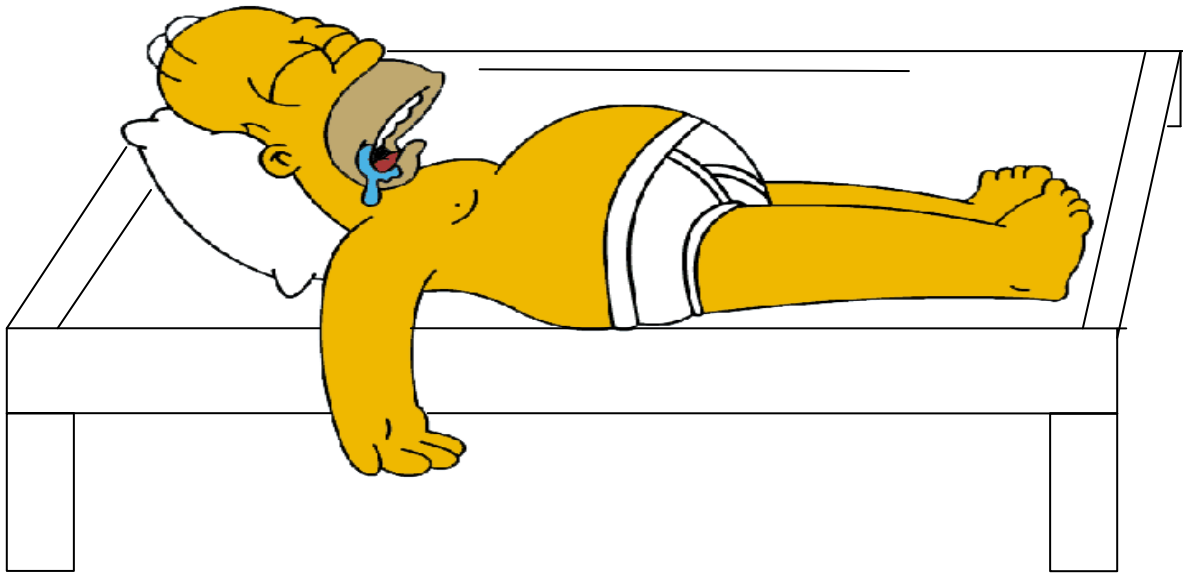


**ALL YOU WANTED TO KNOW ABOUT**



# **SLEEP**

its' basics, philosophy and science

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## 1. All about sleep

### 1.1 Essentials:

Sleep is an unconscious state from which a person can be aroused. It is the suspension of normal consciousness and is electrophysiologically described by specific brain wave criteria. Sleep is a naturally recurring state of relatively suspended sensory and motor activity, characterized by total or partial unconsciousness with the inactivity of nearly all voluntary muscles. It is distinguished from quiet wakefulness by a decreased ability to react to stimuli, and it is more easily reversible than hibernation or coma. This is observed in all mammals, birds, and many reptiles, amphibians, and fish. In humans, other mammals, and a substantial majority of other animals that have been studied (such as some species of fish, birds, ants, and fruit flies), regular sleep is essential for survival.

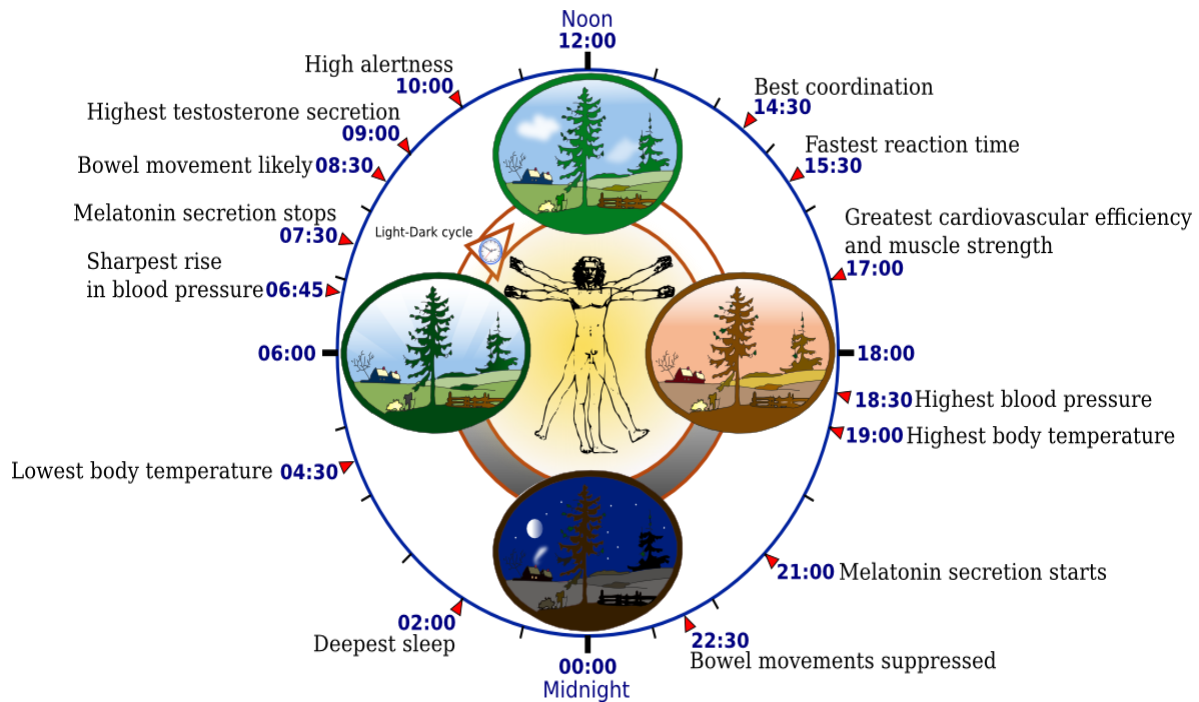


Sleep plays a major role in the normal functioning of human system. It is responsible for diverse human functions which occur when one is at rest (sleep). Sleep wake cycle is like 24 hours of a regular clock. The human clock is also tuned to certain timings and is called the circadian rhythm. This circadian rhythm is responsible for all the behavioral and functional shift of human system (e.g. the diurnal variation in body temperature, blood pressure, etc). The bodily functions changing with circadian rhythm is illustrated in **Figure 1**.

There are several mechanisms involved in maintenance of wakefulness and sleep. Sleep timing is controlled by the circadian clock, sleep-wake homeostasis, and in humans, within certain bounds,

willed behavior. The circadian clock — an inner timekeeping, temperature-fluctuating, enzyme-controlling device — works in tandem with adenosine, a neurotransmitter that inhibits many of the bodily processes associated with wakefulness. Adenosine is created over the course of the day; high levels of adenosine lead to sleepiness. In diurnal animals, sleepiness occurs as the circadian element causes the release of the hormone melatonin and a gradual decrease in core body temperature. The timing is affected by one's chronotype. Chronotype is an attribute of human beings reflecting whether they are alert and prefer to be active early or late in the day. The continuum is often referred to as "morningness/eveningness" or "larks" and "owls" where morning people wake up early and are most alert in the first part of the day, and evening people are most alert in the late evening hours and prefer to go to bed late. Chronotype is also referred to as circadian type, diurnal preference or diurnal variation. It is the circadian rhythm that determines the ideal timing of a correctly structured and restorative sleep episode.

