The background of the slide is a polysomnogram (PSG) recording. It consists of numerous horizontal black traces on a light blue background, representing various physiological signals such as EEG, ECG, and respiratory signals. Vertical blue lines are spaced across the recording, likely indicating time intervals or specific events. The traces show complex, irregular patterns, characteristic of sleep data.

# Introduction to Polysomnography: A Clinician's Guide.

Sherri Kozubal, RRT, CRE, RPSGT, CCSH, CHt



# Objectives



What is normal sleep?



Types of Polysomnography



Sleep disorders and indication for testing.



Levels of testing.



Sleep management options.



Study discussion.

# Polysomnography



Is a multiparameter sleep study to confirm/rule out sleep disorders which includes:

**Routine polysomnography** – Standard test to confirm/rule out sleep disorders (Level 1 and 2).

**Specialized polysomnography** - Diagnose seizure disorders or determine the right ventilation treatment.

**Nocturnal polysomnography with CPAP titration** - Determine the right CPAP pressure settings.

**Split-night polysomnography** - A combination of routine polysomnography and nocturnal polysomnography with CPAP titration

**Multiple sleep latency test (MSLT)** - Measures daytime sleepiness to help diagnose narcolepsy and determine the severity of sleep apnea

**Maintenance of wakefulness test (MWT)** - Measures a person's ability to stay awake in a dark room



# Levels of Polysomnography



## Level 1:

- Conducted in a sleep lab or hospital.
- Monitors brain waves, oxygen levels, heart rate, breathing, eye movements, and leg movements.

## Level 2:

- Can be done at home or in a sleep lab.
- Similar to Level 1 but without a technician present or video.

## Level 3 (HSAT):

- Conducted at home using a portable device.
- Monitors breathing activity, oxygen levels, and heart rate.
- Primarily used to diagnose obstructive sleep apnea.

# Sleep Tests (continued)

## Special Mention for Pulse Oximetry:

- Formerly Level 4 and no longer indicated due to lack of specificity
- Desaturation Event Index (DEI) measures the number of times per hour that a person's blood oxygen level drops by a certain percentage during sleep. These drops in oxygen saturation are often linked to breathing interruptions, such as those caused by sleep apnea.
- DEI may be used to assist triage process through higher level testing.



# Sleep Stages



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Stage N1 = transitional, light stage of sleep, and least amount of each sleep cycle (1 to 5 minutes).

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Stage N2 = 50% of the sleep cycle. Sorts useful memories for easy retrieval.

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Stage N3 = Deep sleep and approx 20% of the total cycle. Responsible for body repair and memory consolidation.

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REM sleep = approximately 20-25% of total sleep cycle. Two phases: Phasic and Tonic. The parts of the brain associated with learning are activated.



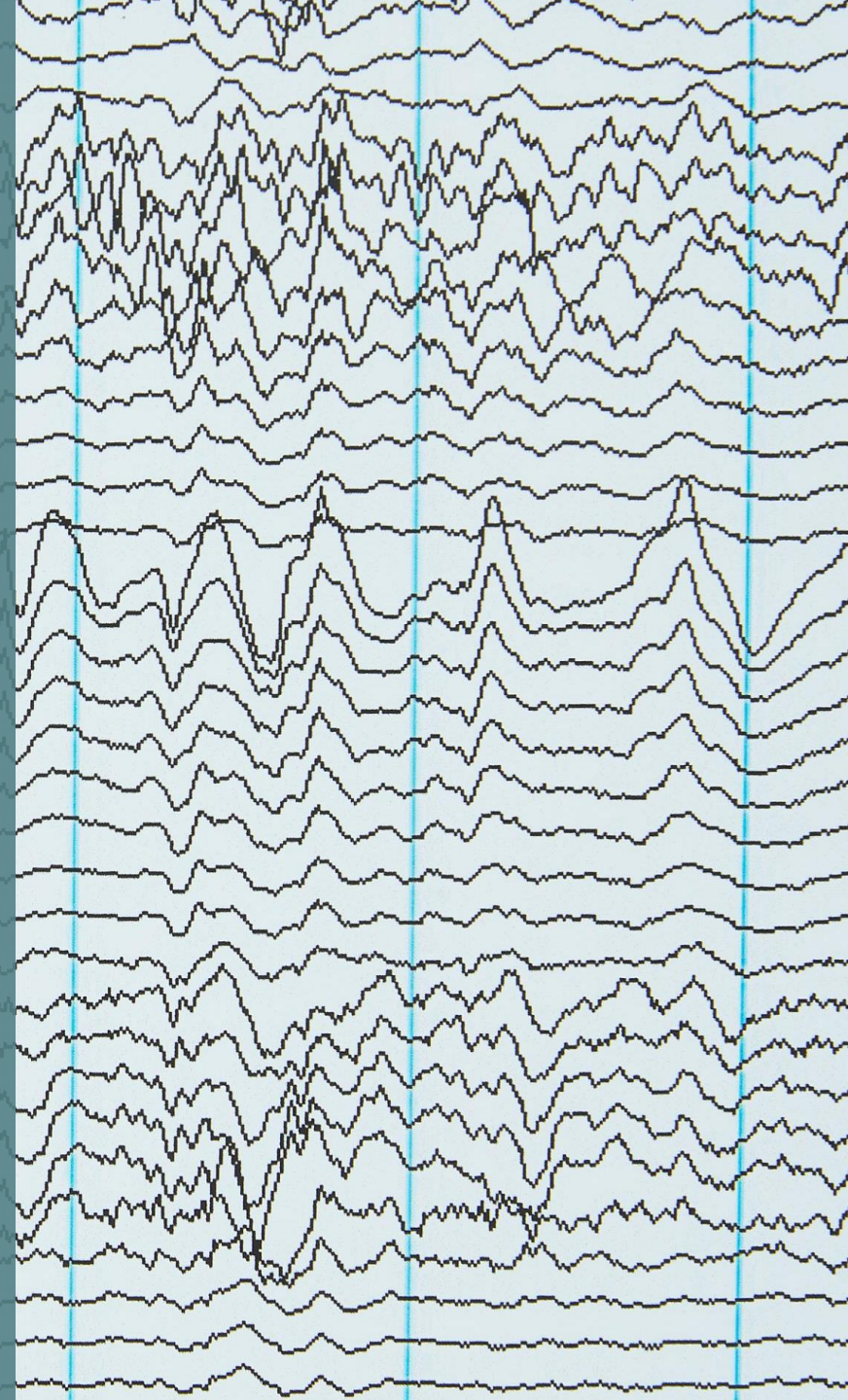
# Normal Sleep Structure

A normal sleep period of 7 – 9 hours is comprised of approximately 5 cycles sleep.

Each cycle has a rhythm of 4 sleep stages, encompassing NonREM and REM. NonREM is broken down into 3 stages, N1, N2, and N3.

Time spent in N3 decreases over the course of the night.

