CHAPTER - II

REVIEW OF LITERATURE
[A] CONCEPTS OF MEDITATION IN TRADITIONAL YOGIC AND SPIRITUAL LITERATURE

‘He who sees the entire world of animate and inanimate objects in himself and also sees himself in all animate and inanimate objects because of this does not hate any’

*is a Yogi*

- *Iśāvāsy ā Upaniṣat*
1.0 BACKGROUND AND SCOPE

Yoga is both the goal as well as the means to achieve a state of perfect harmony. Yoga is a state of complete absorption, union (Yoga sthiti) with absolute Reality i.e., Universal Consciousness. The word Yoga comes from the Sanskrit root word ‘Yuj’ which means integration, or a meeting with the true Self (Apte, 1992). Yoga is also an art of living and a systematic process to reach the state of Mokśa, endowed with perfect silence, knowledge, power and bliss (Nagendra, Nagrathana, 2001).

The world that we perceive and experience (around and within us) is one reflected by our own minds. If that ‘mirror’ is covered with dust or dirt (of ignorance, wrong values in form of vāsanās, and sasāskāras) the reflection from it is distorted. However if one cleanses and polishes the mirror of the mind, it reflects the Reality, the true nature of Self, which is God. This cleansing is accomplished by the practice of yogic disciplines and austerities, which includes the control of the senses and the various forms of meditations. Yoga is to purify, control (nirodha) and slowdown (praśamana) the mind and its modifications (vṛttis) by skill (kauśala) and knowledge (viveka).

Indian tradition offers different disciplines to arrive at this state of absolute freedom according to different predispositions, temperaments (guṇas) and abilities of people. One can reach Mokśa by psychic control (Raja yoga), by intellectual
analysis (*Jñana yoga*), by surrender and devotion (*Bhakti yoga*), by selfless service
(*Karma yoga*), or by combination of all (Vivekananda, 2001).

The theoretical basis and techniques of yoga have been described in ancient Yoga texts. These observations were based on the actual experiences of the ancient sages, who studied what was taking place within them. Around 900 BC the Sage Patanjali, compiled the principles of yoga in the form of yoga aphorisms (*yoga-suträs*) and offered an eight fold path of practices called *Aṣṭāṅga Yoga*. The *aṣṭāṅga yoga* has eight limbs: *yama* (restraints), *niyama* (observances of discipline), *āsanās* (postures), *prānāyāma* (regulation of breathing) *pratyahāra* (withdrawal of senses), *dhyāna* (focusing), *dhyāna* (meditation) and *samādhi* (a state complete absorption) (Taimini, 1996, Ch: 2, V: 29).

While moving along this path one gets benefits such as good physical health, a peaceful mind, balanced emotions and in consequence harmonious relations with others and greater efficiency in action. Hence the popularity and awareness about yoga is growing. However, sometimes people practice yoga only to achieve these benefits forgetting the main objective and purpose of yoga. As a result many types of meditation techniques have become prevalent today. Several books and descriptions have been written about these meditation techniques. In spite of this their basis and the principles involved remain vague. The present compilation aims at attempting to clarify the theoretical basis of meditation according to ancient texts.
2.0 AIMS AND OBJECTIVES

The present review was conducted to:

v) Compile authentic information on meditation from classical yogic and spiritual literature.

vi) Study the basic principles and theory of meditation based on traditional literature.

vii) Describe in brief the different methods of meditation and commonalities between them.

viii) Define and present concept of a specific technique i.e., cyclic meditation.
3.0 MATERIALS AND METHODS

3.1 Source material

The traditional yogic and spiritual literature was reviewed. The sources for the present literary search included:

E) Classical yoga texts: (i) Patanjali yoga sūtrās, Vyāsa bhaṣyā on Patanjali yoga sūtrās (iii) Bhagavad gītā, (iv) Hatha yoga pradīpikā, (v) Gheranda saṁhitā and (vi) Shiva saṁhitā


G) Prakharāṇa Granthās like Atma bodha and Vivekacūdamāṇi

H) Texts written by persons recognized as spiritual leaders and visionaries like Sri Ramkrishṇa Pramahansa, Swami Vivekananda and Swami Adhīśwarānanda

3.2 Methods

The verses and relevant information about different aspects of meditation, from the above mentioned sources were first systematically complied and then were sorted according to the defined structure of the sections. The relevant references are cited in the body of the text as well as in the reference section.
4.0 CONCEPT OF MEDITATION

4.1 Definition of meditation

The English word meditation comes from the Latin root word *meditari*, which derives from the same root as the word meaning ‘to heal’. The practice of meditation sets in motion, a process that leads to the restoration of one’s - physical, mental, and spiritual well-being. The English connotation of the word ‘meditation’ is therefore more associated with healing and relaxation (Adiswarananda, 2004). Meditation is also defined as concentration (continuous thinking) and some times as contemplation (repetitive thinking). Whereas in yogic understanding meditation is not mere concentration but it is more than concentration. Therefore it is essential to distinguish the meaning of meditation.

*4.1a Concentration (Ekāgratā):*

Meditation is generally understood as deep concentration on any object. In that sense, everyone meditates, because concentration is indispensable not only for survival but also for success in any walk of life. It is through concentration one can see, hear, work or understand anything. Concentration is the way to gain knowledge about any subject. Through concentration the mind acquires the quality of a lens and can penetrate deeply into an object, external or internal, and perceive its’ real nature. However, practically it is observed and experienced that concentration is tiring, it drains the energy. One cannot concentrate for long. After some time spent in concentration one feels fatigue and stressed because concentration involves intense effort.

In Sanskrit, *ekāgratā* (moving in one direction) means concentration¹, the channelizing of all the mental energies in a single direction. Normally our mind exists
in the state of *cancalatā* (continuously moving) wherein it moves in all directions, jumps (as it were) from one object to another object randomly. The mind in this phase is unstable, turbulent and restless (Chinmayananda, 2001, Ch: 6 V: 34). It flows in all directions according to its likes and dislikes and its patterns. The haphazard flow of thoughts is called as *cancalatā*. Streamlining these scattered energies of the mind in one direction is *ekāgratā*. However this process requires voluntary control and effort. For example, reading a book, watching a movie, driving a car all require different degrees of effort. Thus in concentration mind is directed on a single subject or direction, but there exist multiple thoughts. All these thoughts are interconnected to one another to form a meaningful or logical chain.

4.1b *Dhāraṇā*:

*Dhāraṇā* is a continuation of the process of sensory inhibition or withdrawal called as *pratyahāra*. *Dhāraṇā* is the ‘holding of the mind in a motionless state’, as the *Tri-śikhi-Brahmaṇa- upaniñat* defines this advanced practice (Feuerstein, 2001). *Dhāraṇā* the fifth limb of the Patanjali’s eightfold path is focusing of attention to a given locus (*deśa*), which may be a particular part of the body (such as *cakra*) or an external object that is internalized (such as the image of a deity).

The Sanskrit word *dhāraṇā* stems from the verbal root *dhri* (Apte, 1992), meaning ‘to hold, to fix’. What is being held is one’s attention, which is fixed on an internalized object and the underlying process is called *dhāraṇā*. According to sage Patanjali,
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Deśabandhaścittasya dhāraṇā.
Fixing of mind on a specific object (or a spot, internal or external) is dhāraṇā (Prabhavananda, 2002, Ch: 1 V: 3).

Deṣe nābhicakranāśāgrādau cittasya bandho viṣayāntaraparīhareṇa
yat sthirikaraṇam sā cittasya dhāraṇā ityucyate.

The mental flux could be halted on navel center, tip of the nose or any place as sanctioned by scriptures. Stabilizing the mental flux without disturbance from any corner is termed as dhāraṇā (Sukhanandanatha, 1992).

This is supposed to be practiced by the yogi, who has gone through the previous five limbs, and desirious of attaining Samādhi. Hence directing or stabilizing all mental forces on a particular base or object is known as śuddha-dhāraṇā. – Viṣṇupurāṇam (Sukhanandanatha, 1992).
Thus *dhāraṇā* not only involves concentration but takes to the next step of focused attention. *Dhāraṇā* consists of focusing on a relevant thing and withdrawal from irrelevant. In the process of perception, mind not only aligns with external sense organs (*jñānendriyās*) but also tunes with earlier experiences. Hence *dhāraṇā* also involves a component of remembering i.e., repeated continuous recollection of the object and not allowing the mind to get distracted (Nagendra, Swami, & Mohan, 2003). Thus in *dhāraṇā* mind is confined (*bandha*) to a single object with single thought. Hence *dhāraṇā* requires voluntary control, persistent effort and training (*abhyāsa*).

### 4.1c Dhyāna

The Sanskrit word *dhyāna* means continuous dwelling of mind on a single object. When *dhāraṇā* becomes effortless and continuous it takes the form of *dhyāna*. Often this is translated as meditation. Nevertheless, the word meditation is also used to denote concentration and *dhāraṇā*. In this thesis, meditation means *dhyāna*.

> तत्र प्रत्ययायितानां ध्यानमृ॥
> *Tatra pratyayaikeśātāna dhyānam.*

‘Meditation is uninterrupted, spontaneous flow of the mind towards the chosen object’ (Taimini, 1986, Ch: 3 V: 2).

*Dhāraṇā* naturally leads to the state of meditative absorption, in which the internalized object or locus fills the entire space of consciousness. Just as the one-
pointed-ness of attention is the mechanism of dhāraṇa, ‘one-flowing-ness’ (ekatāñatā) is the underlying process of meditation accompanied by a peaceful, calm disposition. There is no loss of lucidity, but on the contrary, the sense of wakefulness is intensified, even though there is no or little awareness of the external environment.

The psychology of meditation is to cultivate a single thought. A restless mind is like a lake, constantly agitated by the winds of desires, creating thought–waves of diverse intensities. Because of this constant agitation, our true Self at the bottom of the lake cannot be perceived. When, to counter all those many thought–waves, a single thought is consciously cultivated by the repeated and uninterrupted practice of meditation, it develops into a huge wave that swallows up all the diverse ripples and makes the mind transparent and calm. The mind in meditation takes the form of this single thought-wave. The five characteristic features of meditation (dhyāna) are (i) single thought, (ii) effortlessness, (iii) awareness, (iv) slowness and (v) expansiveness. This can be called as defocusing. Meditation is a fine method for learning the secrets of the outer and inner worlds. Meditation is a technique of withdrawing the mind so that it receives rest and rejuvenation. The initial purpose of meditation is to intercept the flux of ordinary mental activity (citta vrūti), which is cause for cancalatā (Feuerstein, 2001).

4.2 Steps in meditation
The process of meditation thus encompasses *ekāgratā, dhāraṇā and dhyāna*, where *ekāgratā* and *dhāraṇā* are the preliminary steps. All types of meditation techniques whether traditional or modern comprise these steps in varying duration.

<table>
<thead>
<tr>
<th>Steps</th>
<th>Process</th>
<th>Key features</th>
<th>Experience</th>
</tr>
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<tbody>
<tr>
<td><em>Ekāgratā</em></td>
<td>Channelizing the multiple thoughts in one direction</td>
<td>- Voluntary control</td>
<td>Focusing, fatigue</td>
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<tr>
<td>Concentration</td>
<td></td>
<td>- Intense effort</td>
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<tr>
<td><em>Dhāraṇā</em></td>
<td>Fixing the mind on one single object with single thought</td>
<td>- Confined repetitions</td>
<td>Sustained attention,</td>
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<td>Focusing</td>
<td></td>
<td>- Withdrawal from irrelevant</td>
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<tr>
<td><em>Dhyāna</em></td>
<td>Continuous and spontaneous dwelling of mind on a single object</td>
<td>- Effortless awareness</td>
<td>Awareness</td>
</tr>
<tr>
<td>Meditation</td>
<td></td>
<td>- Slow expansion</td>
<td>Silence</td>
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<tr>
<td><em>Samādhi</em></td>
<td>Absorption of subject, object and the process</td>
<td>- Expansion</td>
<td>Knowledge</td>
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<td></td>
<td></td>
<td>- Powers</td>
<td>Bliss</td>
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</tbody>
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Swami Vivekananda in his book (Vivekananda, 2001) on Raja yoga says, when the mind is focused on a specific object uninterruptedly for twelve seconds, one achieves one unit of *dhāraṇā*. Twelve such successive units of *dhāraṇā* make one unit of *dhyāna*, and twelve such successive units of meditation, lead to *Samādhi*. *Samādhi* is a state of complete absorption. Patanjali says

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तदेवार्थंतात्त्विन्नां स्वरूपःपशुण्मिव समाधि: ॥

Tadevārthamāttranirbhāsāṁ svarūpaśuṇyamiva samādhiḥ.
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The same (contemplation) when there is consciousness only the object of meditation and not of itself (the mind) is *Samādhi* (Taimini, 1986, Ch: 3 V: 3).
The absorption is attained when meditation becomes constant and continuous, and the mind merges in the object of meditation. There exists no tripiti. Samādhi is a quantum jump into next level of consciousness, the realm of knowledge, power and bliss (Nagendra, Swami, & Mohan, 2003).