Homeostatic sleep propensity (the need for sleep as a function of the amount of time elapsed since the last adequate sleep episode) must be balanced against the circadian element for satisfactory sleep. Along with corresponding messages from the circadian clock, this tells the body it needs to sleep. Sleep offset (awakening) is primarily determined by circadian rhythm. A person who regularly awakens at an early hour will generally not be able to sleep much later than their normal waking time, even if moderately sleep-deprived. Sleep duration is affected by circadian rhythm which is regulated by a gene named DEC2. Some people have a mutation of this gene; they sleep two hours less than normal.



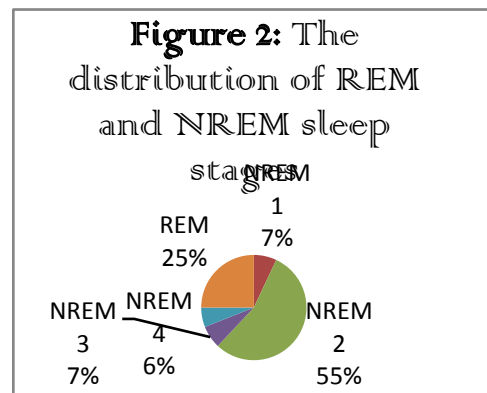
**Figure 1:** The circadian rhythm with corresponding major physiological functions of human body.

## 1.2 Types of Sleep:

In mammals (including human beings) and birds, sleep is divided into two broad types: Rapid Eye Movement (REM) and Non-Rapid Eye Movement (NREM or non-REM) sleep. Each type has a distinct set of associated physiological, neurological, and psychological features. For technical reasons NREM sleep is further classified by

researchers into three stages: N1, N2, and N3, which is also called delta, or slow-wave, sleep (SWS). See **Figure 2.**

In common terms, REM sleep is known as dream sleep. It is believed that a person dreams during the period of REM sleep. Whereas NREM sleep serves a restful and restorative function.



### 1.3 Traditional Indian views on sleep:

There have been several verses in numerous traditional Indian texts highlighting the concept of sleep, a few verses are selected here to explain the concept of dream, its nature the need for sleep and the understanding of deep sleep. There are large volumes of verses dedicated on the concept of dream and we get to know the thorough study and in depth knowledge of our ancient seers with regard to the subject of dream.

Ancient Indian texts of Ayurveda do provide reference on the concept of sleep.

An explanation by Sage Atreya ( *Atreya Samhitha*) defines sleep to be a state in which the body relaxes. He also emphasized on sleep to be very essential for survival like food for sustenance of human body.

देहं विश्रमति यस्मात्स्मा निद्रा प्रकीर्तिता ।

*deham viśramati yasmātsmā nidrā prakīrtitā |*

देह वृत्तौ यथाहारस्तथा स्वप्न समासतः ॥आत्रेय संहिता

*deha vṛttau yathāhārastathā svapna samāsataḥ | | ātreya saṁhitā.*

The process by which the body relaxes, that state is sleep- according to Atreya. The way in which body is supported by food, same way sleep is also important component for our body.

The *Charaka Samhitha* also puts forth similar understanding on sleep as the state that occurs on the dissociating of the mind, sensory and motor organs from their objects.

यदा तु मनसि क्लान्ते कर्मात्मानः क्लमान्विताः ।

विषयेभ्यो निवर्तन्ते तदा स्वपिति मनवः ।३५ ।

*Yadā tu manasi klānte karmātmānaḥ klamānvitāḥ |*

*viṣayebhyo nivartante tadā svapiti manavaḥ* | 35 |

When the mind including sensory and motor organs is exhausted and they dissociate themselves from their objects, then the individual sleeps. [Charaka.Samhitha.10.35]

The traditional references on sleep does match with the modern division of sleep as REM sleep or dream sleep which is referred to as *swapna avastha* and NREM sleep as *susupthi avastha*. There are numerous references explaining these concepts in detail. The following *slokas* give a glimpse on the concept of dream sleep as understood through the traditional scriptures.

अन्यथा युहतः सुप्तो निद्रा तत्त्वमजानतः ।

*Anythā gruhmataḥ suapnoae nidrā  
tatvamajānataḥ* |

Dream is the misapprehension of reality, sleep is the state in which one is in a state of non-apprehension of reality [Māṇḍūkya Kārikā.1.15].

The illusionary nature of dream state and its comparative relation to awakened state is given in the fourth sloka of the second chapter of Māṇḍūkya Kārikā

अन्तःस्थानात्तु भेदानां तस्माज्जागरिते स्मृतम् ।

यथा तत्र तथा स्वप्ने संवृतत्वेन भिद्यते ॥४ ॥

*Antaḥsthānāttu bhedānām tasmājjāgarite smṛtam |  
yathā tatra tathā svapne saṁvṛtatvena bhidyate* | 4 |

Different objects cognized in dream are illusory because they are being perceived to exist. For the same reason the objects seen in the waking state are also to be considered as illusory. As in the waking state so in the dream the nature of objects remains the same. The only difference is the limitation of space in the case of dream objects they being seen within. [Māṇḍūkya Kārikā .2.4]

The nature of association of the dreamer to the objects of the dream is explained in the following verses and their relation to the practical condition of the dreamer's ever changing mind is also expanded upon in the Māṇḍūkya Kārikā as follows.

अपुर्वं स्थनिधर्मे हि यथा स्वर्गनिवासिनाम् ।  
तानयं प्रेक्षते गत्वा यथैवेह सुशिक्षितः ॥८॥  
*Apurvaṁ sthanidharme hi yathā  
svarganivāsinām ।  
tānayaṁ prekṣate gatvā yathāiveha  
suśikṣitaḥ ॥ 8 ॥*

The objects perceived by the dreamer when they are of such nature as not easily met within the waking state, undoubtedly owe their existence to the practical condition in which the dreamer with his mind works for the time being as in the case of those residing in heaven. The dreamer associating himself with the dream conditions experiences those objects even as one when sent with full instructions goes from one place to another and sees the objects belonging to that place.  
[Māṇḍūkya Kārikā .2.8]

The state of mind on awakening from sleep is elaborated in the next verse and also mentions about the failure to remember those dreams on awakening.

मित्रचैः सह सम्मन्त्रय सम्बुद्धो न प्रपद्यते ।  
ग्रहितं चापि यत्किञ्चित् प्रतिबुद्धो न पश्यति ॥ ३५ ॥  
*Mitradyaiḥ saha sammantrya sambuddho  
na prapadyate ।  
grṛhitaṁ cāpi yatkicīt pratibuddho na  
paśyati ॥ 35 ॥*

The dreamer on being awakened realises his illusory part of the conversations he had with his companions during his dream. Moreover he does not retain in the waking state anything which he had acquired or received in his dream. [Māṇḍūkya Kārikā 4.35]

In the following verses, the illusory nature of dreams is explained citing logical reasons to substantiate the unreality of dreamer and dream, the difference between the body that is resting in sleep and the dream-body participating in the dream.

स्वप्ने चावस्तुकः कायः प्रिथगन्यस्य दर्शनात् ।

यथा कायस्तथा सर्वं चित्तदृश्यं वस्तुकम् ॥ ३६ ॥

*Svapne cāvastukaḥ kāyaḥ prithaganyasya  
darśanāt |*

*yathā kāyastathā sarvaṁ citta dṛśyaṁ  
vastukam | | 36 | |*

The body which is actively participating in the dream life must necessarily be unreal since the other body of the dreamer is perceived as lying in the bed as distinctly different from his dream-body. Like the body everything cognised in the dream is certainly unreal. [Māṇḍūkya Kārikā.4.36]

While affirmation of unreality of dreams are explained the answers to question like why do the experiences in dream appear so real? is answered in the next verse with reference to the relationship between waking state and dream state.