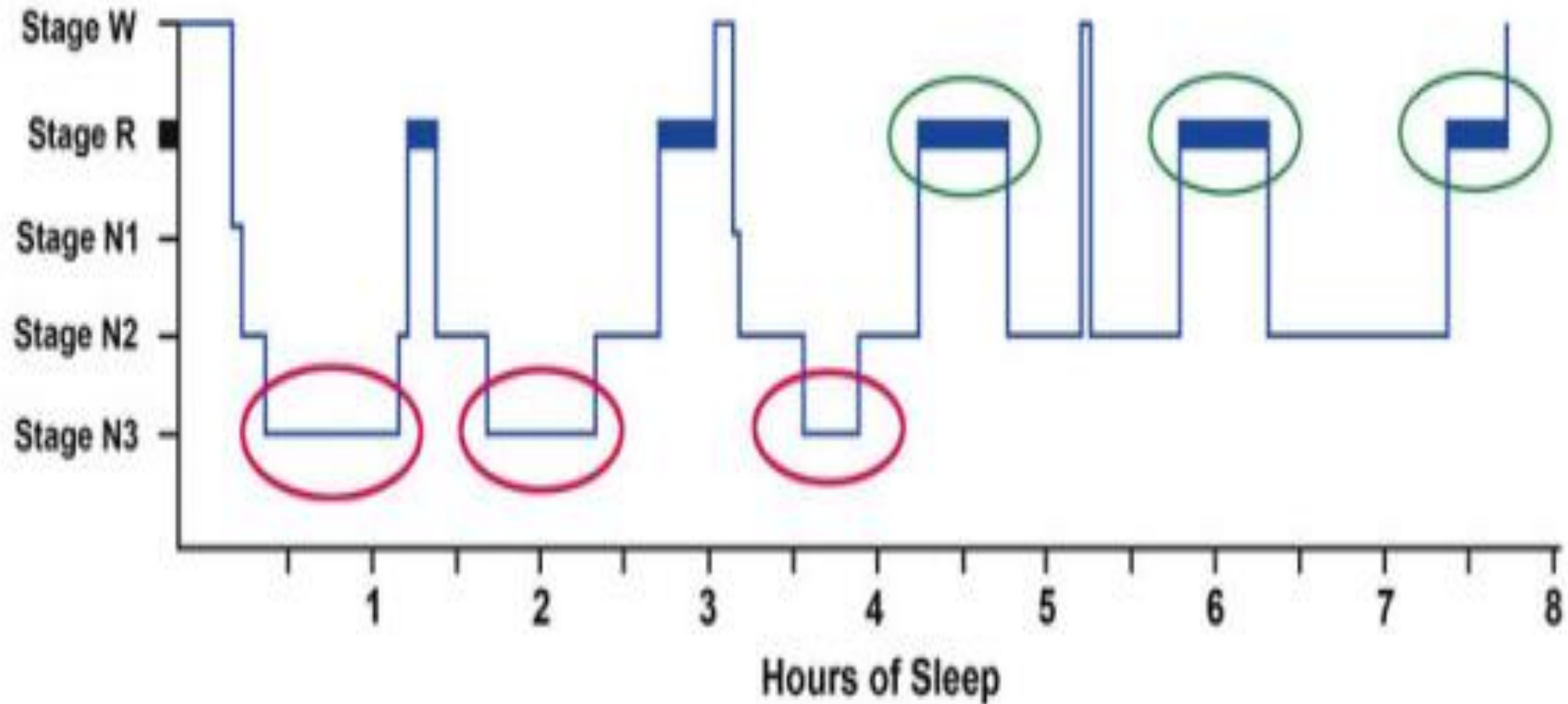
Time in REM increases throughout the night.



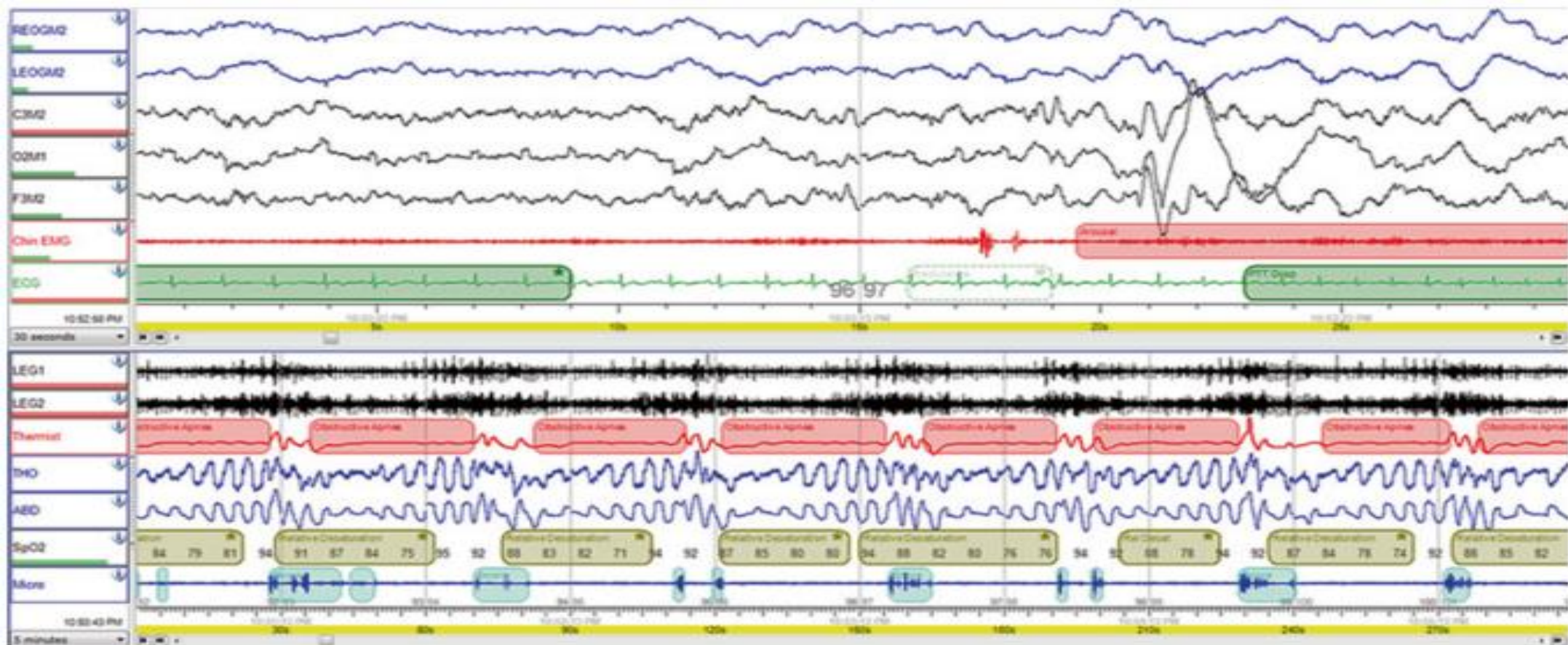


# Normal Sleep Architecture

(Pandi-Perumal, 2014)