4.2a Objects of meditation

Meditation involves three factors i.e., meditator, the object of meditation and the process of meditation (triputi). The object of focus is generally sacred and can be personal or neutral, concrete or abstract, a word or an idea, an image or a symbol, a divine form or personality.

The Yoga sutrās of Patanjali mention the following as the possible objects of meditation: (i) the effulgent or radiant light which is beyond all sorrow (jyotishmati), (ii) the heart of an illuminated being (vītrāgi) who is free from all passion and attachment (iii) the subtler dimensions and knowledge of sleep and dream state or (iv) anything (yathābhimata) that is spiritually uplifting. Such a thing may be a place, some scenery, an idea or any other thing that would evoke concentration of mind (Adiswarananda, 2004).

The texts on Hatha yoga say on the object of concentration can be outside the body like a jyoti or bindu in case of trāṭaka, sun (surya) and moon (candra) or can be inside the body like breath, movement of prana, sensations of processes in the body, various cakra or even the mind (genesis of thoughts) itself (Muktibodhananada, 2003).
According to the tradition of Vedanta following objects are preferred for meditation: (i) a divine form, (ii) an Incarnation of God, (iii) the divine Lord as inmost Self of Supreme Teacher, (iv) *vīraṭa puruṣa* or the Cosmic Personality, (v) the sacred word *Om*, (vi) *Gāyatri mantra*, or the sacred prayer of the Vedas (vii) the meaning of any of the four *mahāvākyas*, or great Vedic saying or (viii) the meaning of a sacred text, word or mystic syllable (Adiswarananda, 2004).

### 4.2b Requisites of meditation

**Posture:** The perfect posture for meditation is that in which the spine, the head, the chest, and the neck are kept erect and there is no movement of the body, and the mind remains in a state of equilibrium (Madhusudhan, & Gambhiranada, 1998, Ch: 6 V: 35). However, meditation can also be practiced while body being in slow actions or motion.

**Time:** Although there is no fixed time for the practice of meditation, the sacred texts mention four times that are most favorable and auspicious. The first of them is time between three and five in the morning (*brahmamuhurta*). The second is midday, when nature has a tendency to return to calmness and rest. The third is the hour of dusk (*godhuli*), when day merges into night and nature becomes tranquil. And the fourth is midnight, when a deep silence pervades all of nature. Experienced teacher advocate that the time for meditation once chosen, must be observed every day, because there is a cycle or rhythm in the movement of forces, spiritual as well as material (Mokshadananda, 1997).
Place: The *Vyasa Suträs* state “There is no low of place; wherever the mind is concentrated, meditation should be practiced” (Adiswarananda, 2004). According to sacred texts of Vedanta, a mountain, a riverbank, a temple, a place where the practice of meditation has been successfully carried out by many spiritual seekers (*tapobhumi*) and a solitary place free from distractions (Vivekananda, 1971).

Direction: The meditator is advised to sit facing the east, because the earth’s daily rotation is from west to east. By facing the east, one faces the direction of motion (Adiswarananda, 2004).
4.3 The states of mind

Generally mind is defined as a flow of thoughts. The conglomeration of thoughts is mind (Nagendra, 2001). This process of thoughts is always ongoing and is related with the information and inputs given by the external organs of perception and the feedback obtained from the earlier memories and impressions. In yogic understanding, the mind has four functional facets i.e., manas, buddhi, citta and ahaṅkāra together called as antahkaraṇa (internal instrument).

The oscillating nature of thoughts is manas (saṅkalpavikalpatmika), discriminative ability is buddhi (niścayatmika), stored impressions and patterns is citta (anusandhānātmika) and feeling of ‘I’ ness, the ego is ahaṅkāra (Chinmayanada, 2002, V: 93, 94). This mind oscillates between any of the following five states

Mind often functions in restless or turbulent way (kṣipta), sometimes becomes dull and stupefied (mūḍha), sometimes becomes distracted and divided (vikṣipta), sometimes becomes concentrated and one pointed (ekāgra) and rarely becomes restrained and suspended (niruddha). These are different grounds or fields of functioning of the mind (cittabhūmayaḥ) (Bangali Baba, 2002). This is presented schematically in Fig. RL1.
Fig. RL1: Vicious cycle of states of mind

- **Dull** (कमता): Predominance of Tamas (Tamas)
- **Restlessness** (क्षितिजत्व): Predominance of Rajas and Tamas (Rajas & Tamas)
- **Propels for action** (क्रम): Determined by likes and dislikes (Raga Dosa)
- **Concentrated state** (एकांत): Predominance of Rajas & Sattva (Rajas & Sattva)
- **Experience of happiness or pain**
- **Perception of object**
- **Momentary suspension of mind**: Accumulation & intensification of inner forces (स्वयं बोध: सुख निरूप)

**Cancalata** (कांतलाता)
Review of literature

The *Bhagavad Gita* describes the mind by four epithets: restless, turbulent, powerful, and obstinate (Chinmayananda, 2001, Ch: 6 V: 34). An ancient proverb depicts the restless mind addicted to the pleasures of the senses as a mad elephant, while Swami Vivekananda has compared the restless mind to a monkey that not only is drunk with the wine of desire but simultaneously stung by the scorpion of jealousy and overtaken by the demon of pride. The restless mind is like a monster that can make life a nightmare - but that same mind, when subdued and controlled, becomes a most trusted friend and helper, guaranteeing peace and happiness. The strong likes (attachments) and dislikes (repulsions) make mind restless and induce desires. To pamper whatever desires arise in the mind would be counterproductive, leading only to greater restlessness. In *Bhagavad Gita* it is described as..

\[ \text{ध्यायतो विषयान् पुनः सष्टेषुपुन्नालयेते। सज्ज्ञा, सज्ज्ञाये कामः कामात् कोयोद्भिज्जायते।} \text{॥२६२॥} \]

\[ \text{कऽधातु भवति समेत: समेतहुतं समृतिविभ्रमः। समृतिभ्रवंदु बुद्धिनाशो बुद्धिनाशात् प्रणासयति।} \text{॥२६३॥} \]

Dhyāyato viṣayān punaḥ saṅgasteṣāṃprajāyate. Saṅgāt saṅjāyate kāmāḥ kāmāt
krodho’bhijāyate. Krodhād bhavati sammohāḥ sammohāt smṛtivibhramaḥ.
Smṛtibhramśād buddhināśo buddhināśat praṇaṣayati.

Brooding on the objects of senses, man develops attachment to them; from attachment comes desire; from desire anger sprouts forth. From anger proceeds delusion; from delusion, confused memory; confused memory ruins the ability of discrimination; and due to that finally he perishes (Chinmayananda, 2001, Ch: 2 V: 62, 63).

Desire leads to generation of more thoughts; repetition of thoughts and experience makes deeper impressions converting them in to emotions. Punishing the mind through self-torture and mortification would merely repress the desires, driving them underground (subconscious). Trying to transform the mind by changing our environment would be futile because wherever we go, our mind with all its habitual tendencies goes with us. The mind never becomes controlled...
automatically; it must be controlled consciously. The only alternative, according to the *Bhagavad Gītā*, is to slowdown the mind (sublimation) and face it by control and regulation.

 Shanaiḥ śanairūpamened kudava dhūritiṣṭhitayā | ātmanānām manasānāt manah kṛtvā na kiñcādapi cintayet. II 6. 25

With intellect set in firmness, attain quietude little by little (step by step); with the mind fixed on the Self, do not think of anything (Chinmayananda, 2001, Ch: 6 V: 25).

The methodology of yoga is to control and purify the subconscious (region of *vāsanās* and *sāmnāskāras*) with the help of conscious effort. Restlessness of body is to be overcome by slow and mindful practice of postures (*āsanas*). Irregular breath, an indicator of mental restlessness, is to be made regular by smooth and rhythmic breathing (*prāṇāyāma*). The out going thoughts and improper tendencies of the mind must be substituted by cultivating of moral and ethical virtues. Meditation helps to gain this control and constant awareness. Meditation begins with concentration and intense focusing on the chosen object and *dhyāna* happens only when mind becomes effortlessly and continuously one-pointed like the flow of oil poured from one vessel into another. Sage Patanjali says “meditation is uninterrupted flow of mind on its object. This itself turns into *samādhi* when the object alone shines and the thought of meditation (and of the meditator) is lost, as it were” (Usharbudh, 1986). That state of mind is *niruddha* where thoughts do not exist. Meditation is only possible in wakeful state of consciousness. How mind exists in different states of consciousness and can be evolved higher is schematically depicted in Fig. RL2.
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Sleep (suṣūti sthāna) unconscious state

Dream (śāmr sthāna) subconscious state

Wakeful state of consciousness (jāgūt sthāna)

No mind state (निरूप्त स्थिति)

Concentrated state of mind (एकाद्र स्थिति)

Dull, lethargic, inactive mind (मृदू स्थिति)

Restless, turbulent state of mind (क्षित स्थिति)

Scattered, distracted state of mind (विक्षित स्थिति)

Concentrated state of mind (एकाद्र स्थिति)

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Wakeful state of consciousness (jāgūt sthāna)

Dream (śāmr sthāna) subconscious state

Sleep (suṣūti sthāna) unconscious state

4.4 Goal of

Fig. RL2 Stages of growth of mind
The goal of meditation is complete absorption in the object of meditation (Samādhi), finally leading to communion or union with the Ultimate Reality. Different systems of thoughts and philosophies call it by different names: liberation - Mokṣa, beatific vision of divine – nirvana, awakening, enlightenment – Kaivalya, Self knowledge or knowledge of Brahman, attaining the Kingdom of Heaven within. Longing for this goal distinguishes a human individual from the subhuman beings says Sri Ramakrishna (Mumukhsnanda, 1998).

The goal of meditation is the cessation of all miseries through the realization of the indwelling Self, or Puruṣā, which is Pure Consciousness. The yoga system maintains that the cause of all miseries is ignorance, which deludes the Self, and entangles It in the world of matter. This entanglement is essentially of the mind, and the remedy lies in disentangling the Self from the world of matter and the world of mind. This is only possible through the knowledge of Reality. The aim of meditation is to find the Reality. Meditation leads to Self realization (Satyananda, 1992).

The seers of the Vedas mention four goals of life: knowledge of the right and wrong (dharma), worldly prosperity (artha), fulfillment of legitimate desires (kama) and Self – Knowledge (mokṣa). Self-knowledge is the consummation of all the other goals. According to Upaniṣads in this state, the dualities of subject and object, knower and known, seer and seen, all merge in the indescribable expanse of the Absolute. Consciousness of time and space obliterate, and the fetters of causality broken for forever. No sacrifice is too great to achieve this goal; no effort in this venture is ever lost or wasted. All scriptures of Yoga and Vedanta emphasize on this goal which is the goal of all goals in human life.

4.5 Process of Meditation
The system of Yoga contends that the world of matter and the world of mind are not two different worlds. Material world is part of the world of mind. Matter is grossified form of mind. When the real nature of the mind is known, it no longer deludes the Self. Then the Self alone shines in Its own glory. The mind gets illuminated by that shine – pure to the core. The regular practice of meditation causes calmness of mind, slowness in the flow of thoughts and further leads to purification of mind by release of all knots and blocks in the subtle layers of mind. Meditation helps to address all the unresolved patterns, issues, fears and phobias deep within the subconscious field (Satyananda, 1992). In this technique, willpower plays an important role. Through the exercise of willpower, the mind consciously and deliberately cultivates a single thought to the exclusion of all other thoughts. Meditation begins with concentration on single object and culminates in absorption in that object. Absorption reveals the subtle nature of the object. By knowing it one is able to know the reality of subtle entities in the universe. This is schematically presented in Fig.RL3.
4.6 Benefits of meditation
The benefits of meditation are threefold: physical, psychological and spiritual. Meditation enables the physical and psychic energies to flow into creative, constructive channels instead of burning out in destructive forms. Mind gains the poise, peace, naturalness, serenity, stability of emotions, conservation of energy, and a capacity to bear the frustrations and the ups and downs of the life. Meditation addresses all the unresolved issues and notions of subconscious. Meditation brings about complete behavioral transformation. A new worldview induces a new quality of consciousness, which leads to change in interpersonal relationships. Meditation teaches to act and not to react (Chao Khun, 1968).