ग्रहणज्जागरितवत्तद्देतुः स्वप्न इष्यते ।

तद्देतुत्वाच्च तस्यैव सज्जागरितमिष्यते ॥ ३७ ॥

*Grahaṇajjāgaritavattaddetuḥ*

*svapna iṣyate |*

*taddetutvāttu tasyaiva*

*sajjāgaritamīṣyate | | 37 | |*

Since the experiences of objects in the dream are similar to the experience of objects in the waking state, it is thought to be the waking experiences. On account of this reason, the waking

experiences, which are supposed to be the cause for the dreams, appear as real to the dreamer alone. [Māṇḍūkya Kārikā.4.36]

The interconnecting relationship between the objects of dream, the dreamer and the mind is explained in the next verse, giving a clear picture of their relationship and influence during dreams.

स्वप्नदृक्चित्तदृश्यास्ते न विद्यन्ते ततः पृथक् ।

तथातद्द्रुश्यमेवेदं स्वप्नदृक्चित्तमिष्यते ॥ ६४ ॥

*Svapnadṛkcittadṛśyāste na vidyante*

*tataḥ pṛthak ।*

*tathā tadadruśyamevedam*

*svapnadṛkcittamiṣyate ॥ 64 ॥*

Just as the objects in the mind and the expression of the mind are not separate, similarly , the the mind of the dreamer is not separate from the dreamer himself [Māṇḍūkya Kārikā.4.364.64].

Deep sleep is referred to as *sushupti* in the scriptures like *māṇḍūkya kārikā* and *Yogavāsiṣṭham* , there are several references detailing the process and experiences of deep sleep.

The nature of deep sleep in explained though the following verses

यत्र सुप्तो न कञ्चन कामं कामयते न कञ्चन स्वप्नं पश्यति तत् शुषुप्तम् ।

शुषुप्तस्थान एकीभुतः प्रज्ञानधन एवा नन्दमयो ह्यानन्दभुक् चेतोमुखः

प्रज्ञास्मृतीयः पादः ॥ ५ ॥

*Yatra supto na kañcana kāmaṁ kāmāyate na kañcana*

*svapnam paśyati tat śuṣuṣṭam ।*

*śuṣuṣṭasthāna ekībhutaḥ prajñānadhana ebā nandamayo hyānandabhuk*

*cetomukhaḥ prajñāsmṛtīyaḥ pādaḥ ॥ 5 ॥*

That is the state of deep-sleep where in the sleeper does not desire any objects, nor does he see any problem . The third quarter (Pada) is the Prajnaya whose sphere is deep-sleep in whom all (experiences) become unified or undifferentiated, who is verily a homogenous mass of consciousness, and who is the very gateway for the projection of consciousness into the other two planes of consciousness the dream and the waking. [Māṇḍūkya Kārikā 1.5]

Many a times one associates the state of mind in deep sleep to that of meditation. The following verse clearly cites that the behavior of mind during these two states are not identical

निगृहितस्य मनसो निर्बिकल्पस्य धिमतः ।

प्रचारः स तु बिज्ञेयः सुषुप्तेऽन्यो न तत्समः ॥ ३४ ॥

*Nigr̥hitasya manaso nirbikalpasya dhimataḥ |  
pracāraḥ sa tu bijñeyaḥ suṣupte'nyo na tatsamaḥ || 34 ||*

The behavior that the mind has when it is under control, free from all ideation, and full of discrimination, should be particularly noted. The behavior of our mind in deep sleep is different and is not similar to that (of the control mind) [Māṇḍūkya Kārikā.3.34]

The benefits of a sound sleep are beautifully explained through the next verses and also points towards the protective aspect ( particularly against diseases) through a good sleep.

तद्यत्रैतत्सुप्तः समस्तः सम्प्रसन्नः स्वप्नं न विजानात्यासु

तदा नाडीषु सूप्तो भवति तं न काश्चन पाप्मा स्पृशति तेजसा हि

तदा सम्पन्नो भवति ॥३॥

*Tadyatraitatsuptaḥ samastaḥ samprasannaḥ  
svapnaṁ na vijānātyāsu tadā nāḍīṣu sṛpto  
bhavati taṁ na kāścana pāpmā spr̥ṣati  
tejasā hi tadā sampanno bhavati || 3 ||*

When a person is sound asleep, all his organs are inactive and quiet. He is free from all worries, and he does not have any dreams. The organs then disappear into the veins. No sin can affect him then, for the rays of the sun have surrounded him [Chandogya Upanishad.8.3].

#### **1.4 How do we measure sleep?**

Sleep is been a major interest of researchers since ages. The first measurements of sleep were made based on the subjective experiences of the individuals with the use of questionnaires. However these subjective tools did not yield very consistent and realistic results which lead to the advent of polysomnography.

Sleep stages and other characteristics of sleep are commonly assessed by special equipment called polysomnography in a specialized sleep laboratory. The word ‘polysomnography’ was derived from the Greek root ‘*Poly*’ meaning many, the Latin noun ‘*somnus*’ meaning sleep and the Greek word ‘*graphian*’ meaning to write. Thus this term describes the recording, analysis and interpretation of multiple simultaneous physiological parameters during sleep. It is a comprehensive recording of the biophysiological changes that occur during sleep. Measurements taken include EEG (electroencephalogram – electrical activity of brain), electrooculography (EOG) - eye movements, and electromyography (EMG) - skeletal muscle activity.



**Figure 3: (a)** Polysomnograph



**Figure 3: (b)** Subject sleeping with electrodes and transducers

Electrodes with wires are placed around the face and the scalp to measure these activities. Electrodes are placed using special paste meant to have a good conductivity with skin surface so as to pick the electrical signals from the designated areas as shown in **Figure 3: (a) & (b)**.

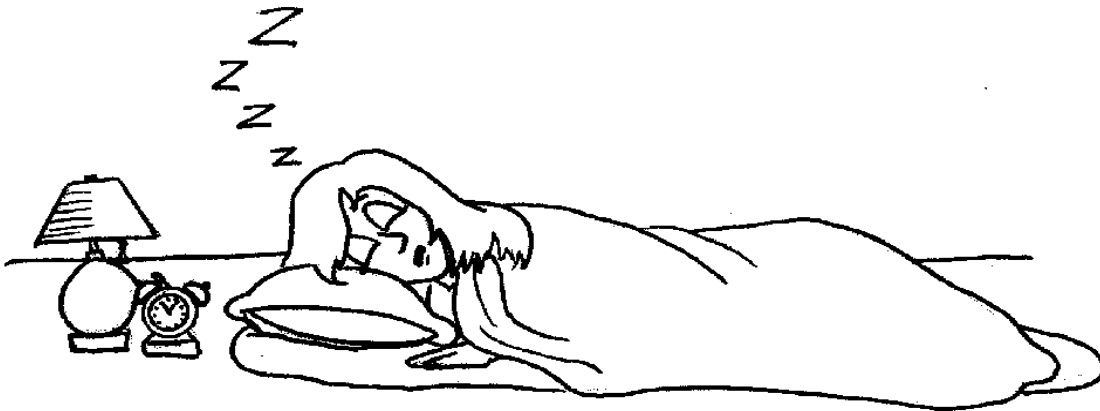
Other parameters like respiration, heart rate (by recording ECG), amount of oxygen in blood (Oxygen hemoglobin saturation; Pulse Oximetry), etc are also recorded to have additional information of the physiological changes occurring during sleep.