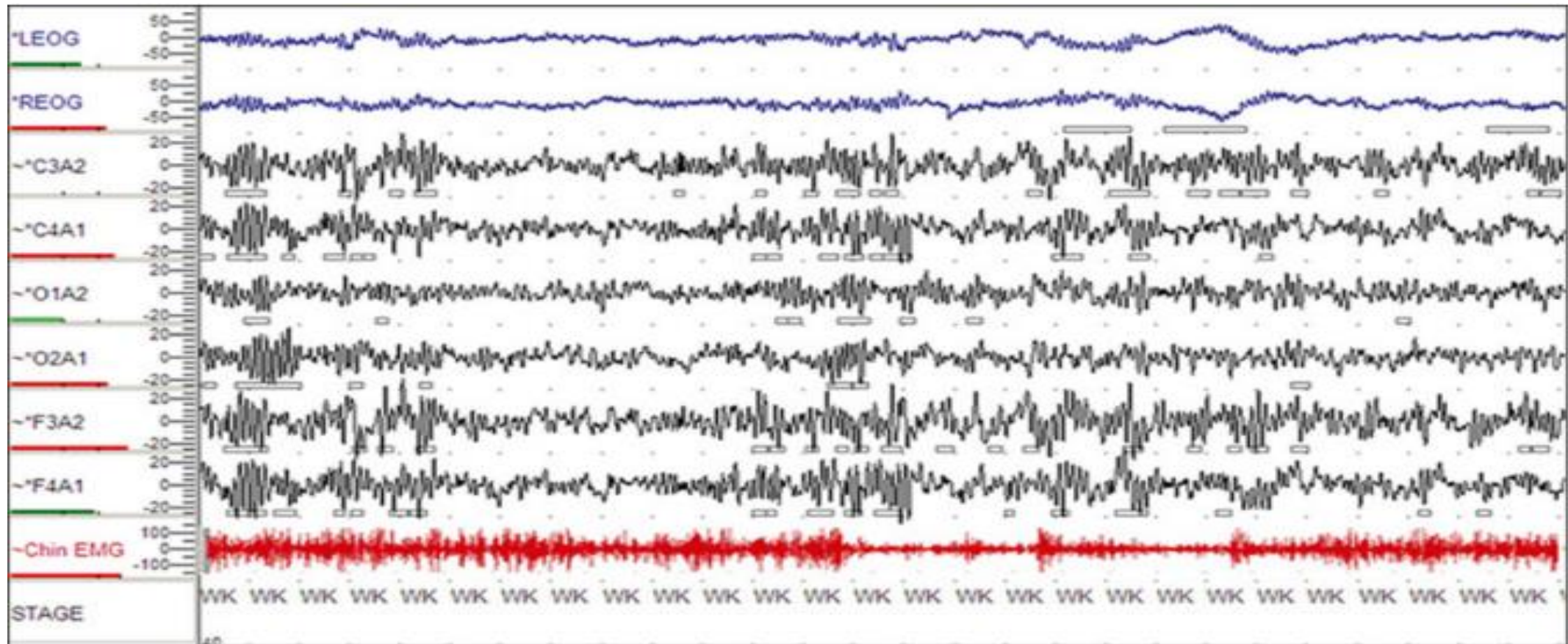






**Fig. 4.7** Typical PSG with the raw data showing in the *upper part* (30-s epoch) the parameters of staging sleep (EOG, EEG, and chin EMG) and the *lower part* (5-min epoch) showing the respiratory channel with obstructive events

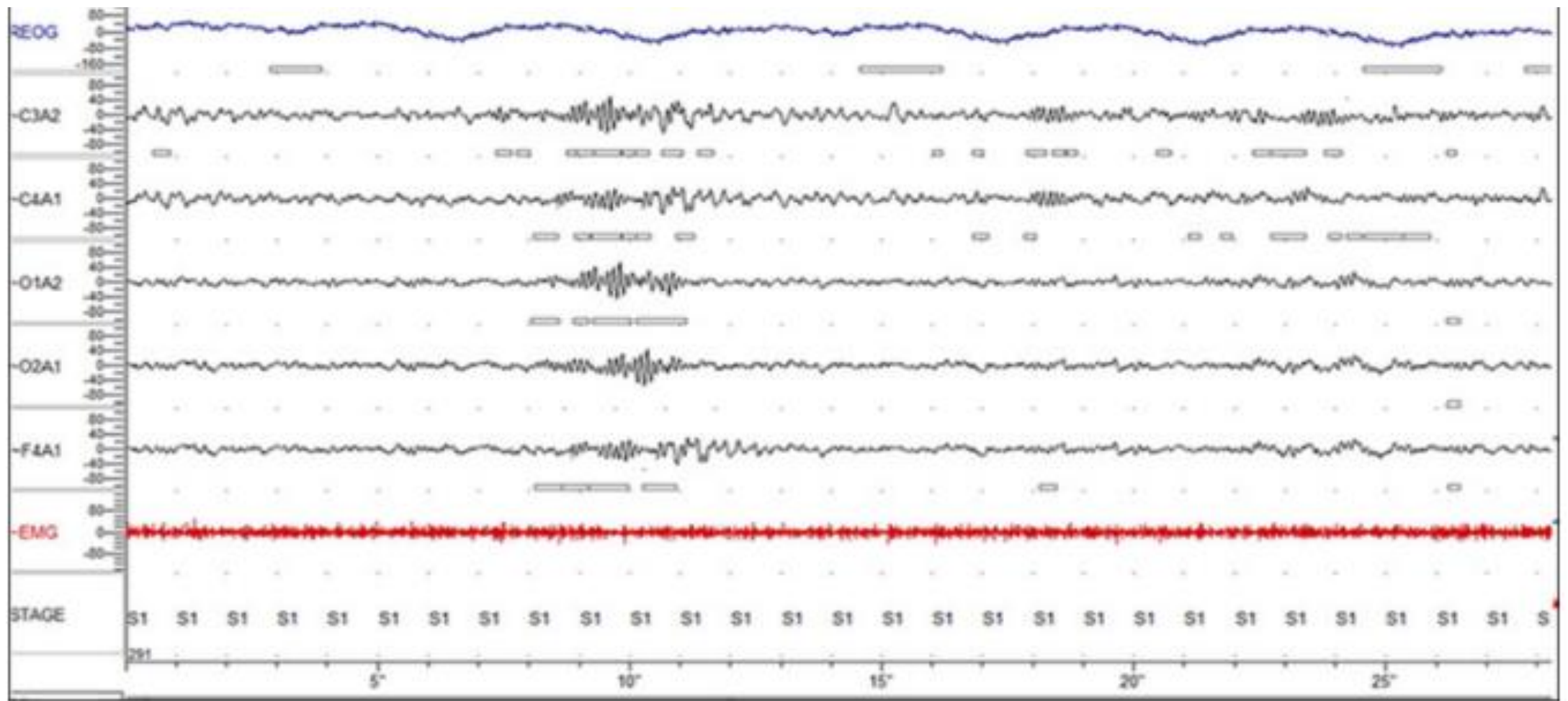
(Pandi-Perumal, 2014)



**Fig. 4.1** 30-s Epoch consisting of the parameters of staging sleep (EEG, EOG, and chin EMG) showing stage W (wakefulness)