Meditation awakens the dormant powers of the mind. Just as a vast amount of energy is hidden in an atom, so too is there a vast reservoir of energy hidden in the depths of our psyche. The sacred texts of Yoga call this sleeping power of the mind *kundalini* (Muktibodhananada, 2003). Life becomes blessed when the *kundalini* is awakened. Practitioner attains certain powers known as *siddhis* (Taimini, 1986). Using the power of the mind, human beings have been able to achieve great wonders in the realm of science and technology. It is the same power of the mind that makes impossible things possible in the realm of spirituality. The story of the evolution of life is the story of the manifestation of mental powers. The mind being clear and free from conflicts becomes more effective and efficient. Meditation brings spiritual illumination which liberates the Self from the trappings of the body-mind complex. Meditation is the only way to Self-Knowledge, and Self-Knowledge can put an end to all the sorrows and sufferings of the life.

A large number of scientific studies have shown positive development in self-actualization, creativity, empathy, reaction time, memory and intelligence, concentration and attention, improved performance in perceptual and motor skills, cognitive abilities following
meditation. It is also observed that the experienced meditators have un-agitated voice, relaxed and kindly appearance, a tension-free gait, grace and charm in all actions. In the words of Śvetāśvatara Upaniṣat, “The first signs of entering in yoga and meditation are lightness, health, absence of desire, a good complexion, a beautiful voice, a fragrance of the body, and less excretions” (Gamabhiranada, 1986). Swami Vivekananda says, “Such is the power of yoga and meditation that even the least of it will bring a great amount of benefit. It will not hurt anyone but will benefit everyone. It will calm down the nervous excitement, bring peace, enables to see things more clearly” (Vivekananda, 2001).

5.0 TECHNIQUES OF MEDITATION

There are different techniques of meditation depending upon the object and the strategy chosen. Despite the difference in objects of focus and techniques of meditation, three key factors have to be present in the practice of any kind of meditation. Those three factors are (i) the object of meditation (locus of focus), (ii) the centre of consciousness (point of awareness)
where the mind is held during meditation, and (iii) the method employed to invoke concentration (Adiswarananda, 2004).

The object of meditation can be anything as described earlier, internal or external, stable or dynamic. The sacred texts of Yoga and Vedanta maintain that the object of meditation must not be frequently changed. The object of meditation is generally held within at a particular center, such as the heart, the forehead, the tip of the nose, or the crown of the head. Or the seeker may place it outside his body, in-front of him on the ideal. However in some meditation techniques the object of concentration and the center of consciousness (awareness) where the mind is held are same. The method employed to invoke concentration is either selected by the seeker or prescribed by the teacher (Guru), and it also must not be changed.

In Buddhist forms of mindfulness meditation technique the locus of focus and the center of awareness remain same and is dynamic, continually moves with the changing processes or phenomena (Chao Khun, 1968). In cyclic meditation as well the locus of awareness keeps on changing along with the slow movements of the body (Nagendra, & Nagrathana, 2001).

5.1 Traditional techniques of meditation

While the goal of all meditation techniques remains the same, the types of mediation vary because of the different approaches used by different systems of thought. The meditation techniques mentioned in different traditional scriptures could be broadly classified (Sukhanandanatha, 1992) as [1] Meditation on concrete (dhyāna on sākāra saguṇa vastu object): (i) Meditation on sound (śabda) i.e. on certain mantra, bija akṣara (syllable in seed form) in form of japā meditation (silent repetition of mantra) or meditation on inner sounds
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(nāda), (ii) Meditation on form (rupā) i.e., on specific ideal or image of deity (iṣṭadēvatā),
tantric codified shapes called yantrās or neutral symbol like flame or light (jyoti), and (iii) Mediation on inner objects like breath, movement of pranā, chakras, genesis of thoughts, or sense of ‘I’. [2] Meditation on abstract (dhyāna on nirākāra nirguṇa object or idea): (i) Meditation on meaning of upaniṣadic statements of universal truths called as mahāvākyas like अहि ब्रह्मसमि (aham brahma smi), तत्त्वमसि (tattvamasi), अयमात्माः ब्रह्म (ayamātmā brahma) and प्रज्ञानां ब्रह्म (prajñānāṁ brahma).

The scriptural texts of yoga and spirituality mention following statements about meditation.

5.1a The Yajur Veda

Om kṛto smarā
O’ devout worshipper, meditate on ‘Om’

5.1b The Upaniṣads

अराहितनामी सहस्ता यत्र नाडयाः स एषोऽन्तःधरते वहुः जायमानः।
Ομम् इत्यू एवं ध्यायात्मां स्वप्नितं व: पाराय तमस: परस्तात।

Arā iva rathānābhau saśīha yatra nādyāḥ sa eṣo’ntaścarate bahudhā jāyamānaḥ.
Aumityevanm dhyāyathā atmānam svastī vai parāya tamasah parastāt.
Where the arteries of the body are brought together like the spokes in the center of a wheel ,
within it ( this self, moves about ) becoming manifold. Meditate on Om as the Self . May you be successful in crossing over to the farther shore of darkness.

Mundaka upaniṣat- (Gamabhiranada, 1995, Ch: 2 V:2.6)

एष सर्वेष भूतेषु गुंधोः दंत्वते

Eṣa sarveṣu bhūteṣu guḍho’’tmā na prakāśate.

Drṣyate tvagrāyaya buddhyā sūkṣmayā sūkṣmadosarśibhiḥ.
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That Self hidden in all beings does not shine forth; but
It is seen by subtle seers through their one-pointed and subtle intellects.

*Katha upaniṣat* - (Chinmayanada, 2002, Ch: 1 V: 3.12)

\[\text{Tāṃ duर्दशां गूढमनुप्रविष्ठं गुहाहितं गगरैं पुराणम्।}
\[\text{अन्यतमयोगाधिगमनं देवं मत्वं धीरों हर्षशोकोऽज्ञाति॥}
\[\text{That Self hidden in all beings does not shine forth; but}
\[\text{It is seen by subtle seers through their one-pointed and subtle intellects.}

*Katha upaniṣat* - (Chinmayanada, 2002, Ch: 1 V: 2.12)

\[\text{विरूध्तं स्थायं समं शरीरेः हृदीन्द्रियाणी मनं समवेदं।}
\[\text{ब्रह्मोपाधिप्रत्येकं विद्यन्तः शोकात्सप्तसंवृत्ति स्वार्थं भयवहानं॥}
\[\text{The wise man who, by means of concentration on the Self, realizes that ancient, effulgent}
\[\text{One, who is hard to be seen, un-manifest, hidden, and who dwells in the *buddhi* and rests in}
\[\text{the body –he, indeed, leaves joy and sorrow far behind.}

*Katha upaniṣat* - (Chinmayanada, 2002, Ch: 1 V: 2.12)

\[\text{तसे शुची शर्कराविहित्वलुका विवाचिति शत्मेऽलश्चल्यादिभिः।}
\[\text{मनिनुकृते न तु चक्षुपीडङ्गे गुहानिवाताथ्यध्ययनं प्रयोजयेत॥}
\[\text{The wise man should hold his body steady, with the three (upper) parts erect, turn his senses,}
\[\text{with the help of the mind, toward the heart, and by means of the raft of *Brahman*; cross the}
\[\text{fearful torrents of the world.}

*Svetāsvatara upaniṣat* - (Gamabhiranada, 1986, Ch: 2 V: 8)

\[\text{व्रह्च तद्विद्यमनिन्त्यरूपं सुखमाय ततसृष्टत्ततं विभाति।}
\[\text{दुरात्सूक्तू पद्यसि स्वतोत्तहे निहितं गुहायाम्॥}
\[\text{That *Brahman* shines forth, vast, self-luminous, inconceivable, and subtler than the subtle.}
\[\text{He is far beyond what is far and yet here very near at hand. Verily, He is seen here, dwelling}
\[\text{in the cave of the heart of conscious beings.}

*Svetāsvatara upaniṣat* - (Gamabhiranada, 1986, Ch: 2 V: 10)
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**Mūṇḍaka upaniṣat**- (Gamabhiranada, 1995, Ch: 3 V: 1.7)

सर्वं खलिवं ब्रह्म तजज्ञानिति शान्त उपासीत।
अथ खलु कङ्गमयः पुरुषो यथाक्रिकवर्मणाऽक्षे पुरुषो भवति तथेतः प्रेत्य भवति स कर्तवो कृच्छ्रित।

`Sarvam khalvidaṁ brahma tajjalāniti sānta upāsita.
Atha khalu kratumayaḥ puruṣo yathākruturasmalloke puruṣo bhavati tathaḥ pretya bhavati sa kratunā kurvita.`

All this is *Brahman*. From It the universe comes forth, in It the universe merges, and in It the universe breathes. Therefore a man should meditate on *Brahman* with a calm mind.

**Chāndogya upaniṣat**- (Swami Swahananda, 1984, Ch: 3 V: 14.1)

Let one meditate That as adoration, desires pay adoration to him. Let one contemplate That as the supreme, he becomes possessed of the supreme. Let one contemplate That as *Brahman’s* destructive agent, one’s hateful rivals perish as also those rivals whom he does not like. He who is here in the person and he who is yonder in the Sun, he is one.

**Tāttirīya upaniṣat** – (Gamabhiranada, 1998, Ch: 2 V: 1)

Though a man may perform penance standing on one leg for a thousand years, it will not, in the least, be equal to one-sixteenth part of concentrated meditation.


5.1c *Bhagavad Gītā*

<table>
<thead>
<tr>
<th>Sanskrit</th>
<th>English</th>
</tr>
</thead>
<tbody>
<tr>
<td>शुची देशे प्रतिष्ठाय स्थिरमासनमात्मनमः।।</td>
<td>Though a man may perform penance standing on one leg for a thousand years, it will not, in the least, be equal to one-sixteenth part of concentrated meditation.</td>
</tr>
<tr>
<td>नात्युच्छते नात्मिनीः चैव चालूजिजः शोकृतमः।।।</td>
<td></td>
</tr>
<tr>
<td><em>Śucau deśe pratiṣṭhāpya sthiramāsanamātmanah.</em></td>
<td></td>
</tr>
<tr>
<td><em>Natyucchitram natinīcam caḷājinakusottaram.</em></td>
<td></td>
</tr>
<tr>
<td>On a clean and pure place neither too high nor too low he spreads kusagrass, a deerskin and a cloth (Tpaśyaananda, 2002, Ch: 6 V: 11).</td>
<td></td>
</tr>
<tr>
<td>तत्रविश्वासने बुद्ध्याध्योगमात्मविश्वेदः।।।</td>
<td>Sitting on that seat he should concentrate the mind, control the senses and thoughts, and practise yoga for self-purification (Tpaśyaananda, 2002, Ch: 6 V: 12).</td>
</tr>
<tr>
<td><em>Tattraikāgram manah kṛtvā yatacitendriyakriyāḥ.</em></td>
<td></td>
</tr>
<tr>
<td><em>Upaviśyāsane yuṇjyādyogamātmaśuddhayē.</em></td>
<td></td>
</tr>
<tr>
<td>सम्म प्रेक्ष्य नासिकायं स्वादिशानवलोकयं।।।</td>
<td></td>
</tr>
<tr>
<td><em>Samāṁ kāyaśīrogrīvaṁ dhārayannacalamāṁ sthiraḥ.</em></td>
<td></td>
</tr>
<tr>
<td><em>Samprekṣya nāsikāgram svam diśaścānavalokayan.</em></td>
<td></td>
</tr>
</tbody>
</table>
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Keeping the trunk, head and neck straight and steady sitting firmly, one should look at the tip of the nose, without looking in other directions (Tpasyaananda, 2002, Ch: 6 V: 13).

