ingesting barbiturates (Folkard & Monk, 1983).

Measures to reduce the negative effects of time change

Before leaving

The athlete should be informed of the possibility that these symptoms may appear, and how to prevent them. A solution for traveling east is to try to start going to bed earlier, to adapt little by little to the time in the place we plan to travel to. Conversely, if the trip is made to the west, we should try to go to bed later.

It is important to sleep well the night prior to departure, at least 8 hours, to start the flight as well rested as possible.

During flight

As soon as you board the plane, it is advisable to change the time on your clock and adjust it to the time at your destination. Avoid drinks like coffee or tea, as they cause dehydration.

To alleviate or avoid problems associated with remaining seated at all times, it would be helpful to perform some arm, trunk and leg stretching exercises that can be done without needing to stand up. It would also be advisable to take frequent walks up and down the aisle of the plane; this will help the athlete stay awake. These stretching and mobility exercises should be performed every 2 hours. It is also advisable to use progressive compression socks, preventing an excessive amount of blood from accumulating in the legs.

It is advisable to drink liquids on a frequent basis, especially water, and to avoid consuming alcohol, Coca-Cola or coffee, given their diuretic (dehydration) and exciting effect on the Central Nervous System (which should be avoided if sleep is desired). The aircraft cabin has very dry air that will promote dehydration.

Meals or dinners should be light, because you will not move much. (Gorostiaga Ayestarán and Olivé Vilás, 2007, p. 65).

Just making it to the destination

“On flights towards the east you should avoid exposure to sunlight in the morning, and try to expose yourself to sunlight in the afternoon. This is how you can adapt more quickly to the time change "(Gorostiaga Ayestarán, and Olivé Vilás, 2007, p.65).

Even if this advice is strictly followed, generally speaking, it will take approximately 1 day per time zone crossed to adapt. So, if the place we are traveling to has a time difference of 5 hours, it will take at least 5 days to regularize our internal clocks.

Programming training loads during this period should be adjusted more to our athlete's state of adaptation than to the competition schedule.

During this phase of adaptation, diet should prioritize the abundant intake of carbohydrates for dinner, while avoiding the intake of alcohol and drinks containing caffeine or theine in order to encourage sleep. "You should also insist on drinking plenty of fluids. Breakfast should contain a high proportion of proteins to promote a state of wakefulness" (Gorostiaga Ayestarán and Olivé Vilás, 2007, p. 65).

"It is important to avoid sleep outside of suitable hours (for example, mid-morning or mid-afternoon), but in case of need (excessive fatigue, recovery of loads), short naps (no more than 2 hours) may be permitted" (Olivé, 2002)

How can we reduce time change symptoms?

In addition to the measures described above to try to reduce the symptoms associated with time changes, appropriate composition of diet and sleep schedule (Gorostiaga Ayestarán, and Olivé Vilás, 2007, p.65), there are other methods that we are going to outline.

Phototherapy

"Phototherapy consists of exposing an individual to an intense source of light during a given period of time, to try to delay or fast-forward a subject's circadian rhythm and thus adapt it more quickly to the time change" (Gorostiaga Ayestarán and Olivé Vilás, 2007, p. 65).

The studies conducted to date on this therapy are not conclusive. As indicated in the Consensus Report for Light Treatment, more studies should be conducted to determine the appropriate parameters of light intensity, exposure time and flight situations that are effective in accelerating the adaptation to time changes (Boulos et al., 2005).

As a general statement, for trips to the east, athletes should be exposed to intense light in the afternoon and should avoid it in the morning.

Substances that stimulate wakefulness

The most commonly used substances to stimulate wakefulness are: amphetamines, promolin, modafinil and caffeine. The only one of them not included in the list of prohibited substances is caffeine; it is the only one that is advisable to take, if it is needed.

Caffeine facilitates wakefulness and the development of mental tasks. It could be ingested if the athlete does not adapt well to the new schedule, to maintain wakefulness and prevent the athlete from falling asleep at times he should be awake. However, we must remember that ingesting caffeine in high doses can cause difficulties falling or staying asleep during normal sleeping hours, which may negatively affect one's adaptation to the time change. (Gorostiaga Ayestarán and Olivé Vilás, 2007, p. 66).

Chronobiotics

These are drugs that act on some biological element of the circadian rhythm structure that, if taken at an appropriate time of the day, can promote a quicker adaptation to the time change. The two most popular supposedly chronobiotic drugs are benzodiazepines and melatonin.

Benzodiazepines act on the GABA receptors of the Central Nervous System, promoting sleep. Some authors take advantage of this effect on the biological clock to stimulate a faster adaptation to the time change. The most commonly used benzodiazepines are Diazepam (not recommended because its effects last from 24 to 48 hours), Lorazepam (whose effects last for more than 10 hours) and Zaleplon (with a shorter half-life and fewer side effects). But they do have side effects, such as decreasing the state of wakefulness and psychomotor performance, which are not good for the athlete.

Melatonin has hypnotic properties and a vasodilator effect that causes body temperature to decrease. It also accessorily stimulates the humoral immune response through interleukin-4 and other cytokines, and is a powerful free radical scavenger. When taken before bed (around 8 p.m. local time), it promotes sleep; thus it could be used to stimulate adaptation to the time change. Plus, it does not have many side effects on one's physical condition the next morning, although it usually produces a feeling of fatigue. (Gorostiaga Ayestarán and Olivé Vilás, 2007, p. 66).