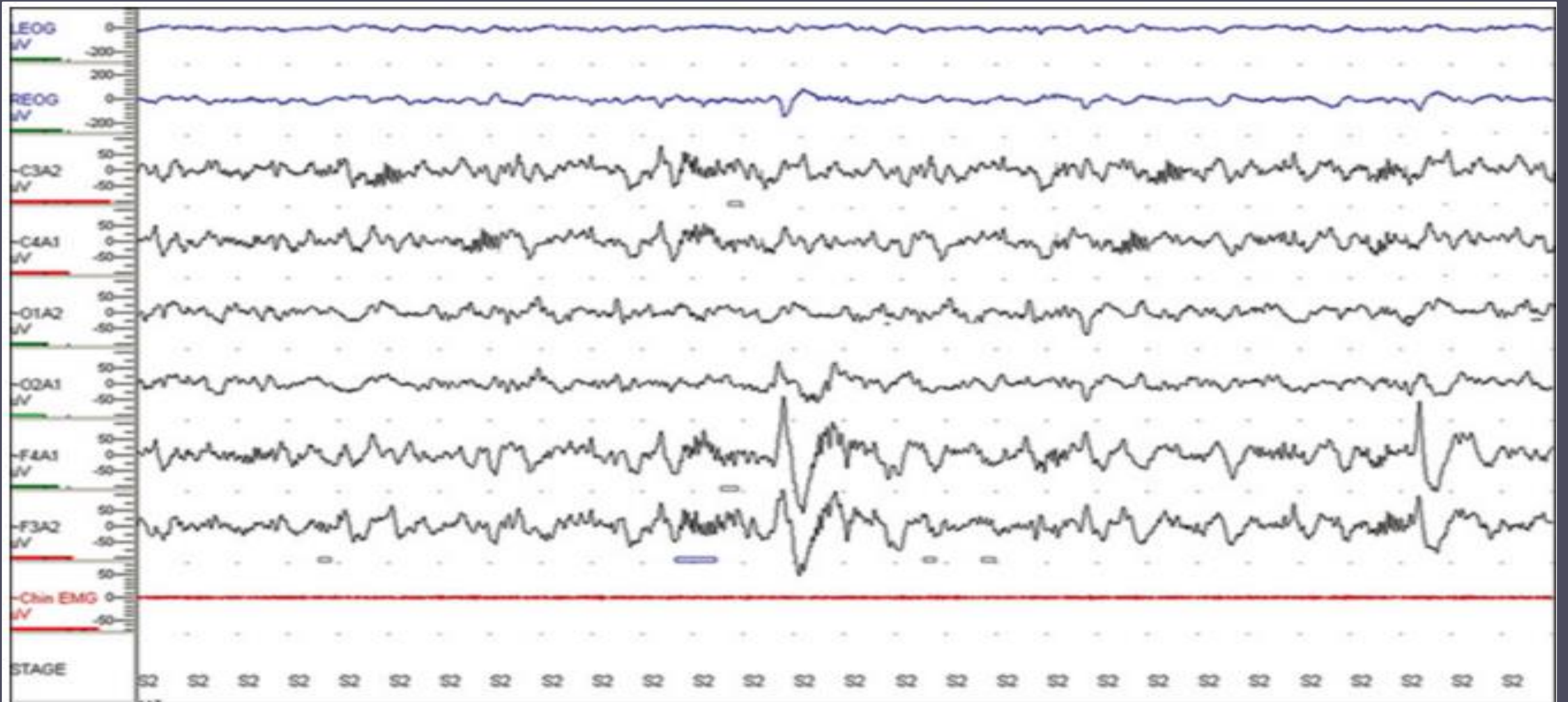
(Pandi-Perumal, 2014)





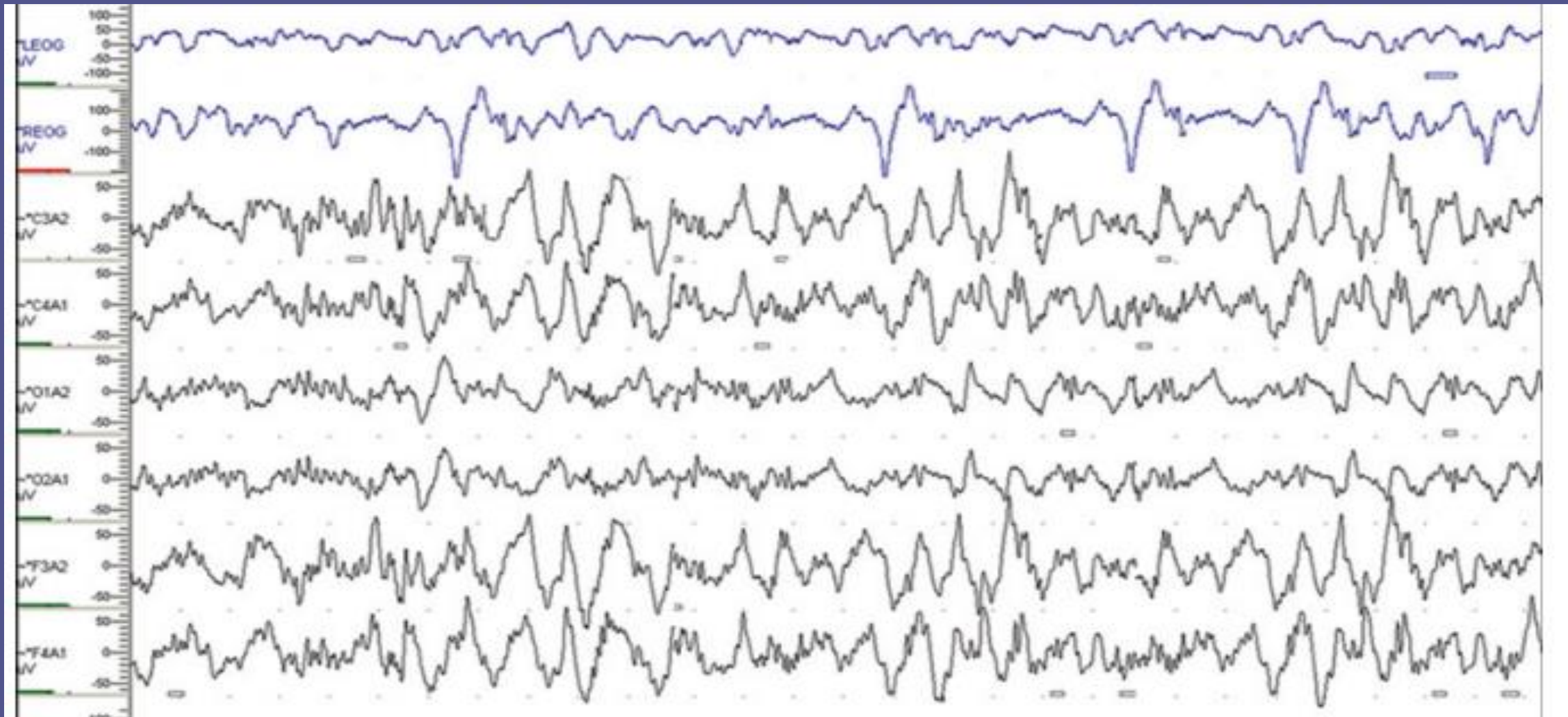
**Fig. 4.2** 30-s Epoch consisting of the parameters of staging sleep (EEG, EOG, and chin EMG) showing stage N1

(Pandi-Perumal, 2014)