A majestically calm, fearless, and a confirmed celebate should withdraw his senses and sit carefully fixing his mind upon Me (Tpasyaananda, 2002, Ch: 6 V: 14).

In this manner, constantly meditating with controlled mind, the yogi, emancipated and eternally peaceful, attains Me (Tpasyaananda, 2002, Ch: 6 V: 15).

5.1d Patanjali Yoga Sutras

Dhāraṇā is the holding of the mind to some particular object. (When the mind holds on to some object, either in the body or outside the body, and keeps itself in that state, it has attained dhāraṇā concentration). An unbroken flow of knowledge about that object is dhyana. When the mind tries to think of one object, to hold itself to one particular spot, such as the top of the head, or the heart, and succeeds in receiving sensations only through that part of the body, and no other part, it has attained dhāraṇā: and when the mind succeeds in keeping itself in that state for some time, it has attained dhyāna, meditation.
5.1e Śaṅkhya Yoga (Bahadur, 1988)

*Cessation of desire is meditation.*

It has been stated that knowledge alone can confer liberation. The author goes on to say how such knowledge can be obtained. When by meditation the mind is untarnished by external objects the impediments in the way of knowledge are removed.

*Meditation is perfected by repelling the modifications of the mind.*

The modifications are real cognition, unreal cognition, imagination, deep sleep and memory. Meditation is accomplished by restrainng them. When this is achieved there takes place the immediate intuition of the object of meditation.

*Meditation is accomplished by dhāraṇā, āsana and svadharma.*

The author mentions how meditation is accomplished. This is by holding the mind in a particular part of the body (dhāraṇā), adopting the needful posture (āsana), and by performance of the varṇa duties (svadharma), i.e., duties belonging to the stage of life in which one is placed.

5.1f Yoga Vāsiṣṭha

मनः प्रशामनोपायः योगः इत्यभिदीयते ॥
Yoga is the trick to calm down the mind.

तद्भवते निर्वाणम् इत्यभियासो महोदयः ॥

यामेवं निशायम् तेन निर्विकल्प्य समाधिना ॥

Tadabhyāṣena nirvāṇam ityabhūṣo mahodayah.
śambhā śyaivam niśāyam te nirvikalpa samādhinā.

ब्रह्मवेदानां

ब्रह्मवेदानां

ब्रह्मवेदानां

Since liberation is (attained) by such practice, the practice (itself) is the supreme fulfillment. Conversing thus in the night, they two (Leela and Goddess) became of the form of the space of consciousness by Nirvikalpa Samadhi (or yogic state of absolute consciousness transcending the differentiation of the knower, knowledge and the known and possessed of the bodily form of heavenly beings)


5.1g Śrīmad Bhāgavata Mahāpurāṇa (Tapayananda, 1982)
“Do you restrain by all means your fickle mind; my son by your superior intelligence set steady on Me. This is the sum and substance of all yoga.” So spoke the Lord to Uddhava” (11.23.61). “The mind that dwells on sense objects gets stuck in them. The mind that remembers Me constantly gets dissolved in Me” says Lord Kṛiṣṇa to Uddhava. That is the mode of meditation advocated by the Bhāgavat. (11.14). Further from verses numbers 31 to 46 of Bhāgavat Mahāpurāṇa (chapter 14 of sub-chapter 11) it is mentioned, how the devotees should meditate on Lord Kṛiṣṇa’s personal and impersonal form and with what attributes one should meditate, when asked by Uddhava.

5.1h Haṭha Yoga Text (Muktibodhananada, 2003)

In Haṭha yoga meditation, more specifically kuṇḍalini meditation, the divine power that lies dormant in every human being is aroused and pulled upward through the cakras, the psychic centers of the body. At the top of the head, the seat of the highest consciousness the union of the individual and absolute consciousness takes place. This is expressed symbolically as the union of Śakti or kuṇḍalini with Lord Śiva. During meditation each cakra is visualized as a lotus with a certain number of petals. The mūlādhāra, svadhiṣṭhāna, maṇīpura, anāhata, viśuddhi and ājñā cakras have four, six, ten, twelve, sixteen and two petals respectively, while sahasrāra has one thousand. The number of petals is determined by the number and position of nādis that emanate from the cakras and give it the appearance of a lotus. Hanging downward when kuṇḍalini is dormant, the nādis turn upward with its ascendance. The cakras may be focused upon by chanting of Om, the all inclusive universal sound vibration, in different pitches. When kuṇḍalini is awakened it does not proceed directly to the sahasrāra unless one is an exceptionally pure yogi.
It must be moved up from one cakra to another and a great of concentration and patience is required. When the kuṇḍalīni finally rises from the ājña to the sahasrāra union take place and this is called liberation. In summary, Hatha yoga itself (by practicing preliminary practices called āsanas, prānāyāmas, kriyas, bandhas mudras) leads to stages of meditation, while it also prepares one’s body and mind for the practice of meditation.

5.1i Prakaraṇa Grantha

Meditate on the Atman, which resides in thee, which is devoid of all limiting adjuncts, the Existence – Knowledge – Bliss – Absolute, the One without a second, and thou shall no more come under the round of births and deaths -Vivekacuḍāmaṇi (Chinmayanada, 2002, V: 288).

5.1j Mahābharata (Ramgopalachari, 1958)

In the Śantiparva of Mahābharata there are references on meditation by Manu, Vyasa, and Vasishtha. Manu says: Since the mind is always stimulated by sense-objects, it is not possible for the ordinary mind to attain to the attribute-less Brahman. It becomes possible only when the senses are merged in the mind, and the mind in the intellect, through uninterrupted concentration. Vyasa says: The process of withdrawing the intellect, the mind and the senses from external objects and merging them in the all-pervading Paramātman leads to the Supreme knowledge. An aspirant of such Knowledge must with deep concentration of mind practice the merging of the mind into the intellect twice a day, both at dawn and dusk. Vasishtha says: Meditation is the greatest power of the yogis. The wise men describe meditation as concentration of mind. Through concentration of mind, he sifts the jīvātman
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from the twenty-four cosmic principles and tries to merge it in the Paramātman. The moment this unity of jīvātman and Paramātman is established, a man becomes jīvanamukta.

5.2 Popular techniques of meditation:

5.2a ‘Om’ Meditation

Yogic teachings consider the syllable ‘Om’ to be the force behind all thoughts. Either chanting or thinking about ‘Om’ is supposed to cause a quiet mental state. Om is the primordial sound from which all other sounds and creation emerge. In Om meditation the meditator first concentrates on an Om picture and then mentally chants mantra ‘Om’ effortlessly and finally expands to an all-pervasive level and goes for blissful silence.

5.2b Transcendental Meditation (TM)

Transcendental meditation (TM) is based on the traditional yogic principles. In TM the meditator sits in a comfortable position silently closing the eyes and repeats a specific mantra mentally from time to time to go beyond thought level. This technique is preached and practiced by Maharshi Mahesh Yogi. This is less rigorous and demanding discipline, apparently easily learned, and hence widely practiced. The TM is defined as ‘turning the attention inwards towards the subtler levels of a thought until the mind transcends the experience of the subtle state of thought and arrives at the source of the thought’.

5.2c Tantric meditation

In this technique the meditator has to repeat a sacred mantra given by the guru, with intense concentration. This meditation is practiced and propagated by the Ananda Marga organization. The technique consist two important steps. First, the meditators sit in comfortable relaxed position and withdraw the attention inwards by ignoring the external
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stimuli and paying attention to their breathing. Then they silently repeat the two lettered personal *mantra* with their breathing.

5.2d *Brahmakumaris Raja yoga meditation*

This meditation technique is preached and practiced by Brahmakumaris Ishawariya Vishwavidyalaya. During this meditation, aspirants sit in a comfortable position with their eyes open, and with effortless gaze fixed on a *jyoti* (light – representing supreme consciousness). At same time they actively generate positive thoughts about the Universal force pervading all over, as light and peace.

5.2e *Zen Meditation*

*Zazen*- Zen meditation is a fundamental part of both the Soto and Rinzai Sects of Zen Buddhism. The aim in this form of meditation is the ultimate state of enlightenment called *Satori*. This technique involves concentration. There are three types in this type of meditation. In the first type, the meditator concentrates on his breathing, counting the breaths or without counting. In second type of meditation the meditator has to solve koans or say non-logical riddles. In third type of meditation the meditator just sits and breathes in a prescribed manner without any aids or concentrating on his breath.

5.2f *Vipassanā Meditation*

*Vipassanā*, which means to see things as they really are, is one of the ancient techniques of meditation. It was rediscovered by Gotama Buddha more than 2500 years ago. In *vipassanā* meditation the meditator, sitting in a comfortable position, initially observes his own breathing and thereafter observes sensations and feelings in various part of the body with an attitude of witness. *Vipassanā* is a way of self-transformation through self-observation. It focuses on the subtle interconnection between mind and body, which can be experienced
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directly by disciplined attention to the physical sensations that form the life of the body, and that continuously interconnect and condition the life of the mind. It is this observation-based, self-exploratory journey to the common root of mind and body that dissolves mental impurity, resulting in a balanced mind full of love and compassion.

5.2g Prekṣā Meditation

This is also an ancient meditation technique practiced in Jainism. Prekṣā means to perceive and realize the subtlest aspects of one’s own self, 'to see the Self'. Prekṣā is derived from the Sanskrit word "Pra + iksha" which means to observe carefully. Basically it sums up the perception of body, psychic centers, breath and observation of mind. In Prekṣā dhyana no thought is forcefully stopped. Instead the art of merely observing the thought process without forming any reaction or attachment is developed. By doing so thoughts themselves cease to appear.

5.2h Yoga nidra

Yoga-nidra (yogic psychic sleep) is a meditative technique, derived from ancient Tantra popularized by Bihar School of Yoga (BSY). Yoga-nidra is described as a systematic method of inducing complete physical, mental and emotional relaxation, while maintaining awareness at deeper levels. Yoga-nidra is performed in Savasana and it consists of progressive relaxation and rotation of awareness all over body, resolve, and visualization of some images of nature and tantric abstract symbols.

5.3 Modern techniques of meditation

The modern way of life poses several hassles and stress to every body whether the person is an overworked executive in an office or a farmer tilling the field under hot sun. The modern man takes up to meditation not for Self realization but approaches these systems with
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objective of achieving (i) good physical relaxation (ii) holistic health (iii) peace of mind (iv) stress management (v) balance of emotions (vi) control of mind (vii) development of personality (Viii) improvement in interpersonal relationships and (ix) efficiency in performance at work.

Today various types of meditation and relaxation techniques are popular world over by different names. Most of these are tailor made techniques and are practiced with guided instruction on audiovisual aids. These techniques could be broadly classified as: (i) Relaxation meditation: these types of meditation techniques comprise the instructions to sequentially relax the all body part by part, slowing of breath and imageries. (ii) Concentration mediations: these types of meditations consists techniques to develop focused attention like gazing at fine points, listening to distant sounds, slow walking etc. (iii) Expansive meditation: these types of meditation techniques comprise the instructions to expand the awareness with infinite objects in nature like sky, ocean, mountains, flow of river, flight of birds etc. (iv) Value based meditation: in these type of meditation techniques after inducing the deep relaxation firm instructions are given to remove fear and anxiety and resolves are given to imbibe moral values like love, patience, compassion, trust and positive attitude etc.

6.0 CYCLIC MEDITATION

6.1 Definition

Cyclic meditation (CM) is a ‘moving’ meditation technique devised to address the needs and problems of modern man (Nagendra, Nagrathana, 2001). Many people find it difficult to relax and get into a meditative state if asked to sit with their eyes closed while others feel drowsy and even fall asleep. Cyclic meditation involves a combination of gentle yogic
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stretching and relaxation. It is based on the principles culled from classical yogic texts like Māndukya Upaniṣat (Chinmayananda, 1984) and Yoga Sutrās of Patanjali. This technique is developed and propagated by Swami Vivekananda Yoga Anusandhana Samsthana and is widely used as an effective therapeutic measure and technique of stress management. It is called so, because it consist the measures of ‘relaxation’ and ‘stimulation’ in cyclic order. This technique includes the practice of certain yoga postures interspersed with relaxation while supine, thus achieving a combination of both ‘stimulating’ and ‘relaxation’ practices.

