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Diabetes and the importance of sleep

Sleep can be defined as a reversible physiological state characterized by a reduction in the level of consciousness, accompanied by a slowing of sensory and motor activity in response to external stimuli. Far from being a passive state, the brain maintains intense, organized, and dynamic activity during sleep, in which different neuronal groups continue functioning with patterns and objectives different from those of wakefulness (1).

Traditionally, sleep has been associated with functions of **repair, recovery, and preparation of the body for the following day**. However, current evidence shows that, due to its integrative role in physiological homeostasis, sleep is a key determinant of overall health. It actively participates in **metabolic, cardiovascular, immunological, cognitive, and emotional regulation**, as well as in the control of body temperature and mental health, among many other functions (1).

This article reviews the most relevant aspects of **sleep hygiene** and its relationship with **diabetes mellitus**, focusing on the physiological mechanisms involved and the available clinical evidence.

The relationship between obstructive

sleep apnea syndrome (OSAS) and diabetes mellitus is not addressed in this review because, due to its high prevalence, pathophysiological complexity, and specific therapeutic management, it deserves an independent monographic article.

Sleep phases

To fulfill its functions, human sleep is organized into structured cycles that progress gradually from wakefulness to deeper states of sleep. These cycles include phases of non-rapid eye movement sleep (NREM), followed by rapid eye movement sleep (REM), which is considered essential for neurocognitive restoration.

Each sleep cycle consists of 4 NREM phases (representing approximately 75% of

the cycle) and 1 REM phase (about 25%). The average duration of each cycle is 90 to 100 minutes, and adequate sleep generally requires 4 to 5 complete uninterrupted cycles, which corresponds to approximately 6 to 8 hours of nocturnal sleep (2). *(Table 1)*

Both short sleep duration (< 6 hours) and prolonged sleep (> 8 hours) have been established as risk factors for developing metabolic syndrome associated with obesity and diabetes mellitus (3).

Sleep chronotypes

Each person has individual sleep patterns, particularly regarding bedtime and waking time. One way to classify them is into 2 main groups: morning types (“larks”) and evening types (“owls”), whose characteristics are shown in *Table 2*. ➤






NREM PHASE 1	NREM PHASE 2	NREM PHASE 3	NREM PHASE 4	REM PHASE
				
LIGHT SLEEP	MODERATE SLEEP	INITIAL DEEP SLEEP	DEEP SLEEP	RESTORATIVE SLEEP
5- 10 min.	10-20 min.	15-30 min.	15-30 min.	20-30 min (duration increases with each cycle)
Easy to awaken			Difficult to awaken	Dreaming phase
Motor activity decreasing	Motor activity progressively decreasing	Relaxed motor activity	Completely relaxed motor activity	Muscle atonia
Vital signs decreasing	Vital signs decreasing	Lowest vital signs	Fluctuat	Constantes vitales fluctuantes.
MINUTES PER CYCLE			90-120 min per cycle	
RECOMMENDED NUMBER OF CYCLES			4-5 uninterrupted cycles	
TOTAL DURATION			6-8 hours of sleep	

Table 1. Sleep phases and their characteristics. Source: Own elaboration.

MORNING CHRONOTYPE (LARKS)	EVENING CHRONOTYPE (OWLS)
• Wake up early	• Wake up late
• Energy peak in the morning	• Energy peak in the evening/night
• Cognitive activity peak in the morning	• Cognitive activity peak in the evening/night
• Go to bed early at night	• Go to bed very late at night

Table 2. Sleep chronotypes. Source: Own elaboration.



» Individuals who fit the evening chronotype tend to be more sedentary, have poorer glycemic control, and are more likely to adopt unhealthy lifestyle habits and consume high-calorie foods—particularly those rich in rapidly absorbed sugars—thereby increasing the risk of obesity, diabetes mellitus, and cardiovascular diseases (4).

Circadian rhythm of sleep

Human beings regulate sleep activity in such a way that, cyclically and daily, they remain awake for approximately 16 hours and asleep for about 8 hours (circadian rhythm).