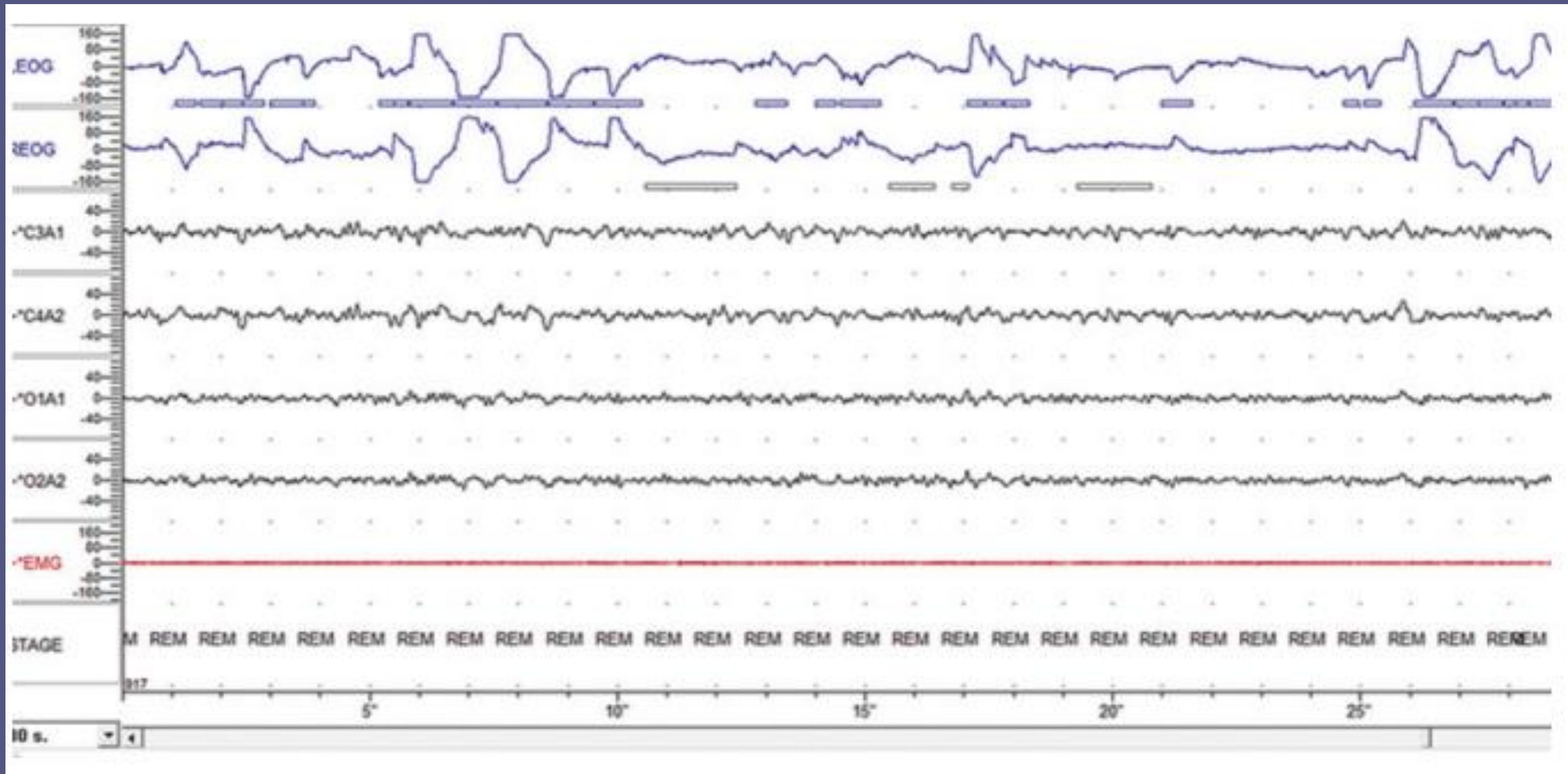


(Pandi-Perumal, 2014)





(Pandi-Perumal, 2014)



(Pandi-Perumal, 2014)



# THEORIES OF SLEEP

**We dream in both NREM and REM. The difference is apparent in the theme.**

**NREM = Shopping list dreams, (body repair)**

**REM = Saving the world dreams (brain repair, processes emotions, consolidates memory)**

**There are many studies and theories around the function of NREM and REM for brain health and body.**

**We know that long term memory consolidation happens in NREM 3 and REM sleep.**

**We also are aware of “waves” of CSF that “wash” the brain with the largest amplitude waves, during Stage 3 sleep.**



# Sleep Hygiene

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Starts the moment you wake.

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Diet, exercise, stress management, and day/night routines.

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Timing, choices, and duration all influence body clock and pressure to sleep.







# What is the role of sleep, diet, and exercise?

Optimal Diet, Exercise, and Sleep is determined individually

We can control digestion, stress management, activity level and light exposure = hormones and metabolism that influence states of alertness.

Bright light, stress, strenuous activity = Increased Cortisol = body alert increase (Beta).

Calm activity, low light, positive emotions = Serotonin and dopamine increase = Alpha (drowsy)

# What is Normal Sleep?

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Many factors to consider such as quality, timing, and duration.

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Individual variability is high due to bio psychophysiological factors.

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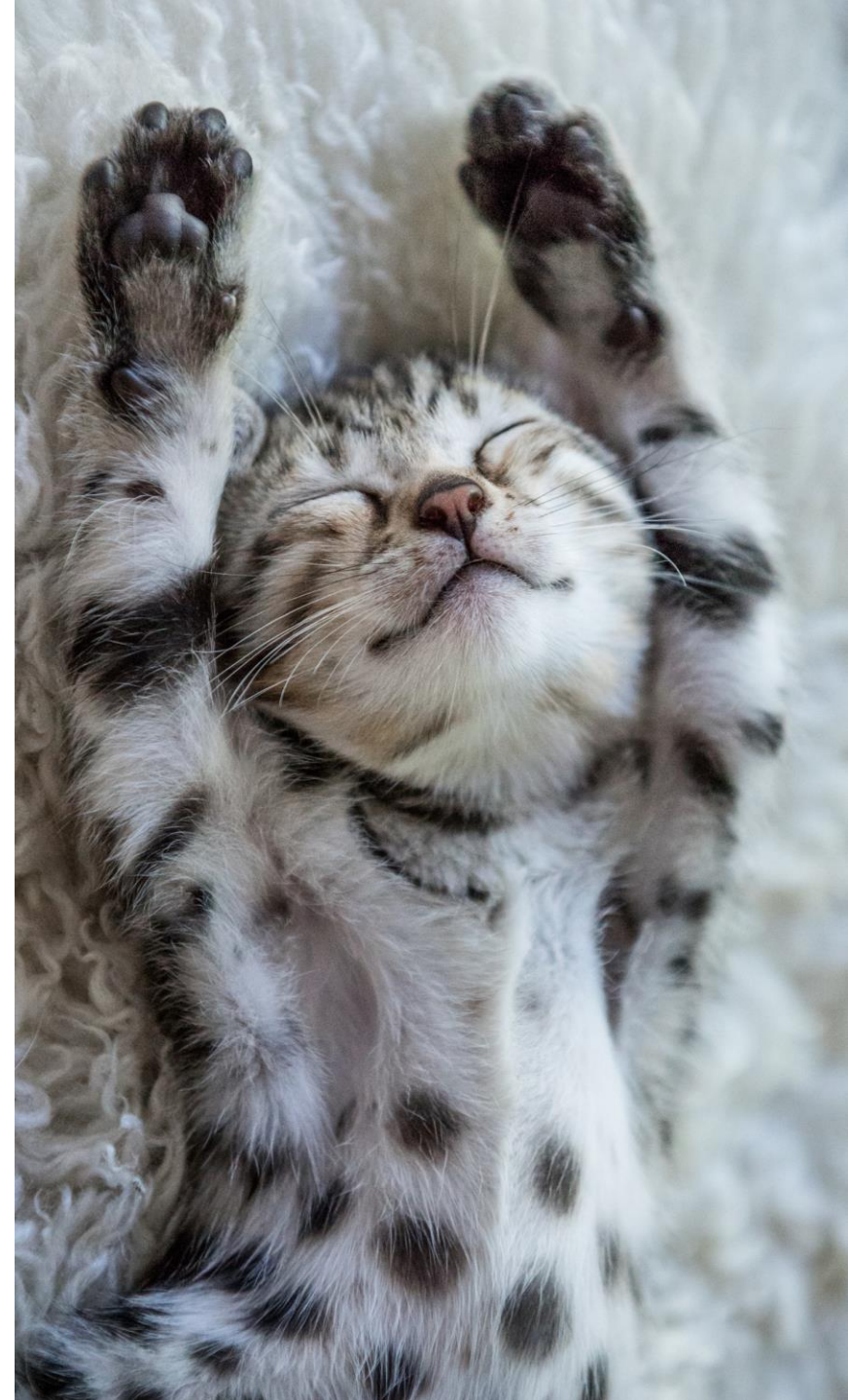
Bio psychophysiological factors = age, gender, cultural influences, demographic, geography, etc.

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Duration is influenced the most by all these factors.

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Basis of AASM consensus for sleep amount necessary to support optimal health in adults as 7 – 9 hours.





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Create a routine based on your preferences and suggestibility and be consistent!

---

Don't get stuck on rules. Your best sleep routine will be unique.

---

Finding your recipe for sleep is about knowledge and awareness of your mind body connection and perception of the world.

---

It's ok to have a "bad" night. What is your body trying to tell you?