6.2 Principles and basis of CM

Cyclic meditation is based on a concept that a combination of both ‘calming’ and ‘stimulating’ measures help in reaching a state of mental equilibrium. It is derived from a statement in Gaudapada’s (Chinmayananda, 1984, Ch:3 V: 44) Māndukya Upaniṣat Karika..

लये सम्बोधयेत् चित्तं विक्षिष्टं शाम्येत् पुनः ।
Laye sambodhayet cittam viksiṣṭam śamayet punah.

सकपार्यं विज्ञानियां तमम्प्राप्तं न चालयेत् ।
Sakṣaṭyaṁ vijnāniyat samapraptaṁ na cālayet.

“In a state of mental inactivity awaken the mind; when agitated, calm it; between these two states realize the possible abilities of the mind. If the mind has reached the state of perfect equilibrium then do not disturb it again”

For the most persons the mental states while doing routine activities (not necessarily associated with yoga) is neither ‘inactive’ nor ‘excited’, but is somewhere between these extremes and hence a combination of ‘awakening and calming’ measures may be better suited to reach a balanced,
relaxed state. The foregoing idea drawn from the traditional texts is the basis for this yoga practice called ‘cyclic meditation’.

Meditation is to gain mastery over the body and mind. The two main hurdles for gaining mastery over the mind are stupor (laya) and agitations (vikṣipta) of mind. This happens in all spiritual (sadhanā) practices. The solution given by Gaudapada is to address (sambodhana) the mind again and again when in stupor or oblivion, and slow down (praśamanā) the mind when agitated. This important principle of practice is found intrinsically knit in all spiritual practices. In all meditation techniques this concept of focusing (activation) and defocusing (slowing down) is present in different proportions. However to practice this one requires to be constantly watchful and aware about changes occurring in the body and mind. Cyclic meditation helps to hone this skill (kauśala) as it consists the cycles of activating (sambodhana) and relaxing (praśamanā) phases with unbroken (tailā dhārarava) dispassionate (nihsaṅgaḥ) awareness. The activation and relaxation is not alone meant at physical level, but of mind as well. The mind is alternately activated by focusing and confining (deśa banḍha) on different changes occurring in body and mind; and relaxed by the process of defocusing (ānantasaṃpattibhyām) with the attitude of witness. Thus cyclic meditation contains the intermittent cycles of dharana (pointed awareness) and dhyana (pervasive awareness) finally stabilizing in the effortless expansive meditative state. When mind settles in the state of balanced equipoise, one must understand the possibilities of mind again getting distracted and hence should not move from that state. Sage Gaudapada further says in Māndukya Upaniṣat Karika (Chinmayananda, 1984, Ch:3 V: 47) that..
When the mind is brought under control through the aforesaid process, does not become lost, in sleep; and also does not again, become dispersed amidst objects; and when the mind become motionless like a lamp in a windless place (aniṅganama); and does not get carried away by anything (anābhāsaṁ); then it gets absorbed and becomes pure expansive Counciouness (nispannaṁ brahma).

6.3 Technique of CM

In the activating phase of cyclic meditation, the yoga postures are practiced about four times slower than that required by classical description. This slower practice requires more effort and subtle awareness than that required by the usual practice. The awareness is kept up throughout the practice with closed eyes, aloofly observing the changes occurring in the body like, changes in respiratory rate, heart rate, blood flow and contraction and relaxation of muscles (Nagendra, Nagrathana, 2001). The postures and relaxation are practiced in such a way that it sets a slow cyclic rhythm in the body, prana (vital energy) and the mind.

Being involved in specific practices keeps an overactive mind ‘busy’ and also stops one from falling asleep. For the best effects it is useful to (i) keep the eyes closed (ii) breathe slowly and rhythmically, and (iii) tune the awareness to the changes occurring in the body while doing slow and unhurried movements. During the practice of CM the attention is enhanced by recognizing pointed awareness, linear awareness, surface awareness, three-dimensional-awareness and all pervasive awareness of body and mind. The practice of cyclic meditation is based on the principles described in the Patanjali Yoga Sutra (Taimini, 1986, Ch: 2 V: 46, 47, 48).
The postures are practiced slowly according to ones physical capacity and comfort. The
stability, effortlessness and mindfulness are emphasized while performing the body
movements. In the final stage meditator is instructed to expand the awareness on infinite
object like sky or ocean, and are encouraged to remain in that state effortlessly for longer
duration. The dual process of awareness and relaxation (stimulate – relax combination) not
only releases the imbalances at body level but also at mental and emotional levels. The
understanding of the subtleties of CM by Jnāna Yoga brings about cognitional transformation
to resolve the subtle intellectual conflicts. Hence CM is considered as a holistic tool with
other practices of the yoga powered by comprehensive knowledge base. The pictorial
description of the postures in cyclic meditation is given in Plate RL 1.

The relaxation techniques that are practiced in cyclic meditation are IRT (instant or
isometric relaxation technique), QRT (quick relaxation technique) and DRT (deep relaxation
technique). In IRT, the sudden isometric contraction of all muscles in the body is followed by
brief relaxation while supine. The QRT is practiced in supine posture, where whole body is
put in to rest while being aware of breathing process and the movement of abdomen and
chest along with respiration. In DRT, the body is systematically relaxed part by part in supine
position. Further the deep relaxation is provided and subtle awareness is maintained by
chanting the syllables ‘A’, ‘U’, ‘M’ and ‘Om’ in sequential order. According to Māndukya
Upaniṣad the syllables ‘A’ ‘U’ and ‘M’ constitute the perimordial sound ‘Om’, which is at
the base of all creations.
Review of literature

Depending upon the applied needs, different versions of CM have been designed. The basic version consists of four standing postures (tāḍāsana, arḍakaticrāsana, pādahastāsana and arḍacakraśana) interspersed with IRT and DRT. In present study this basic version of CM was investigated. In advanced version four standing and two sitting postures (śaśankāsana and āśtrāsana) are interspersed with IRT, QRT and DRT.

Plate RL1: Postures in Cyclic Meditation (CM)

Tāḍāsana Arḍakaticrāsana (Right side) Arḍakaticrāsana (Left side)

Pādahastāsana Arḍacakraśana
7.0 CONCLUSION

Yoga is an ancient Indian Science and way of Life. It offers various techniques to reach the ultimate goal of perfection, endowed with knowledge, power and bliss. Meditation is one such technique that helps to purify, control (nirodha) and slowdown (praśamana) the mind and its modifications (vr̥ttis) by skill (kauśala) and regular practice (abhyāsa). The process of meditation begins with concentration (ekāgratā) and focused attention (dhāraṇā) on the chosen object and dhyāna happens only when mind becomes effortlessly and continuously one-pointed like the flow of oil poured from one vessel in to another. Sage Patanjali says “dhyāna is an uninterrupted, spontaneous flow of mind on its object. This itself turns into samādhi when the object alone shines and the thought of meditation (and of the meditator) is lost, as it were”. The five characteristic features of meditation (dhyāna) are (i) single thought, (ii) effortlessness, (iii) awareness, (iv) slowness and (v) expansiveness (defocusing). Meditation involves three factors i.e., meditator, the object of meditation and the process of meditation (triputi). The object of focus is generally sacred and can be personal or neutral, stable or dynamic, concrete or abstract, a word or an idea, an image or a symbol, a divine form or personality. Meditative styles can be usefully classified into two types - mindfulness and concentrative, which differ in the way attentional processes are
directed. Most meditative techniques lie somewhere on a continuum between the poles of these two general methods.

Mindfulness practices involve allowing any thoughts, feelings, or sensations to arise, while maintaining a witnessing awareness without judgment or analysis. Examples include Zen, Vipassana meditation. Concentrative meditation techniques involve focusing on specific mental or sensory activity: a repeated sound, an image, or specific body sensations such as the breath. Examples include forms of Transcendental Meditation (TM) and Tantric meditation.

Cyclic meditation (CM) involves slow practice of yoga postures interspersed with relaxation, allowing any feelings or sensations to arise, while maintaining a specific attentional stance: awareness of the phenomenal field as an attentive and non-attached observer without judgment or analysis.

Generally in meditational practice the two main hurdles for gaining mastery over the mind are stupor (laya) and excitement (vikṣipta). The solution given by Sage Gaudapada is to awaken (sambodhana) the mind when it is dull, and slow down (praśamana) when agitated. This important principle of practice is intrinsically present in all meditation practices. However to practice this, one requires to be constantly watchful and aware about changes occurring in the body and mind. Cyclic meditation helps to hone this skill (kauśala) as it consists the cycles of activating (sambodhana) and relaxing (praśamana) measures practiced with unbroken (taila dhāravat) dispassionate (niḥsaṅgaḥ) awareness. The activation and relaxation is not alone meant at physical level, but of mind as well. The cyclic meditation contains the intermittent cycles of dharana (pointed awareness) and dhyana (pervasive awareness) finally stabilizing in the effortless expansive meditative state.
3.2 A REVIEW OF THE SCIENTIFIC LITERATURE ON MEDITATION

*Science without religion is lame, religion without science is blind.*

- Albert Einstein (1879 - 1955)

"Science, Philosophy and Religion: a Symposium", 1941
3.2.1 STUDIES ON MEDITATION

The scientific studies of yoga and other forms of contemplative experience have recently become a subject of interest for researchers. In 1925 early scientific studies were reported by Swami Kuvalayananda of Lonavala in a quarterly journal *Yoga Mimāmsā*. These studies helped to initiate interest in yoga research by showing that the physiological effects of yoga could be examined in the laboratory. This was followed by a number of studies which reported that yogis could exert voluntary control over the cardiovascular system and reduce their metabolic rate at will. Around 1960, as Transcendental Meditation (TM) became popular, a number of scientific studies were conducted on meditation. The studies which are most relevant to the present research are mentioned below, and have also been summarized in Table T 3.2.

*Dhyāna* is the generic Sanskrit term for meditation, which in the Patanjali *yoga sutrās* is referred to as an uninterrupted flow of the mind towards the chosen object. It is the intermediate state between mere continuous attention to an object (*dhārana*) and complete absorption in it (*samādhi*) (Taimini, 1961). Depending upon the object and the strategy chosen, there are different techniques of meditations.

3.2.1.A Studies on Transcendental Meditation
Transcendental meditation (TM) is based on traditional yogic principles. A large number of scientific studies have been reported on TM. In 1970, R.K. Wallace reported the physiological effects of TM in 15 normal college students (Wallace, 1971). There was a pre-control period; 5 minutes eyes open and 15 minutes with eyes closed. This was followed by 30 minutes of meditation, after which the subjects sat with eyes closed for 10 minutes, and then with eyes open for 5 minutes. Oxygen consumption was measured in nine subjects by either the open or closed circuit methods. The mean decrease in oxygen consumption was about 45 cm$^3$/minute or 20% compared to the pre-control period. There was a mean decrease in total ventilation during meditation of about 1 liter/minutes. Skin resistance increased at the onset of meditation and decreased to the resting value after meditation. The heart rate of each subject decreased during meditation, with a mean decrease of 5 beats per minute. The most notable change in EEG pattern during TM was an increase in the alpha wave amplitude and regularity, with occasional slow alpha and low voltage theta. ‘Alpha blocking’ to sound and light was present, and did not show habituation.

In a later study, Wallace, Benson and Wilson (1971) reported their observations on 36 subjects (28 males and 8 females). The subjects acted as their own controls. The pre-control period consisted of 10-30 minutes with eyes closed and eyes open for a similar duration. After 20-30 minutes of meditation they were asked to stop meditating and sit with their eyes closed for 10 minutes, then with their eyes open for the same time. They reported a decrease in oxygen consumption (an average decrease of 17%) from a mean of 251.2 ml/minutes before meditation to 211.4 ml/minutes during meditation and gradually increasing after meditation to 242.1 ml/minutes. Minute ventilation decreased by about 1 liter/minutes and respiratory rate decreased about 3 breaths/min during meditation, though neither were statistically significant. The mean lactate concentration decreased from a pre-control level of
11.4 mg, to 8.0 mg/100 ml. The average heart rate decreased during meditation by 3 beats per minute. Rectal temperature remained fairly constant during meditation. The skin resistance increased markedly at the onset of meditation and decreased after meditation but remained higher than before meditation. Based on the EEG findings along with those of other variables TM came to be described as ‘wakeful hypometabolic state’.