There are different scientific studies such as Claustrat, Brun, David, Sassolas & Chazot (1992) and Lagarde et al. (2001) that show that ingesting melatonin may benefit this resynchronization of biological clocks. If one decides to follow a melatonin treatment, then the purity of the product should be checked and it should be purchased from accredited centers, otherwise its purity is not guaranteed. The best effect is obtained in doses of 2-5 milligrams (doses greater than 5 milligrams do not improve symptomatology) taken shortly before bedtime in the destination location. Treatment should start on the day of travel and at bedtime in the new location and should be followed for the first two and four days at the destination location. It should be noted that ingesting melatonin is contraindicated in people taking warfarin oral anticoagulants and those suffering from epilepsy (Herxheimer & Petrie, 2002).

Physical exercise

As previously mentioned, there is evidence that physical exercise can act as a regulator of the internal clock. We know that individuals who do physical exercise continuously demonstrate a greater ability to adapt to schedule changes. Athletes also adapt better when they train from the very first day after their arrival to the destination. In the case of a trip to the east, the best time to train on the first day is in the afternoon, and not in the morning, because by doing exercise in the afternoon, after the drop in body temperature, the biological clock fast forwards, which is what needs to happen in order to adapt to the time change when traveling to the east. (Gorostiaga Ayestarán and Olivé Vilás, 2007, p. 68).

Troembolism syndrome on long-distance flights

Thromboembolic events (VTE) are directly related to the duration of the flight (more than 8 hours) (Chandra, Parini, & Mozaffarian, 2009).

The risk of suffering a pulmonary embolism (PE) on the day of arrival after a long flight is 0.5/1 x 6 and increases to 27/1 x 10 PTE (deep vein thrombosis, DVT, or PE) during the first 14 days following arrival (Lapostolle et al., 2001).

The estimate is 1.1 PTE per million people per day, a figure that is very close to the incidence of this disease in the healthy population, which is 1.9-5.2 people per million per day. If we are very rigorous and perform an ultrasound study on passengers of long-haul flights, the diagnosis of DVT increases to 3-12% (Huges et al., 2003). This discrepancy between the figures is due to the fact that asymptomatic DVT is 5-20 times more frequent than symptomatic episodes.

Risk factors

The risk of suffering an episode is 18% higher for each 2-hour increase in the duration of the journey, and is even 26% higher (per 2h) when the journey is exclusively made by airplane (Chandra et al., 2009). The realistic risk of symptomatic events in passengers over age 50 is 1/600 for flights longer than 4 hours, and 1/500 for flights longer than 12 hours (Geerts, Bergqvist, & Pineo, 2008).

Seven VTE risk factors related to air travel (both for tourist class and first class) or travel by car, train or bus, have been identified:

1) The duration of long flights (more than 6 hours): the risk increases by 2.3 times compared to shorter flights (Chandra et al., 2009).
2) Over age 40 (45% of the 126 DVT cases) (Philbrick, Shumate, Siadaty & Becker, 2007).
3) Females (three times as likely as males) (Lapostolle et al., 2009).
4) Women who take oral contraceptives (OA) or hormone replacement therapy (HRT).
5) Varicose veins of the lower limbs (Philbrick et al., 2007).
6) Obesity (BMI> 30, Philbrick et al., 2007).
7) Genetic thrombophilia (Philbrick et al., 2007). High levels of coagulation factors II and VIII (Kuipers, Cannegieter, Doggen, & Rosendaal, 2009).
8) Other risk factors, such as tall stature, short stature, and so on.

Etiology

On most commercial flights, there is a degree of hypoxia in the cabin comparable to living at an altitude of 1800-2400 m. This is because maintaining the ideal air pressure difference between the interior and exterior compartments would require a large amount of fuel, which would add weight to the aircraft. These conditions of hypoxia are dangerous, especially for patients with chronic cardiovascular or pulmonary diseases (Silverman, & Gendreau, 2009), which probably play a role in the activation of the coagulation system during air travel (Mohr, 2008).

Air flights longer than 8h long significantly increase procoagulant activity in 17% of healthy people, and in particular in those who present thrombophilia, or in women who use contraceptives or hormone replacement therapy.

On top of that, the space available to move about in tourist class is considerably reduced, which causes venous stasis and procoagulant activity to increase. Immobility during the flight is related to almost 75% of DVT cases.

Another factor that stimulates this procoagulant activity is the degree of dehydration that prevails during the flight due to low humidity in the cabin (8-12%), lower intake of liquids and consumption of coffee or alcoholic beverages, which cause diuresis and favor hemoconcentration and blood hyperviscosity.

Preventative measures

We can divide them into two large groups: individual measures and improved flight conditions.

- Individual measures: the first condition is to detect at-risk individuals on the team who, bearing in mind the factors outlined above, will need special attention. Generally speaking, long periods of sitting must be avoided. In order to do so, we will provide some exercises consisting of moving the calf muscles when in a seated position, taking small walks around the plane every 2-3 hours, drinking water frequently and avoiding drinking alcohol, coffee or tea.

Venous stasis can be prevented by using graduated elastic stockings, which have been proven to reduce the incidence of VTE by almost 90% in standard-risk patients. Pharmacological prophylaxis is reserved for high-risk patients. There is no evidence that antiplatelet drugs (aspirin, clopidogrel) reduce the incidence of VTE in high-risk patients. Taking one enoxaparin in a dose of 1 mg/kg, 2-4 hours before long-haul flights, significantly decreases the incidence of VTE from 4.8 to 0% (Brenner, 2009, Cesarone et al., 2002).

- **Improved environmental conditions in the airplane cabin**: cabin pressure must be maintained in hypobaric conditions (altitude of 1.8-2.5 km), and an adequate relative humidity must be maintained in order to mitigate, to the extent possible, dehydration of the air conditioning units. Passengers should also be encouraged to drink liquids that do not contain alcohol, coffee or tea.

  Another aspect is increasing the space between seats to allow passengers to stretch their legs and contract their calf muscles. Finally, optimal levels of oxygen should be ensured inside the cabin.

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