BUILDING YOUR  
ROUTINE:

TOOLS AND  
TIMING



# Clinical Sleep Health Triage



OPTIMAL SLEEP  
HYGIENE



CHIEF COMPLAINT,  
CLIENT GOALS,  
MEDICAL HISTORY,  
PROVINCIAL  
GUIDELINES.



BIO  
PSYCHOPHYSIOLOGICAL  
FACTORS BEFORE  
DETERMINING NEEDS.





# Sleep Disorder Categories

The ICSD-3-TR (June 2023) categorizes sleep disorders into six major groups:

1. Insomnia Disorders
2. Sleep-Related Breathing Disorders
3. Central Disorders of Hypersomnolence
4. Circadian Rhythm Sleep-Wake Disorders
5. Parasomnias
6. Sleep-Related Movement Disorders





# Insomnia Disorder

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A complaint of trouble initiating or maintaining sleep which is associated with daytime consequences and is not attributable to environmental circumstances or inadequate opportunity to sleep. (ICSD-3)

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Includes both acute and chronic forms of Insomnia.

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Chronic Insomnia = Insomnia persisting for at least 3 months at a frequency of at least 3 times per week.

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Acute (Short Term) Insomnia – Disorder meets same criteria but persists less than 3 months

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Advanced age, female gender, those with lower socioeconomic status, and those with medical or psychiatric illness are risk factors for chronic or acute models.





# Sleep Related Breathing Disorders

The ICD-11 (June 2023) classifies sleep-related breathing disorders into 4 groups:

1. Obstructive Sleep Apnea Syndromes (OSA)
2. Central Sleep Apnea Syndromes (CSA)
3. Sleep-related Hypoventilation Disorders
4. Sleep-related Hypoxemia Disorder

# Central Disorders of Hypersomnolence

The ICD-10 requires at least three months of daily sleepiness, which can be defined as daytime sleep episodes or an "irrepressible" need to sleep. Two main groups:

## 1. Primary

Narcolepsy type 1 (NT1), narcolepsy type 2 (NT2), idiopathic hypersomnia (IH), and Kleine-Levin syndrome (KLS)

## 2. Secondary

Hypersomnia caused by a medical or psychiatric disorder, a drug or substance, or insufficient sleep syndrome (ISS)





A hand is shown from the bottom left, reaching upwards towards a bright sun in the sky. A faint rainbow is visible in the background. The overall scene is warm and bright, with a soft glow from the sun.

# Circadian Rhythm Sleep-Wake Disorders

The ICSD-3-TR (June 2023)  
categorizes six disorders:

1. Advanced sleep-wake phase disorder (morning lark)
2. Delayed sleep-wake phase disorder (night owl)
3. Irregular sleep-wake rhythm disorder (non restorative and irregular pattern)
4. Jet lag disorder (time zone or social)
5. Non-24-hour sleep-wake rhythm disorder (poor light exposure, blindness)



# Parasomnias

Involve abnormal behaviors or experiences while sleeping. Grouped by REM or NREM Sleep Staging.

REM: Recurrent isolated sleep paralysis, Nightmare Disorder, RBD.

NREM: Sleep terrors, Sleep walking, Confusional Arousals, Sleep Related Eating Disorder

Sleep Related Hallucinations, Exploding Head Syndrome, Sleep Enuresis, Sexsomnia, Catathrenia



# Sleep Related Movement Disorders

A group of conditions that cause abnormal movements or behaviors during sleep.

1. Restless legs syndrome (RLS) - Associated with genetics, pregnancy, nutrient deficiencies, and medical conditions.
2. Periodic limb movement disorder (PLMD) Repetitive, rhythmic and occur every 20-40 seconds.
3. Sleep-related bruxism (SLB) - Repetitive jaw muscle activity, such as clenching or grinding of the teeth. Occurs during sleep or wake, and can cause abnormal tooth wear, jaw pain, headaches, or jaw locking.
4. REM sleep behavior disorder (RBD)





# Expected Outcomes of Intervention



# Unique Demands of Healthcare System

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Patient care is 24 hours a day and adrenaline/cortisol filled.

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Emergent patient care favors dedication to patient outcome as opposed to self-care.

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Fatigue = dedication/excellence culture.

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We work within a system that is inflexible to circadian rhythm resets between shifts.

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Environment of artificial light and chaotic activity.

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A bad day at work can be a loss of life, even when we do everything right.





# Reduce the stress, bring on the sleep.

The more you practice a calm state of mind, the stronger your mindset becomes.

Stronger mindset = increased resiliency and lower stress

Having a strong state of mind is an important part of reducing Insomnia episodes.

Apps: Calm and NapFlix suitable for use anywhere, anytime.

Calm = mostly audio, feel good vibes;  
NapFlix uses visual and audible monotony.

Breathwork: Mindful, 4-7-8, and Diaphragmatic Breathing



# Why is Alpha state important?

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Typical wake brain activity while performing daily activities is Beta.

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In order to transition to sleep or Theta, we must pass through Alpha first.

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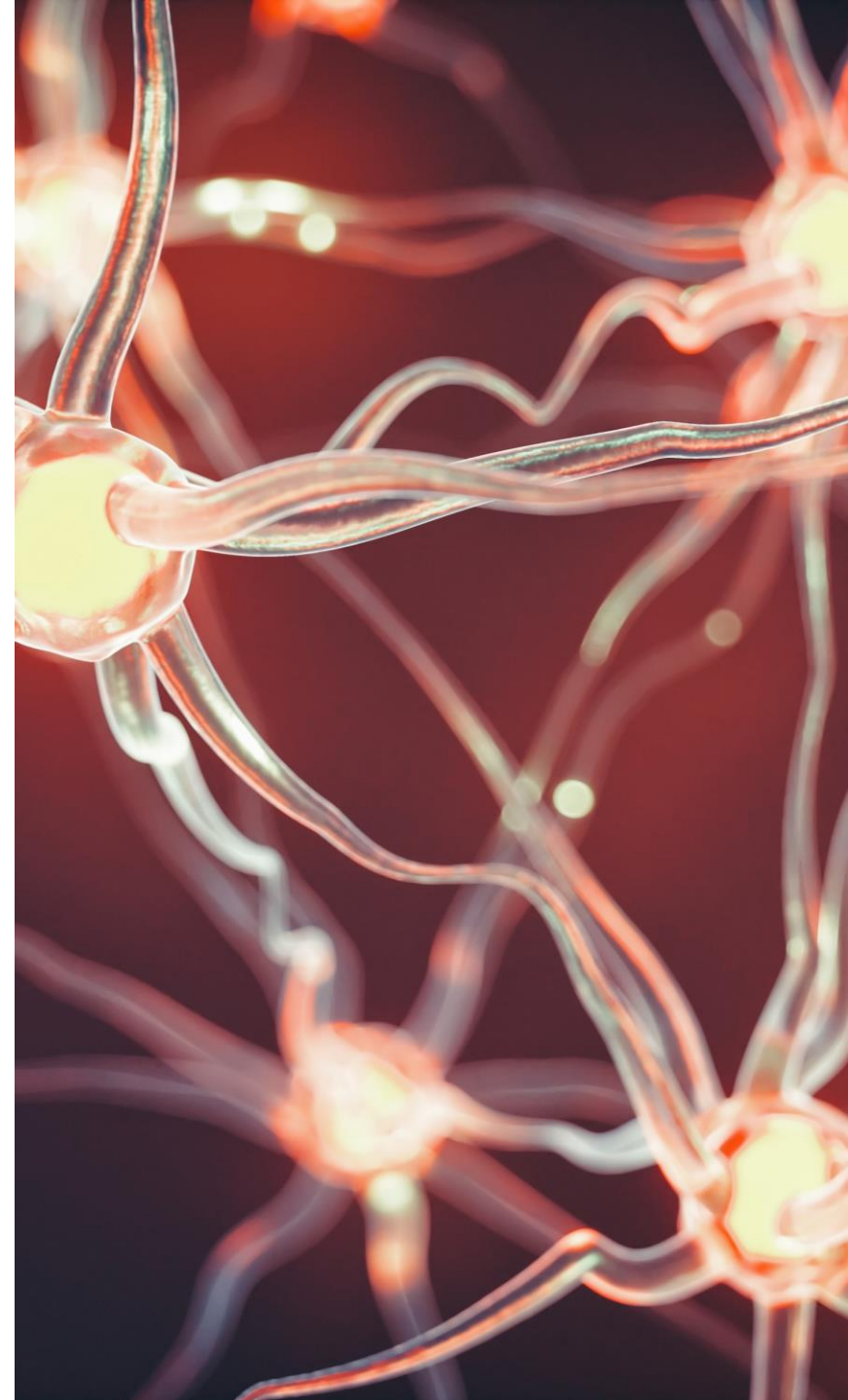
Activity like exercise, electronic use, or problem-solving delays sleep onset until the brain overrides and crashes into Theta.