Orme-Johnson (1973) reported a study on 16 subjects, 8 of them were meditators and 8 were controls. The meditators had a mean experience of 15 months. They studied GSR habituation and spontaneous GSR fluctuations. In a second experiment, they studied 6 meditators (with experience of meditation ranging from 2 - 54 months) and 8 non meditators. Though habituation was initially similar for the two groups, the meditators habituated in significantly fewer trials than non-meditators. Also, there was a low frequency of spontaneous GSR fluctuations in meditators as compared to controls. The mean rate of spontaneous GSR fluctuations was 6.14 in 10 minutes compared to 18 - 25 in 10 minutes meditation Vs pre-control periods. The meditators had 8.7 responses in 10 minutes during rest compared to 21.0 in 10 minutes for non-meditators.

Banquet (1973) compared meditators with matched controls measuring the hypo metabolic state reaction time (RT) during a series of visual stimuli. Meditators showed faster RT with less mistakes, and N100 and P200 of larger amplitude and shorter latency. The transient effects were opposite for the 2 groups, i.e., longer RT and larger P300 amplitude was observed following meditation while following rest there was no change in RT and a decrease in the P300 amplitude. These results suggest selective attention capacity and information processing strategies associated with meditation.

Later, Wilson, Jevning and Guich (1987) studied oxygen consumption, carbon dioxide production and acid/base changes in 62 subjects during two hypo-metabolic states (35 during
transcendental mediation and 27 during un-stylized rest). The results indicated that during these hypo-metabolic states, arterial-venous carbon dioxide content difference declined, and that during Transcendental Meditation, arterial-venous carbon dioxide content difference briefly disappeared. This change was thought due to both an increase in arterial carbon dioxide content and a decrease of venous carbon dioxide content. Similar, but opposite and smaller, changes occurred in arterial and venous oxygen content. The respiratory quotient was low at all times and decreased during the hypo-metabolic states. Subsequently there have been reports of other studies on TM indicating it’s clinical applications and usefulness in enhancing the cognitive performance and perceptual and motor skills.

TM practice was studied using a passive auditory paradigm listening trial with variable inter-stimulus intervals (1-4 s) between identical tone stimuli (Cranson, Goddard, & Orme-Johnson, 1990). The subjects were non-meditator controls, novice, and highly experienced TM meditators with mean ages of 20, 28, and 41 years, respectively; IQ scores did not differ among the groups. Passive P300 potential latency was shorter for the two meditation groups, with the long-term meditators showing the shortest P300 latency regardless of their age. These results imply that AEPs might reflect meditation trait differences. An auditory oddball task was used with eyes-closed to assess experienced TM meditators at pre-test baseline, after 10 min of rest, or after 10 min of TM practice with conditions counterbalanced across subjects (Travis, & Miskov, 1994). P300 latency decreased at Pz after TM practice relative to no change after the rest condition. Taken together, these reports suggest the possibility of some meditation effects on the P300 component.

Recently, Travis, Tecce, Arenander and Wallace (2002) studied patterns of EEG coherence, power and contingent negative variation in long-term meditating subjects who report that Transcendental Experiences (TE), which first occurred during their
Transcendental Meditation (TM) practice, now subjectively co-exist with waking and sleeping states. In order to investigate neurophysiological correlates of this state, they recorded the EEG in these subjects and in two comparison groups during simple and choice contingent negative variation (CNV) tasks. In individuals reporting the integration of the transcendent with waking and sleeping, CNV was higher in simple but lower in choice trials, and 6 - 12 Hz EEG amplitude and broadband frontal EEG coherence were higher during choice trials. Increased EEG amplitude and coherence, characteristic of TM practice, appeared to become a stable EEG trait during CNV tasks in these subjects. Hence they proposed that these significant EEG differences may underlie the inverse patterns in CNV amplitude seen between groups. An 'Integration Scale,' constructed from these cortical measures, was considered to possibly characterize the transformation in brain dynamics corresponding to increasing integration of the transcendent with waking and sleeping.

3.2.1.B Studies on Zen Meditation

In 1960 Hirai found changes in the breathing during Zen meditation. The breath rate decreased to 4 - 5 breaths per minute. The same study reported an acceleration of the pulse rate during meditation to a rate between 80 and 100 beats/minute. A further study on Zen meditators, demonstrated an alpha suppression response, a sudden attenuation of alpha waves in response to a stimulus, which did not habituate to repeated click stimuli during Zen meditation whereas controls habituated after the fifth or sixth click (Kasamatsu, & Hirai, 1966). This was taken to reflect a ‘hypersensitivity’ of attention during Zen meditation.

In another study on experienced Zazen meditators, a decrease in spontaneous skin conductance responses during Zazen was reported (Akishige, 1968). The same study also showed that there was a decrease in oxygen consumption and rate of respiration, associated
with Zen meditation. Sugi and Akutsu (1968) observed a 20% decrease in oxygen consumption associated with meditation in 10 Zen monks with many years of experience. Goyeche, Chihara and Shimizu (1972) compared Zen meditation with relaxation in 8 subjects. There was reduction in breath and heart rate during Zen meditation. Becker and Shapiro (1981) studied 5 groups of subjects: Zen meditators, TM subjects, Yoga subjects and 2 groups of non-meditators. The subjects were given click stimuli and they all demonstrated alpha suppression and subsequently habituation, with no differences among groups.

Recently, the frontal midline theta rhythm was correlated with cardiac autonomic activities during Zen meditation (Kubota, Sato, Toichi, Murai, Okada, Hayashi, & Sengoku, 2001). A standard procedure of Zen meditation requiring sustained attention and breath control was employed as the task to provoke frontal midline theta rhythm (F_m theta), and simultaneous EEG and ECG recordings were performed. For the subjects in which Fm theta activities were provoked (6 men, 6 women, 48% of the total subjects), peripheral autonomic activities were evaluated during the appearance of Fm theta as well as during control periods. Successive inter-beat intervals were measured from the ECG, and heart rate variability was used to assess cardiac sympathetic and parasympathetic functions separately. Both sympathetic and parasympathetic indices were increased during the appearance of F_m theta compared with control periods. Theta band activities in the frontal area were correlated negatively with sympathetic activation. This suggested a close relationship between cardiac autonomic function and activity of the medial frontal neural circuitry. In another study conducted on 22 healthy subjects to evaluate the effect of Zen meditation on EEG coherence and heart rate variability (HRV) in relation to trait anxiety scores, there was an increase in slow alpha interhemispheric EEG coherence in the frontal regions and an increase in the HF power and a decrease in the LF/HF ratio and heart rate (Murata, Takahashi, Hamada, Omori,
Kosaka, Yoshida, & Wada, 2004). These results suggest that lower trait anxiety more readily induces meditation with a predominance of internalized attention, while higher trait anxiety more readily induces meditation with a predominance of relaxation.

3.2.1.C Studies on Tantric Meditation

Elson, Hauri and Cunis (1977) studied Ananda Marga meditators; both amateur and experienced practitioners (average experience was 1.8 years). They found an increase in alpha and theta activity during meditation. There was a decrease in skin conductance and rate of respiration. In another study Corby and others investigated 2 groups of 10 meditators each (Corby, Roth, Zarcone, & Kopell, 1978). One group had an average experience of 4.4 years. All the subjects were very committed to the practice of meditation and practiced for a minimum of 3 hours per day. There was also a control group. Meditators showed a statistically significant increase in alpha and theta activity compared to the control group. This study also reported changes in autonomic variables. There was an increase in skin conductance (i.e., lowered skin resistance) and absence of a deceleratory heart rate orienting response. Heart rate and respiratory rate changes were not significant within the group. During meditation there was a trend for heart rate to decrease relative to the control group. One of the subjects had a near samādhi experience, and they recorded an increase in heart rate, respiratory rate and a marked decrease in skin resistance.

3.2.1.D Studies on ‘OM’ Meditation

In an early study on evoked potentials during Om meditation Telles and Desiraju (1993) used, for the first time two important modifications in the research design for yoga research. The subjects were studied using the ‘self-as-control’ design and the two types of sessions, meditation and non-meditation, were repeated thrice in each subject. Auditory middle latency
evoked potentials were recorded during the practice of meditation. This study highlighted two points, (i) meditation is best described as a physiological state of ‘alertful rest’, and (ii) considerable physiological variations were seen both intra- and inter-individually. Similar results were seen when autonomic and respiratory variables were studied in Om meditators (Telles, Nagarathna, & Nagendra, 1995). When repetition of ‘Om’ was compared with the repetition of ‘One’, there was a difference in the autonomic and respiratory responses (Telles, Nagarathna, & Nagendra, 1998). Both types of sessions resulted in a decrease in the heart and breath rates, but repetition of Om alone reduced the skin resistance, suggesting a subtle change in the mental state, related to the significance of the syllable. These results were reinforced by a study of similar design, in which the variable recorded was the auditory middle latency evoked response during both ‘Om’ and ‘One’ sessions (Telles, Nagarathna, Nagendra, & Desiraju, 1994). Based on changes in the evoked potentials it was described that repetition of ‘Om’ resulted in significant changes in sensory relay at a neural center (i.e., the thalamus), with more neurons being (i.e., higher amplitude) recruited and information processing was facilitated (i.e., latency that was reduced). In persons who had over 5 years of meditation experience the changes in auditory middle latency evoked potentials, suggested that changes occurred at more complex brain areas corresponding to auditory association cortices (Telles, & Desiraju, 1993). Another recent report has described differences between the physiological states in sleep and in meditation (Naveen, & Telles, 2003).

3.2.1.E Studies on Brahmakumaris Raja yoga Meditation

Eighteen male subjects were studied using the ‘self-as-control’ design and the two types of sessions, meditation and non-meditation, were repeated thrice in each subject. The heart rate during the meditation period was increased compared to ‘baseline’ as well as compared to during the non-meditation period of control sessions. In contrast there was no significant
change during meditation, for the group as a whole, in GSR, respiratory rate and finger plethysmogram amplitude. The individual level analysis revealed that changes in autonomic variables suggestive of both activation and relaxation occurred simultaneously in different subdivisions of the autonomic nervous system in a meditator. Apart from this, there were differences in patterns of change among the persons who practiced the same meditation (Telles, & Desiraju, 1993a).

In an another study conducted on eleven experienced practitioners of Brahmakumaris Raja Yoga meditation, meditators while participating in a functional magnetic resonance imaging (fMRI) study, were able to reach a deep meditative state (suggested by pulse rate and breath rate changes), while in the ‘loud’ scanner environment (Khushu, Telles, Kumaran, Naveen, & Tripathi, 2000). All subjects reported vivid visual images related to the content of the meditation after the session. One subject showed significant activation in the primary visual cortex. Recently, it has been shown that Brahmakumaris Raja Yoga meditation produces changes at the level of the mesencephalon – diencephalon (i.e., possibly thalamic level) (Telles, & Naveen, 2004).

3.2.1.F Studies on Tai Chi Chuan Meditation

Tai Chi Chuan (TCC) is a traditional Oriental ‘moving’ mediation technique based on Taoist philosophical principles of Yin and Yang (the opposite forces) and breathing techniques. TCC consists of a combination of a series of rhythmic sequential movements providing a smooth, continuous, low-intensity activity and a kind of yogic relaxation through deep breathing and self-awareness. Since ancient times Tai Chi practitioners have claimed a number of beneficial effects from its frequent use such as relief from muscular tension, reduced anxiety, stress, and pain, and increased balance, self-awareness, and strength (Sandlund, & Norlander, 2000). According to Qu there are two major reasons for these
experiences (Yan, 1995). First, participants have to be very focused and concentrated when practicing, and by doing so they exclude other distractions and stressors and experience an inner peacefulness. Second, the nature of the art, with smooth, slow and rhythmic movements, facilitates muscular relaxation and flexibility.

Jin (1989) assessed psychological and physiological changes following Tai Chi practice in 33 beginners and 33 practitioners. Using a three-way factorial design, the subjects were divided into groups on the basis of experience, time of practice, and phase (before, during, or after Tai Chi intervention). Participants filled out the Profile of Mood States (POMS) and Trait Anxiety Inventory form before and after testing, and their heart rate, noradrenaline excretions, and cortisol concentrations were measured pre-testing and post-testing. Compared to baseline, practice of Tai Chi raised heart rate, increased noradrenaline-excretion in urine, and decreased salivary cortisol concentration. Elevated heart rates during testing indicated Tai Chi as a moderate cardiovascular exercise. Cortisol levels dropped compared to pre-testing; Jin explains this with the fact that the Tai Chi physical workload only represents 50% of VO\(_2\) max, (indicating a low workload). Subjects reported less tension, depression, anger, fatigue, confusion and state-anxiety, they felt more vigorous, and in general they had less total mood disturbance after Tai Chi practice. Mood improved significantly during Tai Chi, and remained positive one hour after practice.