All these parameters are digitally recorded on a computer in different wave forms which are further analyzed and interpreted by an expert in form of sleep stage percentages.

## **2 Normal Human sleep**

### **2.1 Sleep architecture**

A normal adult typically sleeps for 8 hours. Of the total sleep time, an adult spends 75 – 80 percent in stage NREM and around 20 – 25 percent in REM sleep which usually occurs at the latter half of sleep. Therefore a normal healthy adult spends about 90 – 120 minutes per night in REM sleep in 4 – 5 periods. In total, the typical 8 hours sleep is divided into about 1.5 – 2 hours of REM sleep and about 6 hours of repeated descent into NREM sleep and subsequent ascent to



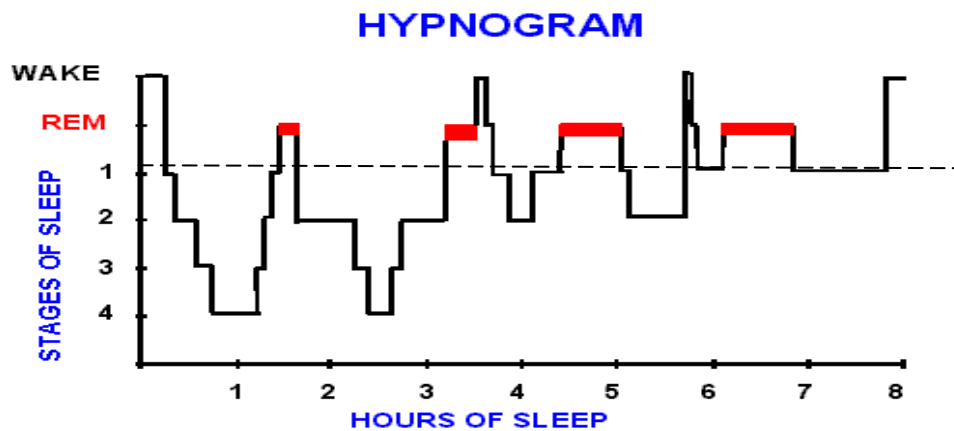
Sleep proceeds in cycles of REM and NREM, the order normally being N1 → N2 → N3 → N2 → REM. There is a greater amount of deep sleep (stage N3) early in the night, while the proportion of REM sleep increases later in the night and just before natural awakening. In humans, each sleep cycle lasts from 90 to 110 minutes on average and each stage may have a distinct physiological function. This can result in sleep that exhibits loss of consciousness but does not fulfill its physiological functions (i.e., one may still feel tired after apparently sufficient sleep).

However sleep requirement varies with age as it serves varied functions. Children need more sleep per day in order to develop and function properly: up to 18 hours for newborn babies, with a declining rate as a child ages. A newborn baby spends almost 9 hours a day in REM sleep. By the age of five or so, only slightly over two hours is spent in REM. This progressive decrease in REM with age is presented in **Table 1**.

Age and condition	Average amount of sleep per day
Newborn	up to 18 hours
1–12 months	14–18 hours

1–3 years	12–15 hours
3–5 years	11–13 hours
5–12 years	9–11 hours
Adolescents	9–10 hours
Adults, including elderly	7–8 (+) hours
Pregnant women	8 (+) hours

**Table 1:** Duration of normal sleep corresponding to respective ages and physiological conditions  
 A graphical representation of the shift of sleep cycles is called a Hypnogram. It gives an illustration of the distribution of NREM & REM sleep across the whole night record. (**Figure 4**)



**Figure 4:** Hypnogram

## 2.2 Importance of Good Sleep

Sleep is one of the basic needs of human being. A number of vital tasks carried out during sleep help maintain good health and enable people to function at their best. Not getting enough sleep can be dangerous. Around and about 1/3 of an average human's lifecycle is spent sleeping. Several important changes occur in the human body during sleep. It maintains the biological clock of human system.

The amount of sleep each person needs depends on many factors, including age, health, recent physical exertion, and mental activity. Sleep is a necessary and vital biological function. It is essential to a person's physical and emotional well being. Studies have shown that without enough sleep, a person's ability to perform even simple tasks declines dramatically.

The average sleep-deprived individual may experience impaired performance, irritability, lack of concentration, and daytime drowsiness. They are less alert, attentive, and unable to concentrate effectively. Additionally, because sleep is linked to restorative processes in the immune system, sleep deprivation in a normal adult causes a biological response similar to the body fighting off an infection. Persistent sleep deprivation can cause significant mood swings, erratic behavior, hallucinations, and in the most extreme, yet rare cases, death.

Sleep appears necessary for our nervous systems to work properly. Without sleep, the nerve cells or neurons may become so depleted in energy or so congested with the by-products of normal cellular activities that they begin to malfunction. Sleep also may give the brain a chance to exercise important neuronal connections that might otherwise deteriorate from lack of activity. Too little sleep leaves one drowsy, impairs memory and leads to physical tiredness too. If sleep deprivation continues, hallucinations and mood swings may develop.

Deep sleep coincides with the release of growth hormone in children and young adults. Many of the body's cells also show increased production and reduced breakdown of proteins during deep sleep. As noted by the American sleep association , proteins are the building blocks needed for cell growth and for repair of damage from factors like stress and ultraviolet rays, deep sleep may truly be "beauty sleep." Activity in parts of the brain that control emotions, decision-making processes, and social interactions are significantly reduced during deep sleep, suggesting that this type of sleep may help people maintain optimal emotional and social functioning while they are

awake. Deep sleep may help encode memories and improve learning by pattern repetition during deep sleep as suggested by a study in rats showed that certain nerve-signalling patterns which the rats generated during the day were repeated during deep sleep.

### 2.3 What does Indian tradition say about good sleep?

Ayurveda does also list out the conditions where in day sleep would be ideal based on the occupation, attitudes, behaviours and health conditions of the individual.

मुक्त्वातिभाष्यानाध्वमद्यस्त्रीभारकर्माभिः ।

क्रोधशोकभयैः क्लान्तान् श्वासहिच्चातिसारिणः ॥ अ सं ९- २७

muktvātibhāṣyānādhvamadyastribhāarakarmabhiḥ ।

क्रोधशोकभयैः क्लान्तान् श्वासहिच्चातिसारिणः ॥ अ सं ९- २७

krodhaśokabhayaiḥ klāntān śvāsaḥidmāṭisāriṇaḥ । । a sām 9- 27

वृद्धबालाबलक्षीणक्षततृट्च्छूलपीडितान् ।

vṛddhabālābalakṣiṇakṣatatṛṭcchūlapīditān ।

अजीर्ण्यभिहतोन्मत्तान् दिवास्वप्नोचितानपि ।

ajirṇyabhihatonmattān divāsvapnocitānapi ।

धातुसाम्यं तथा ह्योषां शेल्ष्मा चाङ्गानि पुष्यति ॥ अ । सं ९-२८

dhātusāmyaṁ tathā hyoṣāṁ śeḷṣmā cāṅgāni puṣyati । । a । sām 9-28

sleeping during day is permissible for those who are tired from excess indulgence in speech, riding on animals, walking long distances, alcoholic drinks, sexual intercourse and lifting heavy weights; anger, grief and fear; Those suffering from dyspnea, hiccup and diarrhea; The aged, the young, the debilitated, emaciated, the wounded, the thirsty; those suffering from pain, indigestion; Injury by weapons, insanity and other kind of mental disorders and those habituated to sleeping at day time. It produces in them, equilibrium of dhātu's and plumpiness of the body by body humor kapha [*Astanga Samgraha*]

The concept of excess sleep and its ill effects were very well understood and different conditions for their cause have been elaboratively listed in *Astanga Samgraha*. The process of excess sleep is said to be caused by the excess humor of kapha in the body which obstructs the orifices of the body leading to heaviness of the body, and laziness follows it which in turn leads to excess sleep. The different ill health conditions of the body produced by such injudicious sleep is given are jaundice, fever, nausea, cough etc.