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When WASO occurs, the brain pressure to sleep is not enough to force theta, resulting in Middle Insomnia.

---

A person trained in initiating Alpha state will be able to initiate sleep quickly at any point in the sleep period.



# Making the mental switch...



Soft lighting



Meditation/  
Visualization



Listening to calming  
music/Audiobooks



Reading



Breathwork



Gentle stretching



# Give yourself a buffer...



The AASM suggests a 30-60 min buffer before bed.



= mental switchover from work brain to sleep brain.



Often dismissed purposely due to schedule demands, excessive fatigue, and monkey mind.



The reality is that most people will often fall asleep much sooner than 30 to 60 minutes when using the suggested techniques.





# Breaking old patterns...

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Learned behavior = Negative Experience = Cyclical Insomnia

---

AASM suggests we reassociate sleep with the positive by waiting until we are tired to go to bed and utilizing the bed for sleep and sex only.

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Adding in other stimulating “wake” activities cues our bodies and brains that bed is for wake time

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Reassociating bed with positive in a repetitive way gives rise to new positive associations with bed.

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These are the behavioral foundations of Cognitive Behavioral Therapy for Insomnia (CBT-I) and Brief Behavioral Treatment for Insomnia (BBTI).



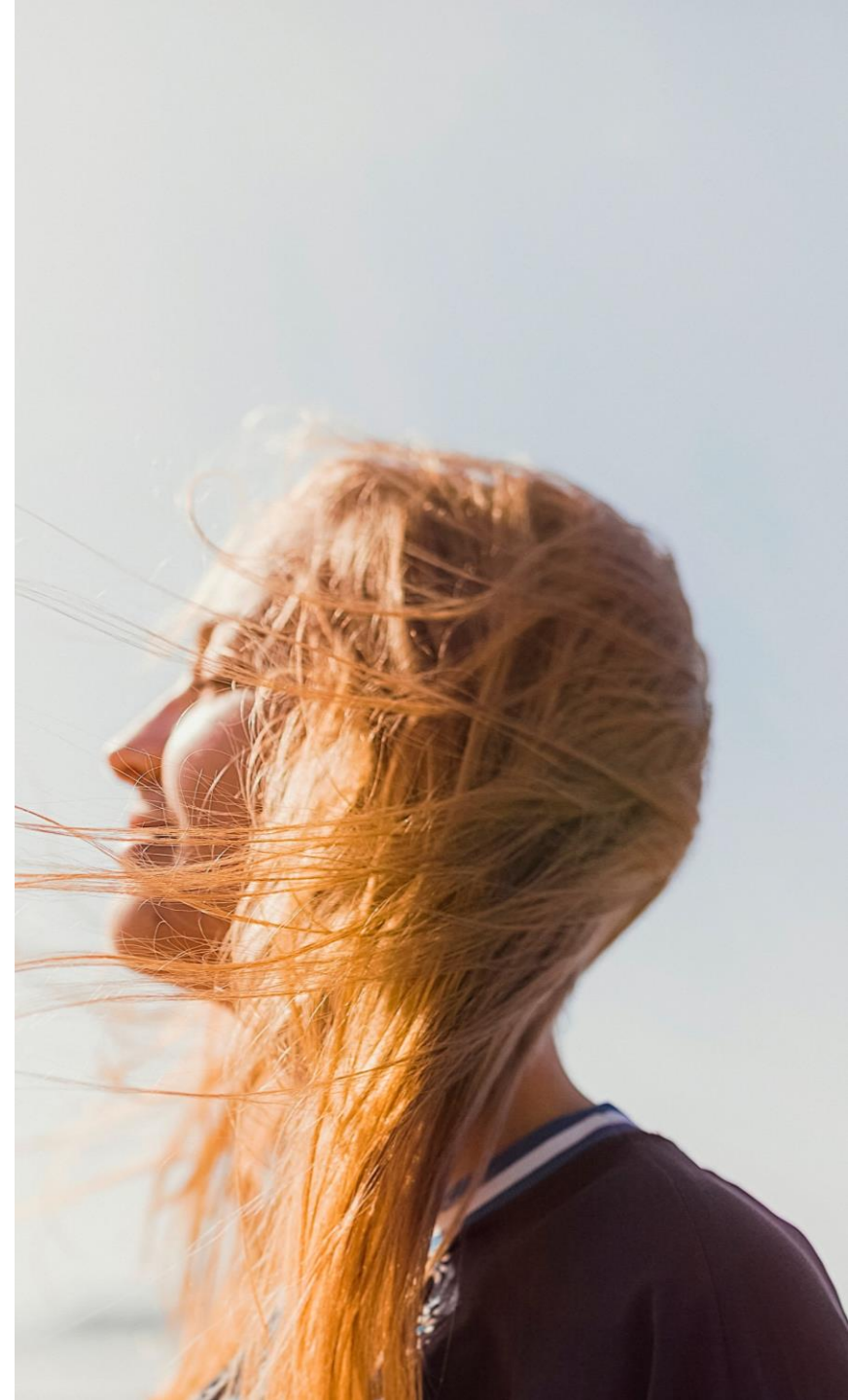
# Managing Fatigue: Better Sleep

Use of calming medications such as Hypnotics and Sedatives to improve total sleep time.

Managing light exposure (brightness and timing) to reset internal master clock or stimulate Melatonin production. Darkness = Melatonin, leading to sleep pressure.

Melatonin timing and dosage are key to optimal desired effectiveness, mitigating side effects, and avoidance of worsening symptoms.

Higher doses of Melatonin have sedative effects and lower doses assist in realigning circadian rhythms.



# Managing Fatigue: Stimulants



Timing is everything.



Modafinil for persistent fatigue.



Caffeine in small amounts, first half of a shift.



Exercise in right amounts and timing.



Eye movement = Beta activity.



# Pharmacotherapy

Dependent upon comorbidities, availability, cost, patient preference, and treatment goal.

Often used in combination with CBT-I to boost effectiveness of treatment.