Another study examined the ventilatory and cardiovascular responses to the long form of Yang's style TCC (Brown, Mucci, Hetzler, & Knowlton, 1989). In addition, the subjects' TCC responses were compared to their ventilatory and cardiovascular responses during cycle ergometry at oxygen consumption (VO\(_2\)) equivalent to the mean TCC - VO\(_2\). Six experienced (group mean 8.3 years) male TCC practitioners served as subjects and the data were collected during the ‘Cloud H and movement of the TCC’ exercise. Lower responses for ventilatory frequency (Vf) (11.3 and 15.7 breaths/minute), ventilatory equivalent
Review of literature

(V_{E}/V_{O_2}) (23.47 and 27.41), and the ratio of dead space ventilation to tidal volume (V_{D}/V_{T}) (20 and 270c) were found in TCC in comparison to cycle ergometry. The percentage of minute ventilation used for alveolar ventilation was significantly higher during TCC than cycle ergometry, with mean values of 81 and 73 liters respectively. Cardiac output, stroke volume, and heart rate were not significantly different between TCC exercise and cycle ergometry at the same oxygen consumption. It was concluded that, during TCC, expert practitioners show significantly different ventilatory-responses leading to more efficient use of the ventilatory volume than would be expected from comparable levels of exertion on a cycle ergometer.

Similarly, 15 men aged between 26 to 56 (group mean ± SD, 39.9 ± 9.5) years were studied for heart rate responses and oxygen consumption during the practice of TCC by using an open circuit K4 telemetry system (Lan, Chen, Lai, & Wong, 2001). Subjects had experience of classical Yang TCC practice more than one year (group mean ± SD, 5.8 ± 2.4 years). Blood lactate was measured before and immediately after TCC practice. Additionally, breath-by-breath measurement of cardiorespiratory function and sequential determination of blood lactate were performed during the incremental exercise of leg cycling. Measurements obtained during the TCC practice and exercise testing were compared to determine the exercise intensity of TCC. While performing TCC, the mean HR of subjects was 140 ±10 beats per minute, and the mean oxygen consumption was 21.4 ± 1.5 ml/kg/min. Compared with the data of the exercise test, the HR during TCC practice was 58% of the heart rate range. The oxygen consumption during TCC practice was 55% of the VO_{2} peak. Additionally, the level of blood lactate immediately after TCC practice was 3.8 mM, which reflected the level of lactate during TCC, approximated the onset of blood lactate accumulation (OBLA). This indicated that TCC provides moderate aerobic exercise.
In another study Jin (1991) examined Tai Chi, as a moving meditation, for its efficacy in post stressor recovery in 48 adult male and 48 adult female Tai Chi practitioners, who were randomly assigned to 4 treatment groups: Tai Chi, brisk walking, meditation, and neutral reading. A "blind" experimenter who had the subjects come in twice to the laboratory conducted the experiment. The participants were then subjected to both mental and emotional stress: arithmetic and other difficult mental tests under time pressure and loud noise, and an emotionally stressful movie. After the second session, the groups continued with one hour of each of the experimental activities. The heart rate, urine, blood pressure, and tension/mood scales (POMS and STAI-Y) were measured. The results showed that the exercise intensity of Tai Chi and brisk walking was considered as moderate and resulted in a release of noradrenaline, which may be beneficial to health. All four conditions appeared to be effective in reducing mood disturbance, and the Tai Chi group showed a greater reduction in state anxiety compared to the reading group.

Psychological changes associated with 16 week moderate and low intensity exercise training programs, two of which possessed a cognitive component, were evaluated. Subjects were healthy, sedentary adults, 69 women and 66 men. Participants were randomly assigned to a control group (C), moderate intensity walking group (MW), low intensity walking group (LW), low intensity walking plus relaxation response group (LWR), or mindful exercise (ME) group - a Tai Chi type program. Women in the ME group experienced reductions in mood disturbance (tension, depression, anger, confusion, and total mood disturbance) and an improvement in general mood. Women in the MW group noted greater satisfaction with physical attributes (body cathexis), and men in MW reported increased positive affect. This supported the hypothesis that exercise plus cognitive strategy training programs are more effective than exercise programs lacking a structured cognitive component in promoting
Another study compared post-exercise affect after sessions of aerobic dance, weight training, martial arts, Tai-Chi and yoga, and as a control, music appreciation (Szabo, Mesko, Caputo, & Gill, 1999). The results indicated that the combined Tai Chi and yoga group reported higher levels of "tranquillity" than all other exercise groups. Further, they reported lower psychological distress, fatigue, and exhaustion as compared to the martial arts group.

Recently it was reported that a three month intervention of Tai Chi given to college students brought about a significant improvement in general health, vitality, bodily pain, perception of mental health and emotional stability (Wang, Taylor, Pearl, & Chang, 2004).

### 3.2.2 STUDIES ON YOGIC RELAXATION TECHNIQUES

#### 3.2.2.A Studies on Śavāsana

Lying flat on the ground with the face upwards, in the manner of a corpse, is śavāsana. It reduces fatigue and enables the mind and body to relax (Mukatibodhananda, 2001). Śavāsana is the corpse pose. Shava means ‘corpse’.

A randomized controlled trial was conducted on twenty five patients of essential hypertension using śavāsana therapy (Sundar, Agrawal, Singh, Bhattacharya, Udupa, & Vaish, 1984). Śavāsana therapy was continued for six months. There was significant reduction in both mean systolic and diastolic blood pressure and antihypertensive drugs score in yoga groups. In 65 % of patients of yoga, blood pressure was controlled with śavāsana alone without any drug. In another study the efficacy of meditation and śavāsana in promoting self-actualization and changes in self-reported stress was studied among 62 college students (Janowiak, & Hackman, 1994). Two groups were given mantra meditation.
and a yogic relaxation technique referred to as śavāsana. Pre and post test measures were taken on the Personal Orientation Inventory and the Behavioral Relaxation Scale. Both groups showed significant increases in scores on self-actualization; however, no differences were found between groups. Meditation training was associated with larger gains in scores on measures of systematic relaxed behavior than of the relaxation training.

In another study śavāsana was found effective in coping with stress manifestations (Bera, Gore, & Oak, 1998). The recovery from induced physiological stress in śavāsana and two other postures (resting in chair and resting supine) was compared. 31 males and 6 females (age 21-30 yrs) were allowed to rest in one of the above postures immediately after completing the scheduled treadmill running. The recovery was assessed in terms of heart rate (HR) and blood pressure (BP). HR and BP were measured before and every two minutes after the treadmill running till they returned to the initial level. These results revealed that the effect of stress was reversed in a significantly shorter time in śavāsana, compared to resting in a chair and a supine posture.

The yoga based relaxation technique has also shown to reduce physiological signs of arousal (Vempati, & Telles, 2002). 35 male volunteers whose ages ranged from 20 to 46 years were studied in two sessions of yoga-based guided relaxation and supine rest. Assessments of autonomic variables were made for 15 subjects, before, during, and after the practices, whereas oxygen consumption and breath volume were recorded for 25 subjects before and after both types of relaxation. A significant decrease in oxygen consumption and increase in breath volume were recorded after guided relaxation. There were comparable reductions in heart rate and skin conductance during both types of relaxation. During yoga relaxation the power of the low frequency component of the heart-rate variability spectrum reduced, whereas the power of the high frequency component increased, suggesting reduced
sympathetic activity. Also, subjects with a baseline ratio of LF/HF > 0.5 showed a significant decrease in the ratio after guided relaxation, while subjects with a ratio ≤ 0.5 at baseline showed no such change. These results suggested that sympathetic activity decreased after guided relaxation based on yoga, depending on the baseline levels.

In 10 normal adults RR interval variation (RRIV), deep breathing difference (DBD), and heart rate, blood pressure and rate-pressure-product (RPP) response to a cold pressor test (CPT) were measured before and immediately after śavāsana (Madanmohan, Udupa, Bhavanani, Krishnamurthy, & Pal, 2002). Śavāsana produced a significant increase in DBD and an appreciable but statistically insignificant increase in RRIV suggesting an enhanced parasympathetic activity. Significant blunting of cold pressor-induced increase in heart rate, blood pressure and RPP by śavāsana was seen during and even five minutes after CPT suggesting that śavāsana reduces the load on the heart by blunting the sympathetic response. It was concluded that śavāsana can enhance the ability to withstand stress induced by CPT and this ability can be achieved even with seven days of śavāsana training.

Recently the effect of a yoga based relaxation technique on psychological variables in exam going students was studied (Malathi, & Damodaran, 1999). The study was conducted on medical students (n = 50) during routine activities and prior to their examination. Anxiety status (Spill Berger’s anxiety scale) showed a significant reduction after yoga practice. In addition the anxiety score which rose prior to exams showed a significant reduction on the day of exam after practice. These results showed the beneficial role of yoga based relaxation techniques in not only causing reduction in basal anxiety level but also attenuating the increase in anxiety score in stressful state such as exams. A significant reduction in number of failures in yoga group as compared to the control group was also observed. The feedback scores indicated improvement in various variables such as better sense of well being, feeling of relaxation, improved
concentration, self confidence, improved efficiency, good interpersonal relationship, increased attentiveness, lowered irritability levels, and an optimistic outlook in life.

3.2.2.B Studies on yoga based isometric relaxation

A study was conducted on yoga based isometric relaxation technique. Forty male volunteers with ages ranging from 16 to 46 years were studied in two sessions; yoga based isometric relaxation technique (IRT) and supine rest (SR) (Telles, & Vempati, 1999). Assessments of autonomic variables were made in 15 subjects, before and after the practices, whereas oxygen consumption, breath rate, breath-volume were recorded in 25 subjects, before and after IRT and SR. A significant decrease in breath rate after IRT and finger plethysmogram was recorded after SR. This indicated that yoga based IRT is useful in reducing the physiological signs of anxiety and stress and not every person is able to relax in supine rest.

3.2.2.C Studies on Śānti kriyā

Śānti kriyā is a mixture of combined yogic practices of breathing and relaxation (Satyanarayana, Rajeswari, Rani, Krishna, & Rao, 1992). Eight healthy male volunteers (age group 25.9 ± 3 years) were subjected to śānti kriyā practice daily for 50 minutes for 30 days. The body weight, blood pressure, oral temperature, pulse rate, respiration, ECG and EEG were recorded before and after the practice on the 1st day and subsequently on 10th, 20th and 30th day of their practice. They were also given a perceptual acuity test to know their cognitive level on the 1st day and also at the end of the study (day 30). Results indicated a gradual and significant decrease in the body weight from day 1 to day 30 and an increase in alpha activity of the brain during the course of 30 days. Also there was increased oral temperature by 3°F and decreased respiratory on all practice days. Increase of alpha activity
both in occipital and pre-frontal areas of both the hemispheres of the brain denoted an increase of calmness.

3.2.2.D Studies on Yoganidra

Global cerebral blood flow (CBF) distribution (with the 150 – H2O PET technique) and spectral EEG analysis was done in nine young adults, who were highly experienced yoga teachers, during the yoganidra relaxation meditation, and during the resting state. In meditation, differential activity was seen, with the noticeable exception of V1, in the posterior sensory and associative cortices known to participate in imagery tasks. In the resting state of normal consciousness (compared with meditation as a baseline), differential activity was found in dorso-lateral and orbital frontal cortex, anterior cingulate gyri, left temporal gyri, left inferior parietal lobule, striatal and thalamic regions, pons and cerebellar vermis and hemispheres, structures thought to support an executive attentional network (Lou, Kjaer, Friberg, Wildschiodtz, Holm, & Nowak, 1999).