The other extreme of sleep disorders i.e., lack of sleep or insomnia also is explained. Scriptural references from Ayurveda have given detailed account of the causes of the insomnia, its symptoms and the effects produced from this condition.

**विरेकः कायशिरोर्वमनं रक्तमोक्षणम् ।**

*virekaḥ kāyaśīrorvamananī raktamokṣaṇam |*

**धूमः क्षूत्तुड्व्यथाहर्षशोकमैथुनभीक्रुधः । अ सं ९- ३४**

*dhūmaḥ kṣūttuḍvvythāharṣaśokamāithunabhīkrudhaḥ | a saṁ 9- 34*

**चितोत्कण्ठाऽसुखा शय्यासत्वोदादार्यं तमोजयः ।**

*citotkaṇṭhā' sukḥā śayyāsatvodādāryaṁ tamojayaḥ |*

**रूक्षान्नं चाहिताम् निद्रां वारयन्ति प्रसङ्गिनीम् ॥ अ सं ९- ३५**

*rūkṣānnam cāhitām nidrāṁ vārayanti prasāṅginīm | | a saṁ 9- 35*

**एत एव च विज्ञेया निद्रानाशस्य हेतवः ।**

*eta eva ca vijñeyā nidrānāśasya hetavaḥ |*

**कालशीलक्षयो व्याधिवृद्धिश्चानिलपित्तयोः ॥ अ सं । ९- ३६**

*kālaśīlakṣayo vyādhirvṛddhiścānilapittayoḥ | | a saṁ | 9- 36*

Purgation of body and of the head, vomiting, blood letting, inhalation of smoke, hunger, thirst, pain, happiness, grief, sexual intercourse, fear, anger, worry and such other emotions; uncomfortable bed, increase of *satvaguṇa* victory over *tamoguṇa*, dry food and intense engagement (indulgence of any kind of rigorous work); lapse of the usual time and habit, effect

of diseases, increase of *vāta* and *pitta* (bodily humors) in the body- all these are the causes for loss of sleep

Even minute changes such uncomfortable bed have been listed to be a reason for lack of sleep and this adds to show the comprehensive depth and understanding that our ancient ayurvedic practitioners had every detail pertaining to the subject of study. The action and interaction among the various body humors of *vata*, *pitta* and *kapha* have also been noted to reasons for lack of sleep.

**आनूपौदकमांसानं भक्ष्यान् गौडिकपैष्टिकान् ।**

*ānūpaudakamānsānani bhakṣyān gauḍikapaiṣṭikān |*

**शालीन्मद्यानि माषांश्च किलाटान् माहिषं दधि ॥ अ सं ९-४२**

*śālīnmadyāni māṣāṁśca kilāṭān māhiṣani dadhi | | a san 9-42*

**अभ्यङ्गोद्वर्तनस्नानमूर्धश्रवणपूरणम् ।**

*abhyāṅgordvartanasnānamūrdhaśravaṇapūraṇam |*

**चक्षुषस्तर्पणं लेपः शिरसोवदनस्य च ॥ अ सं ९- ४३**

*caḥṣuṣastarpaṇani lepaḥ śirasovadanasya ca | | a san 9- 43*

**प्रवाते सुरभौ देशे सुखां शय्यां यथोचिते ।**

*pravāte surabhau deśe sukhaṁ śayyāni yathocite |*

**संवाहनं स्पर्शसुखं चित्तज्ञैरनुजीविभिः ॥ अ सं ९- ४४**

*saṁvāhanani sparśasukhaṁ cittajñairanujīvibhiḥ | | a san 9- 44*

**सर्पिःक्षीरानुपानं च जिवनीयैः श्रतं पिबेत् ।**

*sarpīḥkṣīrānupānani ca jivanīyaiḥ śratani pibet |*

**कान्ताबाहुलताश्लेषो निवृत्तिः कृतकृत्यता ॥ अ सं ९-४५**

*kāntābāhulatāśleṣo nivṛtṭiḥ kṛtakṛtyatā | | a san 9-45*

Persons who get insufficient sleep should use milk, sugarcane juice, meat soup and meat of animals of marshy places and of those living in water ; eatables prepared from jaggery and flour ;

rice, wines, black grams, skimmed buttermilk, curds of buffalo milk . These are mentioned as ideal foods for inducing sleep as given in the ninth chapter of *Astang Samgraha*.



### **3. Why do we need sleep?**

Understanding the physiological processes related to sleep would help us in knowing the reasons for the need of good sleep. Wound healing has been shown to be affected by sleep. A study conducted by Gumustekin and others in 2004 shows sleep deprivation hindering the healing of burns on rats.

It has been shown that sleep deprivation affects the immune system. Zager and others demonstrated the relationship between sleep and immunity in 2007, where rats deprived of sleep for 24 hours, were compared with rats with normal sleep, the sleep-deprived rats' blood tests indicated a 20% decrease in white blood cell count, a significant change in the immune system. It is now possible to state that "sleep loss impairs immune function and immune challenge alters sleep," and it has been suggested that mammalian species which invest in longer sleep times are investing in the immune system, as species with the longer sleep times have higher white blood cell counts.

It has yet to be proven that sleep duration affects somatic growth. A study by Jenni and others in 2007 recorded growth, height, and weight, as correlated to parent-reported time in bed in 305 children over a period of nine years (age 1–10). It was found that "the variation of sleep duration among children does not seem to have an effect on growth." It has been shown that sleep—more specifically, slow-wave sleep (SWS)—does affect growth hormone levels in adult men. During eight hours' sleep, Van Cauter, Leproult, and Plat found that the men with a high percentage of SWS (average 24%) also had high growth hormone secretion, while subjects with a low percentage of SWS (average 9%) had low growth hormone secretion.

There are multiple arguments supporting the restorative function of sleep. We are rested after sleeping, and it is natural to assume that this is a basic purpose of sleep. The metabolic phase during sleep is anabolic; anabolic/cell building hormones such as growth hormones (as mentioned above) are secreted preferentially during sleep. The duration of sleep among species is, in general, inversely related to animal size and directly related to basal metabolic rate. Rats with a very high basal metabolic rate sleep for up to 14 hours a day, whereas elephants and giraffes with lower BMRs sleep only 3–4 hours per day.