# AASM Clinical Practice Guideline: Insomnia

<https://doi.org/10.5664/jcsm.8986>

JCSM | Journal of  
Clinical Sleep Medicine

## SPECIAL ARTICLES

### Behavioral and psychological treatments for chronic insomnia disorder in adults: an American Academy of Sleep Medicine clinical practice guideline

Jack D. Edinger, PhD<sup>1,2</sup>; J. Todd Arnedt, PhD<sup>3</sup>; Suzanne M. Bertisch, MD, MPH<sup>4</sup>; Colleen E. Carney, PhD<sup>5</sup>; John J. Harrington, MD, MPH<sup>6</sup>; Kenneth L. Lichstein, PhD<sup>7</sup>; Michael J. Sateia, MD, FAASM<sup>8</sup>; Wendy M. Troxel, PhD<sup>9</sup>; Eric S. Zhou, PhD<sup>10</sup>; Uzma Kazmi, MPH<sup>11</sup>; Jonathan L. Heald, MA<sup>11</sup>; Jennifer L. Martin, PhD<sup>12,13</sup>

<sup>1</sup>National Jewish Health, Denver, Colorado; <sup>2</sup>Duke University Medical Center, Durham, North Carolina; <sup>3</sup>Michigan Medicine, University of Michigan, Ann Arbor, Michigan; <sup>4</sup>Brigham and Women's Hospital, Harvard Medical School, Boston, Massachusetts; <sup>5</sup>Ryerson University, Toronto, Canada; <sup>6</sup>University of Nebraska Medical Center, Omaha, Nebraska; <sup>7</sup>University of Alabama, Tuscaloosa, Alabama; <sup>8</sup>Geisel School of Medicine at Dartmouth, Hanover, New Hampshire; <sup>9</sup>RAND Corporation, Pittsburgh, Pennsylvania; <sup>10</sup>Harvard Medical School, Dana-Farber Cancer Institute, Boston Children's Hospital, Boston, Massachusetts; <sup>11</sup>American Academy of Sleep Medicine, Darien, Illinois; <sup>12</sup>David Geffen School of Medicine at the University of California Los Angeles, Los Angeles, California; <sup>13</sup>VA Greater Los Angeles Healthcare System, Geriatric Research, Education and Clinical Center, Los Angeles, California

1. We recommend that clinicians use multicomponent cognitive behavioral therapy for insomnia (CBT-I) for the treatment of chronic insomnia disorder in adults. (STRONG)
2. We suggest that clinicians use multicomponent brief therapies for insomnia (BTI) for the treatment of chronic insomnia disorder in adults. (CONDITIONAL)
3. We suggest that clinicians use stimulus control as a single-component therapy for the treatment of chronic insomnia disorder in adults. (CONDITIONAL)
4. We suggest that clinicians use sleep restriction therapy as a single-component therapy for the treatment of chronic insomnia disorder in adults. (CONDITIONAL)
5. We suggest that clinicians use relaxation therapy as a single-component therapy for the treatment of chronic insomnia disorder in adults. (CONDITIONAL)
6. We suggest that clinicians not use sleep hygiene as a single-component therapy for the treatment of chronic insomnia disorder in adults. (CONDITIONAL)



Z



# Sleep Restriction Therapy

Enhance sleep drive and consolidate sleep

Initially, limit time in bed to sleep diary reports.

Increase or decrease time based on sleep efficiency reported.

Final time in bed determined by sleep satisfaction and minimal duration.

Contraindicated for mood disorders and seizures.



# Relaxation Therapy

Somatic tension reduction - Abdominal breathing, Progressive muscle relaxation and Autogenic training

Cognitive Arousal Reduction – Guided Imagery Training and Meditation

Depending on one's suggestibility, one method will be more effective than the other.



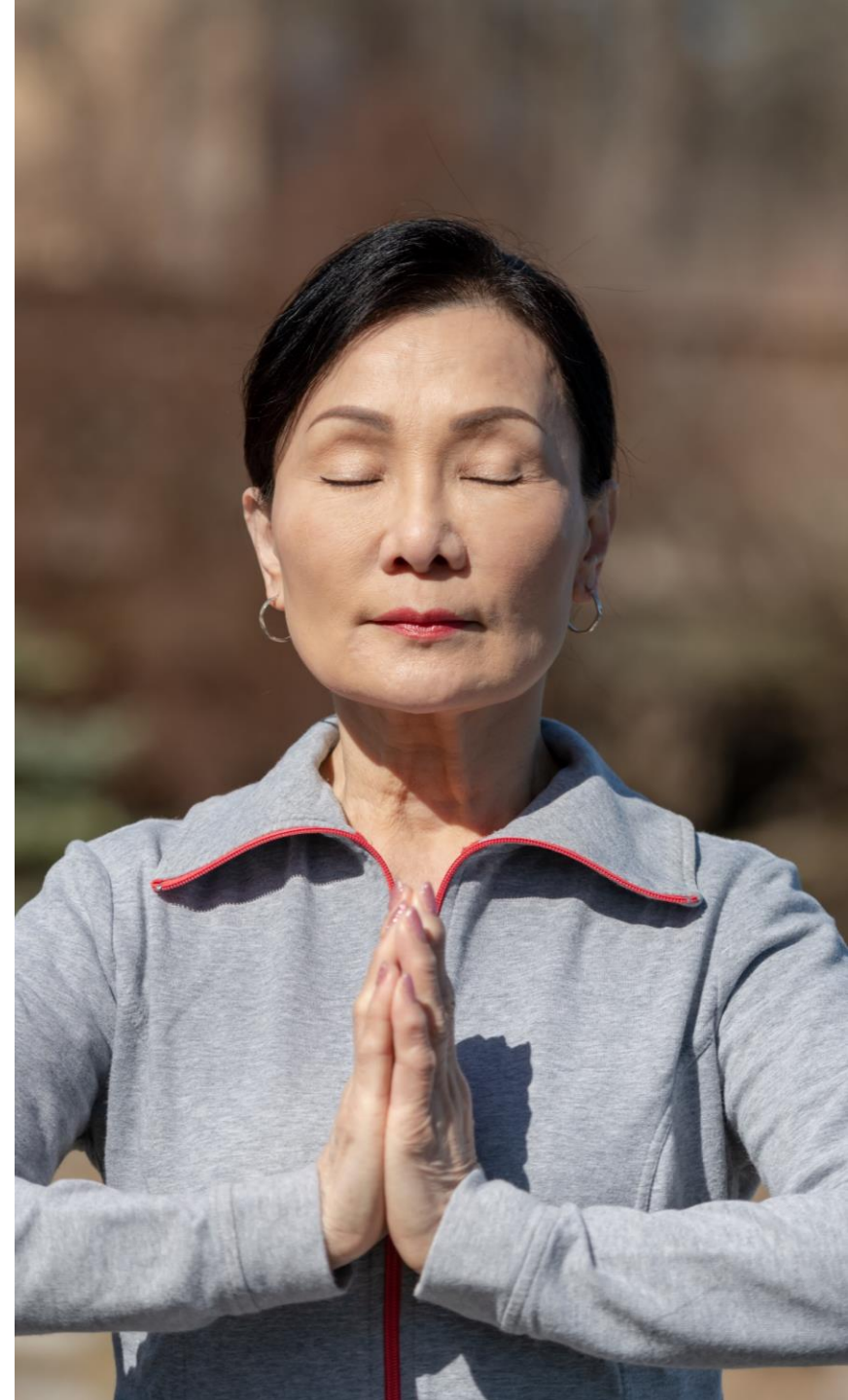


# Mindfulness Therapies

Meditation format

Emphasis on observer, non-judgemental awareness and complete awareness of one's thoughts, emotions, experiences on a moment-to-moment basis.

Combined with Stimulus control, sleep restriction, and sleep hygiene.



# Summary

1. Many factors exist to determine need and appropriate pathway for diagnosis and treatment of reported sleep challenges.
2. One size does not fit all. Listen to your client/patient and take an extensive history before considering testing and treatment for optimal efficacy.
3. Treatment is two pronged. Support healthy behaviours/mindset and treat imbalances/symptoms.



# References

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