This regulatory mechanism is highly complex and involves regulators at both peripheral and central nervous system levels. It responds to sunlight stimuli detected by retinal receptors and transmitted through neural pathways to the suprachiasmatic nucleus of the hypothalamus, the pineal gland, and melatonin secretion, among other processes. These systems act as internal pacemakers for the sleep–wake cycle.

In general terms, regulators that promote wakefulness are referred to as **circadian awakening mechanisms**, while those that promote sleep are referred to as **sleep homeostasis mechanisms**.

Throughout the day, our body gradually accumulates a “need for sleep.” In the morning this need is low and gradually increases as the day progresses. At the same time, our internal clock keeps us awake so we can carry out our daily activities.

As night approaches, the body begins to reduce the signals that keep us awake and increases the sensation of sleepiness. At that time, a hormone called **melatonin** begins to be released, helping us relax and fall asleep.

Melatonin remains elevated throughout the night, allowing sleep to be continuous and restorative. In the morning, its levels decrease and the body reactivates awakening signals, helping us get up and start the day with more energy.

Maintaining regular sleep schedules and respecting the body’s natural rhythm helps improve sleep quality and overall health (5).

Any disruptor that chronically alters this sleep–wake balance (eg, shift work, nighttime activity, limited daytime sunlight exposure, nighttime exposure to artificial light, jet lag) disrupts cardiometabolic regulatory functions during sleep and predisposes individuals to diseases such as diabetes mellitus, obesity, hypertension, and cardiovascular disease (6).

Sleep quality

Good sleep quality is defined as sleep that includes:

1. Adequate sleep latency (time required to fall asleep).
2. Adequate duration.
3. Absence of fragmented sleep.
4. Adequate sleep depth.
5. A subjective feeling of restorative sleep.

Sleep quality can be assessed using the Pittsburgh Sleep Quality Index (PSQI). This is a validated questionnaire consisting of 24 items; 19 are answered by the patient and the remaining 5, if the person sleeps with someone else, are answered by their bed partner. These 5 questions do not contribute to the score but provide additional objectivity. To evaluate the test, it is divided into 7 components (7):

1. Subjective sleep quality.
2. Sleep latency.
3. Sleep duration.

- » 4. Sleep efficiency.
- 5. Sleep disturbances.
- 6. Use of sleep medication.
- 7. Daytime dysfunction.

A lower score indicates better sleep quality (a score < 5 indicates good sleep quality, whereas >5 indicates poor sleep quality).

Recommendations on sleep hygiene and diabetes mellitus

Sleep disorders are common in type 2 diabetes mellitus and cause alterations in sleep quantity, quality, and timing. They are also associated with a higher risk of obesity and disturbances in daytime functioning and glucose metabolism (8, 9). For this reason, the *American Diabetes Association (ADA)* provides specific recommendations.

Among the general sleep hygiene measures that should be recommended are:

1. Avoid watching television or using mobile phones for 2 hours before bedtime (digital disconnection).
2. Perform regular physical exercise, but not within the 3 hours before going to sleep.
3. Avoid coffee, tea, or other nervous system stimulants in the late afternoon or evening.
4. Do not smoke, especially not within one hour before bedtime.
5. Avoid alcohol consumption.
6. Avoid heavy meals before going to bed.
7. Go to sleep wearing comfortable clothing, in a comfortable environment with adequate temperature, minimal exposure to artificial light beforehand, and complete darkness during sleep. **D**

CONCLUSIONS (9,10)

1. **Sleep duration:** Sleeping < 6 hours or > 8 hours is associated with poorer metabolic control in diabetes mellitus.
2. **Sleep quality:** Fragmented sleep, with microawakenings or insufficient depth, predisposes individuals to poorer glycemic control and the development of other comorbidities.
3. **Chronotype:** A morning chronotype is associated with better glycemic control compared with an evening chronotype.

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