

**BEHAVIORAL CRITERIA OF WAKEFULNESS AND SLEEP**  
**PHYSIOLOGIC CRITERIA OF WAKEFULNESS AND SLEEP**  
**SLEEP MACROSTRUCTURE**

- Sleep states and stages
- Sleep cycles
- Sleep latency
- Sleep efficiency (the ratio of total sleep time in bed expressed in percent)
- Wake after sleep onset (WASO)

**FACTORS MODIFYING SLEEP MACROSTRUCTURE**

**HISTORY OF STAGING OF SLEEP**

Macnish suggested there are two forms of sleep

- Complete sleep with total suppression of movement, sensation and all mental activity
- Incomplete sleep with retention of mental activity and dreaming

**HISTORY OF STAGING OF SLEEP**

- Bremner was the first to show striking change in electrical activity of the brain in sleep with the use of an EEG
- Loomis and colleagues delineated the different patterns of EEG activity in sleep  
- this became the basis for the subsequent classification of sleep stages
- 1953 – Aserinsky and Kleitman reported that during sleep rapid eye movements occurred different from the slow rolling eye movement at the onset of sleep
- Dement and Kleitman – correlated the dreaming
- Moruzzi and Jouvet – proved that sleep is an active physiological process with clearly defined electrocorticographic and behavioral changes. These changes are dependent on specific neurochemical mechanisms and the activity of brainstem nuclei and areas extending from the medulla to the diencephalon
- Rechtschaffen & Kales started scoring of sleep stages

**Mechanisms of Electroencephalography (EEG)**

**SLEEP STAGES**

Sleep follows a predetermined pattern of well organized sequential stages and cycles. The structured temporal sequence produces a graphic display known as architecture of sleep.

## **Stages of Sleep**

### **Wakefulness**

- Alpha activity predominant rhythm
- High EMG tone
- Phasic eye movements

### **STAGE I**

- Wakefulness dissipates and posterior alpha disappears while relatively low 4-7 Hz theta with very occasional delta waves. Vertex sharp waves maybe seen but no sleep spindles noted. Slow eye movements are present
- EMG relatively lower tone compared to wakefulness.
- Lasts 5-10 minutes.

### **STAGE II**

- High voltage vertex waves with a negative and positive sharp component (K complex) seen symmetrically at the central regions, maybe associated with sleep spindles
- Sleep spindles- 7-14 Hz lasting for 0.5 seconds.
- Lasts for 15-30 minutes.

### **STAGE III**

High voltage waves  $>75 \mu\text{V}$  delta ( $<2$  Hz) occupies more than 20% but less than 50 %, may have sleep spindles overriding the slow waves.

### **STAGE IV**

- $>50\%$  occupied by high voltage delta.
- Delta sleep- lasts for 30-45 minutes. Then back to stage 2 followed by REM, ending the first cycle of sleep.

### **REM**

- Low voltage intermixed cerebral activity with absent muscle tone and rapid eye movement.
- Saw tooth waves can be seen.
- Appears after 90-100 minutes in a young adult.

### **NREM**

Quiescence, repose  
Low body temperature Hypometabolism.

### **REM**

Neural instability and high cerebral activity that recurs every 90 minute intervals.

## **Characteristics of the 2 major patterns of sleep (REM & Non-REM)**

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**SUMMARY OF NONRAPID EYE MOVEMENT (NREM) AND RAPID EYE  
MOVEMENT (REM) SLEEP STATES**

Total Sleep time (per 24 hours clock time) across age group

**Development of Sleep-wake cycle in children**

Ontogeny of REM and non-REM

**Active Sleep REM (M)**

**Active Sleep REM (LVI)**

**Quiet Sleep Trace alternant (TA)**

**Quiet Sleep: slow wave sleep (HVS)**

Cardiovascular variations between waking and sleep states

**THEORIES OF SLEEP FUNCTIONS**

**Effects of Sleep on Hormone secretion**

**Main components of the brainstem**

- Cranial nerve nuclei & related structures
- Long tracts
- Cerebellar circuits
- Reticular formation & related structures