Energy conservation could as well have been accomplished by resting quiescent without shutting off the organism from the environment, potentially a dangerous situation. A sedentary nonsleeping animal is more likely to survive predators, while still preserving energy. Sleep, therefore, seems to serve another purpose, or other purposes, than simply conserving energy; for example, hibernating animals waking up from hibernation go into rebound sleep because of lack of sleep during the hibernation period. They are definitely well-rested and are conserving energy during hibernation, but need sleep for something else. Rats kept awake indefinitely develop skin lesions, hyperphagia, loss of body mass, hypothermia, and eventually, septicemia and death.

Non-REM sleep may be an anabolic state marked by physiological processes of growth and rejuvenation of the organism's immune, nervous, muscular, and skeletal systems (with some exceptions). Wakefulness may perhaps be viewed as a cyclical, temporary, hyperactive catabolic state during which the organism acquires nourishment and reproduces.

### **3.1 Importance of REM/Dream sleep**

According to the ontogenetic hypothesis of REM sleep, the activity occurring during neonatal REM sleep (or active sleep) seems to be particularly important to the developing organism. Studies investigating the effects of deprivation of active sleep have shown that deprivation early in life can result in behavioral problems, permanent sleep disruption, decreased brain mass, and an abnormal amount of neuronal cell death.

REM sleep appears to be important for development of the brain. REM sleep occupies the majority of time of sleep of infants, who spend most of their time sleeping. Among different species, the more immature the baby is born, the more time it spends in REM sleep. Proponents also suggest that REM-induced muscle inhibition in the presence of brain activation exists to allow for brain development by activating the synapses, yet without any motor consequences that may get the infant in trouble. Additionally, REM deprivation results in developmental abnormalities later in life.

However, this does not explain why older adults still need REM sleep.

### **3.2 Memory and Sleep**

Scientists have shown numerous ways in which sleep is related to memory. In a study conducted by Turner, Drummond, Salamat, and Brown, working memory was shown to be worsened by

sleep deprivation. Working memory is important because it keeps information active for further processing and supports higher-level cognitive functions such as decision making, reasoning, and episodic memory. The study allowed 18 women and 22 men to sleep only 26 minutes per night over a four-day period. Subjects were given initial cognitive tests while well-rested, and then were tested again twice a day during the four days of sleep deprivation. On the final test, the average working memory span of the sleep-deprived group had dropped by 38% in comparison to those who had normal sleep.

Memory seems to be affected differently by certain stages of sleep such as REM and slow-wave sleep (SWS). In one study cited in Born, Rasch, and Gais, used multiple groups of human subjects where one group was awake (control group) and the other group with normal sleep (test group). Sleep and wake groups were taught a task and were then tested on it, both on early and late nights, with the order of nights balanced across participants. When the subjects' brains were scanned during sleep, hypnograms revealed that SWS was the dominant sleep stage during the early night, representing around 23% on average for sleep stage activity. The early-night test group performed 16% better on the declarative memory test than the control group. During late-night sleep, REM became the most active sleep stage at about 24%, and the late-night test group performed 25% better on the procedural memory test than the control group. This indicates that procedural memory benefits from late, REM-rich sleep, whereas declarative memory benefits from early, SWS-rich sleep.

Few studies showed that Slow wave sleep consolidates episodic memory in the brain. A study has also been done involving direct current stimulation to the prefrontal cortex to increase the amount of slow oscillations during. The direct current stimulation greatly enhanced word-pair

retention the following day, giving evidence that SWS plays a large role in the consolidation of episodic memories.

The different studies all suggest that there is a correlation between sleep and the complex functions of memory. Harvard sleep researchers Saper and Stickgold point out that an essential part of memory and learning consists of nerve cell dendrites' sending information to the cell body to be organized into new neuronal connections. This process demands that no external information is presented to these dendrites, and they suggest that this may be why it is during sleep that we solidify memories and organize knowledge.

### **3.3 Preservation and Sleep**

The "Preservation and Protection" theory holds that sleep serves an adaptive function. It protects the animal during that portion of the 24-hour day in which being awake, and hence roaming around, would place the individual at greatest risk. Organisms do not require 24 hours to feed themselves and meet other necessities. From this perspective of adaptation, organisms are safer by staying out of harm's way, where potentially they could be prey to other, stronger organisms. They sleep at times that maximize their safety, given their physical capacities and their habitats.

## **4. What influences sleep?**

### **4.1 Diet**

Diet plays the primary role in maintenance of optimal health. Diet has its effect on all the systems of human body and therefore on sleep patterns. Also shifts in the sleep pattern influences diet intake. Sleep may be either eased or inhibited by different type of diets.

#### **4.1.1 Foods that promote sleep**

**a) Milk and honey promote sleep.** Milk contains tryptophan, an essential amino acid that is among the natural dietary sleep inducers. Tryptophan works by increasing the amount of serotonin, a natural sedative, in the brain. This is why so many folk remedies include warm milk with a teaspoonful of honey, a simple sugar. (Carbohydrates facilitate the entry of tryptophan into the brain.) A turkey sandwich provides another sleep-inducing combination of tryptophan and carbohydrates. A banana with milk gives you vitamin B6, which helps convert tryptophan to serotonin.

**b) Many herbs** are said to be useful for inducing sleep; one of the most popular and reliable is valerian. Its qualifications as a sedative have been supported by research demonstrating that active ingredients in the valerian root depress the central nervous system and relax smooth muscle tissue. Valerian that is brewed into a tea or taken as a capsule or tincture can lessen the time it takes to fall asleep and produce a deep, satisfying rest. It does not result in dependency or cause a “hangover” feeling. Other herbal remedies that have been suggested for sleep problems include teas made of chamomile, hops, lemon balm, and peppermint. Green leafy vegetables also promote a peaceful sleep by helping easy digestion and absorption.

### **c) Recommendations**

If you want to fall asleep more easily, eat a high-carbohydrate snack and avoid high-protein foods in the hour or two before bed time.

In the evening, eat turkey, bananas, figs, dates, yogurt, milk, and whole grain crackers or nut butter. These foods are high in



tryptophan, which promotes sleep. Eating a grapefruit half at bedtime also helps.



tuna,

Avoid bacon, cheese, chocolate, eggplant, ham, potatoes, sauerkraut, sugar, sausage, spinach, tomatoes, and wine close to bedtime. These foods contain tyramine, which increases the release of norepinephrine, a brain stimulant.

Our digestive system slows at night. So, it is harder to digest meals. Avoid heavy meals before bedtime.



late

#### 4.1.2 Foods that inhibit sleep

##### a) Coffee

Caffeine present in coffee, works by temporarily blocking the adenosine receptors in these specific parts of the brain. Adenosine is a chemical that builds up in brain during wakefulness. As adenosine levels increase, scientists think that the chemical begins to inhibit the brain cells that promote alertness and gives rise to the sleepiness which we experience when we have been awake for many hours. Because these nerve cells cannot sense adenosine in the presence of caffeine, they maintain their activity and we stay alert.

duration of its effect depends on the amount of caffeine the amount of time before sleep that the person ingests caffeine, the individual's tolerance level, the degree of sleep debt, and the phase of the individual's internal



The ingested, the ongoing clock.

Avoid caffeine, chocolate, caffeinated sodas and teas.

##### b) Alcohol

Many a times, alcohol is commonly used as a sleep aid. However, although alcohol can help a person fall asleep more quickly, the quality of sleep under the influence of alcohol will be

compromised. Ingesting more than one or two drinks shortly before bedtime has been shown to cause increased awakenings and in some cases disturbed sleep or even insomnia due to the arousal effect the alcohol has as it is metabolized later in the night. In persons with sleep disorders such as sleep apnea, the use of alcohol also tends to worsen its symptoms.