**Major Inputs to the**

**Pontomesencephalic Reticular Formation**

**Neurochemically Defined**

**Nuclear Groups**

**Cholinergic Projection**

**Dopaminergic Projection Systems**

**Noradrenergic Projection Systems**

**Serotonergic Projection systems**

**Histaminergic Projection Systems**

**Orexin Neurons**

**Brainstem circuits important for sleep regulation**

**Non REM Sleep**

**Brainstem circuits important for sleep regulation**

**REM Sleep**

**THEORIES OF SLEEP FUNCTIONS**

**Mean (SE) profiles of blood glucose and serum insulin during intravenous glucose tolerance test, and glucose and insulin responses to breakfast**

**Thyrotropin concentrations, free thyroxine index, and plasma and saliva cortisol concentrations in sleep-debt and sleep-recovery conditions**

**AGE AND INSOMNIA**

**DIAGNOSIS OF THE CAUSE OF INSOMNIA FROM THE HISTORY**

**CAUSES OF INSOMNIA REQUIRING POLYSOMNOGRAPHY**

**MANAGEMENT OF INSOMNIA**

**CHOICE OF BENZODIAZEPINE AND RELATED TYPES OF HYPNOTIC**

**Causes of Primary Insomnia**

- Sleep-state misperception
- Psychophysiological insomnia
- Anxiety states
- Attention deficit hyperactivity disorder
- Chronic fatigue syndrome
- Fibromyalgia
- ? Idiopathic insomnia

**Causes of patterns of insomnia**

**Common causes of secondary insomnia**

- Medical disorders and physical disability
- Dementia
- Parkinsonism
- Restless legs syndrome
- Circadian rhythm disorders
- Depression
- Menopausal symptoms
- Shift work
- Drugs

**Important investigations for sleep disorders**

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## **ASDA classification of sleep disorders 1997**

### **I Dyssomnias**

#### **•Intrinsic sleep disorders**

1.	Psychophysilogic insomnia	307.42-0
2.	Sleep state misperception	307.49-1
3.	Idiopathic insomnia	780.52-7
4.	Narcolepsy	347
5.	Recurrent hypersomnia	780.54-2
6.	Idiopathic hypersomnia	780.54-7
7.	Post-traumatic hypersomnia	780.54-8
8.	Obstructive sleep apnoea syndrome	780.53-0
9.	Central sleep apnoea syndrome	780.51-0
10.	Central alveolar hypoventilation syndrome	780.51-1
11.	Periodic limb movement disorder	780.52-4
12.	Restless leg syndrome	780.52-5
13.	Intrinsic sleep disorder NOS	780.52-9

## **ASDA classification of sleep disorders 1997**

#### **•Extrinsic sleep disorders**

•Inadequate sleep hygiene	307.4-1
•Environmental sleep disorder	780.52-6
•Altitude insomnia	289.0
•Adjustment sleep disorder	307.41-0
•Insufficient sleep syndrome	307.49-4
•Limit-setting sleep disorder	307.42-4
•Sleep-onset association disorder	307.42-5
•Food allergy insomnia	780.52-2
•Nocturnal eating (drinking) syndrome	780.52-8
•Hypnotic-dependent sleep disorder	780.52-0
•Stimulant-dependent sleeping disorder	780.52-1
•Alcohol-dependent sleeping disorder	780.52-3
•Toxin-induced sleep disorder	780.54-6
•Extrinsic sleep disorder NOS	780.52-9

## **ASDA classification of sleep disorders 1997**

#### **•Circadian-rhythm sleep disorders**

•Time zone change (jet lag) syndrome	307.45-0
•Shift work sleep disorder	307.45-1
•Irregular sleep-wake pattern	307.45-3
•Delayed sleep-phase syndrome	780.55-0
•Advanced sleep-phase syndrome	780.55-1
•Non-24-hour sleep-wake disorder	780.55-2
•Circadian rhythm sleep disorder NOS	780.55-9