❖ **Summary on food and sleep**

**Foods to Eat**

■	Chlorophyll-rich foods, such as leafy, green vegetables, steamed or boiled.
■	Microalgae, such as chlorella and spirulina.
■	Oyster shell can be purchased in health food stores and taken as a nutritional supplement.
■	Whole grains: Whole wheat, brown rice, and oats have a calming and soothing effect on the nervous system and the mind. Carbohydrates also boost serotonin, which promotes better sleep.
■	Mushrooms (all types)
■	Fruit, especially mulberries and lemons, which calm the mind.
■	Seeds: jujube seeds are used to calm the spirit and support the heart. Chia seeds also have a sedative effect.
■	Dill
■	Basil

Foods such as bread, bagels, and crackers that are high in complex carbohydrates have a mild sleep-enhancing effect because they increase serotonin, a brain neurotransmitter that promotes sleep.

A glass of warm milk with honey is one of the oldest and best remedies for insomnia. Milk contains tryptophan which, when converted to serotonin in the body, induces sleep and prevents waking.

Lettuce has a long-standing reputation for promoting healthy sleep. This is due to an opium-related substance combined with traces of the anticramping agent hyoscyarnin present in lettuce. Lettuce should be an integral part of your evening diet if you are suffering from sleep disorders. The meal should also include legumes, peanuts, nutritional yeast, fish or poultry. These foods contain vitamin B3 (niacin). Niacin is involved in serotonin synthesis and promotes healthy sleep. Mixed with a little lemon juice for flavor, lettuce juice is an effective sleep-inducing drink highly preferable to the synthetic chemical agents in sleeping pills.

**Foods to Avoid**

■	Coffee
■	Tea
■	Spicy foods
■	Cola
■	Chocolate
■	Stimulant drugs
■	Alcohol
■	Refined carbohydrates (They drain the B vitamins.)
■	Additives
■	Preservatives
■	Non-organic foods containing pesticides.
■	Canned foods or any source of toxicity or heavy metals.

■	Sugar and foods high in sugar and refined carbohydrates. These raise blood-sugar levels and can cause a burst of energy that disturbs sleep.
■	Foods that are likely to cause gas, heartburn, or indigestion, such as fatty or spicy foods, garlic-flavored foods, beans, cucumbers, and peanuts.
■	Foods such as meat that are high in protein can inhibit sleep by blocking the synthesis of serotonin, making us feel more alert.
■	Monosodium glutamate (MSG), often found in Chinese food. This causes a stimulant reaction in some people.
■	Avoid cigarettes and tobacco. While smoking may seem to have a calming effect, nicotine is actually a neurostimulant and can cause sleep problems.
■	Alcohol and caffeine are two beverages/food that you must avoid for a healthy sleep. Avoid caffeine in all forms (tea, coffee, cola, chocolate). See Also: Caffeine Content of Common Beverages for a table of caffeine in common beverages.

The sensitivity to the stimulant effects of caffeine varies greatly from one person to the next.

This is largely a reflection of how quickly the body can eliminate caffeine. Even small amounts of caffeine such as those found in decaffeinated coffee or chocolate, may be enough to cause insomnia in some people.

Alcohol produces a number of sleep-impairing effects. In addition to causing the release of adrenaline, alcohol impairs the transport of tryptophan into the brain, and, because the brain is dependent upon tryptophan as the source for serotonin (an important neurotransmitter that initiates sleep), alcohol disrupts serotonin levels.

Avoid too many ingredients in a meal and too much food late at night.

<b>Do's and Don'ts for a better sleep</b>
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\* Eat a small snack several hours before bedtime. Hunger pangs can wake you up, so don't go to sleep hungry. Choose a small, healthy snack, such as a small bowl of oatmeal or cereal with low-fat milk, or yogurt.

\* Avoid large, high-fat meals before bed. A light snack is fine, but eating too much late in the evening can interfere with sleep.

\* Avoid heavy, spicy foods, especially if you're prone to heartburn. Eating too much may cause you to feel physically uncomfortable when lying down.



\* Don't drink too much liquid. Drinking lots of fluids before bed can cause you to wake up repeatedly to use the bathroom.

#### **4.2 Work pattern:**

The pace of modern living and its associated wrong lifestyle habits have had bad influence on the health of human beings. The working patterns have been adjusted to suit the demands and we do come across increased number of people involved in night shifts and working at odd hours. Individuals who work in the night shift typically have two symptoms. One is insomnia when they are trying to sleep outside of their internal phase, and the other is excessive sleepiness during the time when their internal clock says that they should be asleep. Almost half of all night shift workers regularly report nodding off and falling asleep when they are at work. This has

become an serious and important concern both for individuals and society, given that physicians, nurses, police, airline pilots and other public safety workers are all employed in professions in which peak functioning during a night shift may be critical.

#### **4.3 Disease conditions:**

There are a wide range of disease conditions that can have an impact on sleep. These conditions include chronic pains from arthritis and other musculoskeletal disorders, discomforts from digestive diseases (Ex: gastroesophageal reflux disease), pre-menstrual syndrome and many others. Pain and discomfort tend to limit the depth of sleep and allow only brief episodes of sleep between awakenings.

Individuals of all ages who experience stress, anxiety, and depression tend to find it more difficult to fall asleep. If and when they do manage to get sleep, it tends to be light and includes more of REM sleep and less of deep sleep. This is unfortunately an adaptive mechanism by our bodies which has been programmed to respond to stressful and potentially dangerous situations by waking up. Stress, even those of which are caused by daily concerns, do have the potential to stimulate the arousal response and make restful sleep more difficult to achieve.



## 5. Influence of Yoga on sleep:

### 5.1 Scriptural views:

There is a lot of literature focusing on yoga and sleep. The *Mandukya Upanisad* has described different stages of wakefulness and sleep in a great detail. It describes four distinct states from wakefulness (*Jagritavastha*) to sleep (*Sushuptiavastha*).

जागरितस्थानो बहिष्प्रज्ञः सप्ताङ्ग एकोनविंशतिमुखः स्थूल भुग्वैश्वनरः प्रथमः पादः ॥ ३ ॥

*Jāgaritasthāno bahiṣprajñāḥ saptāṅga ekonaviṁśatimukhaḥ sthūla bhugvaiśvanaraḥ  
prathamāḥ pādāḥ | | 3 | |*

The first quarter is vaésvanārah whose sphere of activity is the waking state, who is conscious of the external world of objects, who has seven limbs and nineteen mouths, and who enjoys the gross objects of the world. [M.K.1.3]

जाग्रदबृताबपि त्वन्तश्चेतसा कल्पितं त्वसत् ।

बहिश्चेतगृहितं सद्युक्तं बैतथ्यमेतयः ॥ १० ॥

*Jāgradabṛtābapi tvantaścetasā kalpitam tvasat |*

*bahiścetaogrhitam sadyuktam baitathyametayaoh || 10 ||*

Even in the waking state, whatever is imagined by the inner consciousness is false and whatever is perceived by the outer consciousness is true. It is reasonable that both these should be unreal. [M.K.2.10]

A human being perceives the joys and sorrows of the external world when he is wakeful (*Jagratavastha*) and yoga helps him to bring about a balance of these external entities thereby harmonizing the body and the mind.

सबस्तु सोपलम्भं च दूयं लकिकमिष्यते ।

अबस्तु सोपलम्भं च शुद्धं लकिकमिष्यते ॥८७॥

*Sabastu sopalambham ca dūyam laokikamiṣyate |*  
*abastu sopalambham ca śudham laokikamiṣyate || 87 ||*

The ordinary (waking) state is admitted to be that quality, coexisting with things of empirical reality and fit to be experienced. The object less ordinary (dream) state is admitted to be without any object and yet as though full of experience. [M.K.4.87]

Excessive sleep is referred to be one of the causes of afflictions according to *Patanjali*. Thus *Patanjali* describes the way of overcoming excessive sleep by the practice of yoga. Thus yoga is known to have a positive effect on sleep of individuals.

## 5.2 Scientific views

Yoga practices have shown to reduce stress and increase the levels of peace and calmness. One of the several applications of these benefits has been its possible the improvement of sleep. Research has been conducted to study of different yoga techniques on stress levels and especially in the quality of sleep. One of the yoga techniques called Cyclic Meditation (CM) which involves alternate stimulation and relaxation is proved to have beneficial effects on various body functions.



effects in  
the effect  
assessing

Adha Kati Chakrasana -  
as in cyclic meditation

A recent study (Patra and Telles, 2009) proved yoga (cyclic meditation) to have a relaxing effect on the heart and thereby subsequent sleep as demonstrated by the shift of sympatho-vagal



balance in favor of parasympathetic dominance. Similar study on the impact of a meditation technique (Cyclic meditation / CM) on sleep have shown to increase the percentage of time spent in slow-wave sleep (SWS) or deep sleep, decreased time spent in rapid-eye movement (REM) sleep or dream sleep, reduced number of awakenings per hour, overall increase in sleep duration, an reported increase in feeling refreshed & feeling good in the morning and decrease in degree to which sleep was influenced by being in laboratory and other associated settings.

A similar study on long term yoga practitioners showed significant psycho-biological differences such as better quality of sleep and modulatory action on the levels of cortisol, suggesting interesting implications for further research (Vera et.al, 2009). Mindfulness based stress reduction [MBSR] was shown to be an effective treatment in improving the quality and duration of sleep in organ transplant recipients, this improvement continued even after 6 months after the completion of MBSR (Kreitzer et.al., 2005).

Sleep disturbances are quite common in old age. A study on the influence of yoga and ayurveda in a geriatric population showed that the Yoga group showed a significant decrease in the time taken to fall asleep, an increase in the total number of hours slept and in the feeling of being rested in the morning based on a rating scale after six months.



Hatha Yogic practices

The other groups did not show any significant changes (Manjunath and Telles, 2005). A randomized control study done in the elderly after practicing yoga (Silver yoga exercise), measured sleep disturbances as one of their mental health indicators (Chen,2009). The

results showed that after 6 months of the yoga practice, there was a significant improvement in the quality of sleep in the yoga group. The same trend continued in similar study on female seniors practicing the same yoga technique (silver yoga exercise). There was significant reduction in the sleep disturbance after the yoga practice (Chen and Tseng, 2008).

A growing body of research suggests that traditional mind-body practices such as yoga help in dealing with many of the conditions associated with menopause and related sleep disturbances. A recent review done on the effect of yoga on menopausal symptoms found that yoga based techniques reduce menopausal symptoms and restores proper sleep (Innes, Selfe, and Vishnu, 2010). A study to assess the efficacy of an integrated approach of yoga therapy (IAYT) in climacteric syndrome did show a significant reduction in sleep disturbance in yoga group when compared to the control group (Chattha et.al., 2008) Similar results were observed in a study (Booth-Laforce, Thurston and Taylor, 2005) on effect of *hatha* yoga for menopausal symptoms, there were significant pre to post- treatment improvements in sleep efficiency, disturbances, and quality of sleep in the yoga group.

Insomnia is the most common sleep disorder worldwide with trends showing a rapid increase in its prevalence along with modern lifestyle and stresses. The ancient system of Kundalini yoga includes a vast array of meditation techniques and many of these techniques were developed as specific meditation techniques to deal with specific disorders which include insomnia and other sleep disorders (Shannahoff-Khalsa, 2004). A simple daily yoga treatment was evaluated in a chronic insomnia population showed significant improvements in sleep efficiency, total sleep time, total wake time, sleep onset latency, wake time after sleep onset at end-treatment when compared with pretreatment values (Khalsa, 2004). The clinical applications of yoga therapy have been widely researched and one of the main areas of its applications has

been in cancer care. The quality of life index has been widely studied to note the effect of yoga before and after the practice of yoga. Sleep is one of the main indices used to assess the quality of life. Yoga practice may assist cancer survivors in managing symptoms of insomnia and sleep disturbances. The effects of Tibetan yoga interventions in patients with lymphoma on their sleep quality was assessed in other study and it showed better subjective sleep quality, reduced sleep disturbances, faster sleep latency, longer sleep duration and less use of sleep medications in the yoga group compared to the waitlist control group (Cohen, 2004).

Thus we see several works done in the area of yoga and sleep clearly highlighting the role of various yoga techniques in providing good quality of sleep across various age groups and clinical conditions. This is also an area of active research that would bring about understanding about the various dimensions of the influence of yoga in sleep in the future.

### **Summary**

Sleep is an unconscious state from which a person can be aroused. Sleep plays a major role in the normal functioning of human system.

Sleep is divided into two broad types: Rapid Eye Movement (REM) and Non-Rapid Eye Movement (NREM or non-REM) sleep. For technical reasons NREM sleep is further classified by researches into three stages: N1, N2, and N3, the last of which is also called delta, or slow-wave, sleep (SWS).

In common terms, REM sleep is known as dream sleep as it is believed that a person dreams during the period of REM sleep. Whereas NREM sleep serves a restful and restorative function.

A normal adult typically sleeps for 8 hours. Of the total sleep time, an adult spends 75 – 80 percent in stage NREM and around 20 – 25 percent in REM sleep which usually occurs at the latter half of sleep. Sleep proceeds in cycles of REM and NREM, the order normally being N1 → N2 → N3 → N2 → REM. There is a greater amount of deep sleep (stage N3) early in the

night, while the proportion of REM sleep increases later in the night and just before natural awakening.

Sleep is measured using specialized equipment called a polysomnograph. This has several amplifiers and other technical set up to record EEG, EOG and EMG of an individual. These three are the basic components to describe different stages of sleep.

Sleep is a necessary and vital biological function. It is essential for a person's physical and emotional well being. It is responsible for faster and proper wound healing, restoration of the immune function, regulation of hormonal secretions of the body. Sleep also restores memory and cognitive functions. Proper sleep is essential for optimum functioning of an individual at all the levels of existence. Sleep restores all the body functions and imparts physiological rest for few systems in the body. It is responsible for normal growth and wellness of an individual.

Various factors can influence sleep. Diet, exercise, stress, work environment, physical disabilities, diseases, etc have a direct effect on the quality of sleep. Milk and honey promote sleep whereas coffee and alcohol inhibit sleep. Painful conditions and few other diseases lead to a disturbed sleep thereby affecting the overall functions of the body.

Yoga is been a useful tool in promotion and balance of sleep wake cycle. Several yoga practices have a direct impact on sleep. Yoga has found to improve sleep efficiency in a diverse population of practitioners from different communities, age and genders. Yoga has rendered relief to all the sleep disorders which were secondary to some chronic diseases or painful conditions.

Thus yoga is the key to health living.

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