### **ASDA classification of sleep disorders 1997**

- Parasomnias
- Arousal disorders
- Confusional arousals 307.46-2
- Sleepwalking 307.46-0
- Sleep terrors 307.46-1

- Sleep-wake transition disorders
- Rhythmic movement disorder 307.3
- Sleep starts 307.47-2
- Sleep talking 307.47-3
- Nocturnal leg cramps 729.82

### **ASDA classification of sleep disorders 1997**

- Parasomnias usually associated with REM sleep
- Nightmares 307.47-0
- Sleep paralysis 780.56-2
- Impaired sleep-related penile erections 780.56-3
- Sleep-related painful erections 780.56-4
- REM sleep-related sinus arrest 780.56-8
- REM sleep behaviour disorder 780.59-0
- Infant sleep apnea 770.80
- Congenital central hypoventilation syndrome 770.81
- Sudden infant death syndrome 798.0
- Benign neonatal sleep myoclonus 780.59-5
- Other parasomnial NOS 780.59-9

### **ASDA classification of sleep disorders 1997**

- Other parasomnias
- Sleep bruxism 306.8
- Sleep enuresis 788.36-0
- Sleep-related abnormal swallowing syndrome 780.56-6
- Nocturnal paroxysmal dyspnea 780.59-1
- Sudden unexplained nocturnal death syndrome 780.59-3
- Primary snoring 786.09-1

### **ASDA classification of sleep disorders 1997**

- Sleep disorders associated with mental, neurologic, or other medical problems
- Associated with mental disorders 290-319
- Psychoses 290-299
- Mood disorders 296-301, 311
- Anxiety disorders 300, 308, 309
- Panic disorders 300
- Alcoholism 303, 305

### **ASDA classification of sleep disorders 1997**

•Associated with neurologic disorders	320-389
•Cerebral degenerative disorders	330-337
•Dementia	331
•Parkinsonism	332
•Fatal familial insomnia	337.9
•Sleep-related epilepsy	345
•Electrical status epilepticus of sleep	345.8
•Sleep-related headaches	346

### **ASDA classification of sleep disorders 1997**

•Associated with other medical disorders	
•Sleeping sickness	086
•Nocturnal cardiac ischemia	411-414
•Chronic obstructive pulmonary disease	490-496
•Sleep-related asthma	493
•Sleep-related gastroesophageal reflux	530.81
•Peptic ulcer disease	531-534
•Fibromyalgia	729.1

### **ASDA classification of sleep disorders 1997**

•Proposed sleep disorders	
•Short sleeper	307.49-0
•Long sleeper	307.49-2
•Subwakefulness syndrome	307.47-1
•Fragmentary myoclonus	780.59-7
•Sleep hyperhidrosis	780.8
•Menstrual-associated sleep disorder	780.54-3
•Pregnancy-associated sleep disorder	780.59-6
•Terrifying hypnagogic hallucinations	307.47-4
•Sleep-related neurogenic tachypnea	780.53-2
•Sleep-related laryngospasm	780.59-4
•Sleep choking syndrome	307.42-1

### **Classification of important sleep disorders**

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### **Sleep hygiene**

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The two process model involves a sleep homeostatic process (S) and a circadian process (C). Sleep deprivation causes a progressive increase in process S, while fluctuations in process C persist.

Antisnoring appliance

- Snore ball

.(from fairbanks DNF: Snoring: A general overview with historical perspective. In Fairbanks DNF. Mickelson SA, Woodson BT (eds); Snoring and Obstructive Sleep Apnea, 3<sup>rd</sup> ed. Philadelphia, Lippincot Williams and Wilkins, 2003, p2, with permission)

- Chin and mouth strap

- Sleep-wake control immediately after 8 h westward travel.

- The sleep propensity is the sum of the circadian and homeostatic drives

**Pattern of Sleep**

NATURE OF SLEEP AND ITS DISORDER