Another study on yoganidra has demonstrated an association between endogenous neurotransmitter release and conscious experience (Kjaer, Bertelsen, Piccini, Brooks, Alving, & Lou, 2002). Using 11C- raclopride PET, increased endogenous dopamine release in the ventral striatum was found during yoga-nidra meditation. Participants underwent two 11C-raclopride PET scans: one while attending to speech with eyes closed, and one during active meditation. During yoga-nidra meditation 11C- raclopride binding in ventral stream decreased by 7.9%. This corresponded to a 65 % increase in endogenous dopamine release. The reduced raclopride binding correlated significantly with a concomitant increase in EEG theta activity, a characteristic feature of meditation. All participants reported a decreased desire for action during meditation, along with heightened sensory imagery. This suggested
that being in the conscious state of meditation causes a suppression of cortico-striatal glutamatergic transmission.

3.2.2.E Studies on yoga stretching and relaxation

In a study the effects of three different procedures, relaxation, visualization and yogic stretch and yogic breathing (pranayama) on perceptions of physical and mental energy and on positive and negative mood states was assessed in a group of normal volunteers (n=71, age range 21-76) (Wood, 1993). Yogic stretch and yogic breathing produced a significantly greater increase in perceptions of mental and physical energy and feelings of alertness and enthusiasm than the other two procedures. Relaxation made subjects more sleepy and sluggish immediately after the session than yogic stretch and yogic breathing. Visualization made them more sluggish but less content than yogic breathing and more upset than relaxation after the second session. Thus, a 30 minutes program of yogic stretch and breathing exercises which is simple to learn and which can be practiced even by the elderly had a markedly 'invigorating' effect on perceptions of both mental and physical energy and increased high positive mood.

Another study investigated the psychological and physical effects of training of body awareness and slow stretching on persons with chronic toxic encephalopathy (CTE) (Engel, & Andersen, 2000). The body-mind training consisted a guided relaxation technique combined with meditative stretching. Eight subjects with CTE, 48.5 years, were trained for 8 weeks. Outcome measures were percentage alpha brain waves (alpha %), electromyography (EMG) on the frontalis muscle, state-trait anxiety (STAI), creativity (RAT), and mood measured as anxiousness, humour and mental fatigue. The mean alpha increased 52% during the training period and the EMG decreased 31%. State anxiety decreased 22% during the training period, but no changes were observed in trait anxiety and in the creativity score. The
level of anxiousness and fatigue before a training session decreased during the training period. The results suggested an improved ability for physical and mental relaxation as indicated from the lower EMG, the higher alpha percentage and the decrease in state anxiety following the meditative stretching.

3.2.3 STUDIES ON GENERAL RELAXATION TECHNIQUES

3.2.3.A Studies on progressive muscle relaxation

Thirty six volunteer subjects were assigned to one of three conditions: progressive relaxation, clinically standardized meditation, or a waiting list control group asked to relax daily (without specific instruction). At the end of 5 week period, they were tested for psychophysiological and cognitive responses to stressful stimuli. The meditation group exhibited higher heart rate and higher integrated frontalis electromyographic (EMG) activity, but they also showed greater cardiac decelerations following each tone, more frontal alpha and fewer symptoms of cognitive anxiety than other two groups. The relaxation group showed more muscular relaxation (Lehrer, Schoicket, Carrington, & Woolfolk, 1980). Later on a randomized controlled study was done to compare the effect of relaxation technique which employ a somatic attentional focus (progressive muscle relaxation) and technique with cognitive focus (mantra meditation) on 61 subjects with anxiety (Lehrer, Woolfolk, Rooney, McCann, & Carrington, 1983). Both techniques generated positive expectancies and produced decrease in a variety of self reported symptoms and on EMG. Progressive muscle relaxation produced greater reduction in forearm EMG responsiveness to stressful stimulation and generally more powerful therapeutic effect than meditation. Meditation produced greater cardiac orienting responses to stressful stimuli, greater absorption in the task and better motivation.

Another study compared relaxation and meditation as part of a program of stress-reduction in industry (Carrington, Collings, Benson, Robinson, Wood, Lehrer, Woolfolk, &
A total of 154 New York telephone employees self-selected for stress learned one of three techniques: clinically standardized meditation (CSM), respiratory one method meditation (ROM) or progressive relaxation (PMR) or served as waiting list controls. At 5.5 months, the treatment groups showed clinical improvement in self-reported symptoms of stress, but only the meditation groups showed significantly more symptom reduction than the controls. The meditation groups had a 78% compliance rate at 5.5 months with treatment effect seen whether subjects practiced their techniques frequently or occasionally. The safe and inexpensive semi-automated meditation training has considerable value for stress-management programs in organizational settings.

Oxygen consumption, tidal volume, respiratory rate, heart rate, systolic and diastolic blood pressure were measured before the subjects (n=39) learned Transcendental Meditation (TM: n = 21) or Jacobson's Progressive Relaxation (PR: n = 18) and immediately after learning both techniques and again tested after 5, 10, and 15 weeks follow-up. Both groups displayed significantly lowered metabolic rates (reduction in oxygen consumption, tidal volume, RR, diastolic blood pressure and HR) during TM or PR. However the TM group displayed more significant decreases during meditation and during activity than did the PR group. The more significant and comprehensive results for mediators were explained primarily in terms of the greater amount of time the TM group spent on their technique, plus the differences in the two techniques themselves (Throll, 1982).

3.2.3.B Studies on relaxation training

A study was conducted on attentional capacity in 25 normal elderly subjects who were trained in techniques to improve face-name recall (Yesavage, & Jacob, 1984). Techniques consisted of relaxation training and a mnemonic device. Their anxiety was measured simultaneously with attentional measures. Results indicated that subjects showing the
significant reduction in anxiety and cognitive interference and the significant increase in
attention also showed the most face-name recall following training. The results suggest that
the anxiety in elderly persons has a cognitive component that interferes with performance on
attentional and memory tasks, but which can be reduced through relaxation training.

In another study PET was used to investigate cerebral activity relating to the cognitively
driven modulation of sympathetic activity (Critchley, Melmed, Featherstone, Mathias, &
Dolan, 2001). The subjects were trained to perform a biofeedback relaxation exercise that
reflected electrodermal activity and were subsequently scanned performing repetitions of four
tasks: biofeedback relaxation, relaxation without biofeedback and two corresponding control
conditions in which the subjects were instructed not to relax. Relaxation was associated with
significant increase in left anterior cingulate and globus pallidus activity, whereas no
significant increase in activity was associated with biofeedback compared with random
feedback. The interaction between biofeedback and relaxation, highlighting activity unique to
biofeedback relaxation, was associated with enhanced anterior cingulate and cerebellar vermal
activity. This study implicated the anterior cingulate cortex in the intentional modulation of
bodily arousal and suggests a functional neuroanatomy of how cognitive states are integrated
with bodily responses.

The effect of supine floating (SF) relaxation on heart rate, blood pressure and cardiac
autonomic nervous activity in ten male subjects (n=10, mean age: 22.4 yrs) was studied
(Nishimura, & Onodera, 2000). Cardiac autonomic nerve activity was estimated with the
power spectrum analysis of heart rate variability (HRV) by using the Fast Fourier
Transformation (FFT). HF during SF condition was significantly increased; LF/HF, heart rate
and blood pressure were significantly decreased. These data indicated that cardiac vagal
activity is enhanced and sympathetic nervous activity is suppressed by reciprocal response.
3.2.4 STUDIES ON CYCLIC MEDITATION

Cyclic meditation has the unique feature of combining simple yogic postures (stretching) practiced with very slow, mindful body movements, rhythmic breathing, expansive awareness and chanting and relaxation in supine position.

A study was conducted to compare the effect of cyclic meditation (a calming and stimulating technique) on oxygen consumption with that of śavāsana (a calming technique) (Telles, Reddy, & Nagendra, 2000). The oxygen consumption, breath rate, and breath volume of 40 male volunteers (group mean ± SD, 27.0 ± 5.7 years) were assessed before and after sessions of cyclic meditation (CM) and before and after sessions of śavāsana (SH). These assessments were done while breathing oxygen through a closed circuit Benedict-Roth apparatus. The two sessions (CM, SH) were one day apart. Cyclic meditation included the practice of yoga postures interspersed with periods of supine relaxation. During SH the subject remained in supine position throughout the practice. There was a significant decrease in the amount of oxygen consumed and in breath rate and an increase in breath volume after both types of sessions. However, the magnitude of change on all three measures was greater after CM: (i) Oxygen consumption decreased 32.1% after CM compared with 10.1% after SH; (ii) breath rate decreased 3.6 cpm after CM and 1.9 cpm after SH; and (iii) breath volume increased 28.8% after CM and 15.9% after SH. These results supported the idea that a combination of yoga postures interspersed with relaxation reduces arousal more than relaxation alone. The increase in depth of respiration with reduction in breath frequency, suggested physiological relaxation.
Review of literature

The above studies have described the psycho-physiological changes during different meditation and relaxation techniques, including cyclic meditation. However there have not been reports of simultaneous recording of (i) indices of psycho-physiological arousal and (ii) those of attention. This was attempted to be done in the present study in which the meditation technique selected was cyclic meditation which has already been shown to reduce psycho-physiological arousal.
## Abbreviations used in Table T 3.2

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AEP</td>
<td>Auditory Evoked Potentials</td>
</tr>
<tr>
<td>BMR</td>
<td>Basal Metabolic Rate</td>
</tr>
<tr>
<td>BOC</td>
<td>Basal Oxygen Consumption</td>
</tr>
<tr>
<td>BP</td>
<td>Blood Pressure</td>
</tr>
<tr>
<td>CNV</td>
<td>Contingent Negative Variation</td>
</tr>
<tr>
<td>d</td>
<td>day</td>
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<tr>
<td>EC</td>
<td>Eyes Closed</td>
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<tr>
<td>EO</td>
<td>Eyes Open</td>
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<tr>
<td>Exp</td>
<td>Expiration</td>
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<tr>
<td>Expt</td>
<td>Experiment</td>
</tr>
<tr>
<td>EKG, ECG</td>
<td>Electrocardiogram</td>
</tr>
<tr>
<td>EEG</td>
<td>Electroencephalogram</td>
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<tr>
<td>EMG</td>
<td>Electro-myogram</td>
</tr>
<tr>
<td>EOG</td>
<td>Electro-oculogram</td>
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<tr>
<td>Gp</td>
<td>Group</td>
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<tr>
<td>Gps</td>
<td>Groups</td>
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<tr>
<td>GSR</td>
<td>Galvanic Skin Resistance</td>
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<tr>
<td>HR</td>
<td>Heart Rate</td>
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<tr>
<td>HRV</td>
<td>Heart Rate Variability</td>
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<tr>
<td>HF</td>
<td>High frequency</td>
</tr>
<tr>
<td>5-HIAA</td>
<td>5-Hydroxy Indole Acetic Acid</td>
</tr>
<tr>
<td>Insp</td>
<td>Inspiration</td>
</tr>
<tr>
<td>Ld</td>
<td>Lead (as in standard leads of ECG)</td>
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<tr>
<td>LF</td>
<td>Low frequency</td>
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<tr>
<td>m</td>
<td>months</td>
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<tr>
<td>Medtn</td>
<td>Meditation</td>
</tr>
<tr>
<td>Min</td>
<td>Minute</td>
</tr>
<tr>
<td>MMN</td>
<td>Mismatch Negativity (auditory)</td>
</tr>
<tr>
<td>n</td>
<td>number of subjects/patients</td>
</tr>
<tr>
<td>OC</td>
<td>Oxygen Consumption</td>
</tr>
<tr>
<td>PaCO2</td>
<td>Partial pressure of Carbon dioxide in arterial blood</td>
</tr>
<tr>
<td>PaO2</td>
<td>Partial pressure of oxygen in arterial blood</td>
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<tr>
<td>RR</td>
<td>Respiratory Rate</td>
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<tr>
<td>RT</td>
<td>Reaction time</td>
</tr>
<tr>
<td>S</td>
<td>Subjects</td>
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<tr>
<td>ss</td>
<td>subjects</td>
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<tr>
<td>SC</td>
<td>Skin conductance</td>
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<tr>
<td>sec</td>
<td>second</td>
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<tr>
<td>Temp</td>
<td>Temperature</td>
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<tr>
<td>VE</td>
<td>Pulmonary Ventilation</td>
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<tr>
<td>Vs</td>
<td>Versus</td>
</tr>
<tr>
<td>Symbols used</td>
<td>Increase, ↓ Decrease, &lt; Less than, &gt; Greater than, → followed by, * Original article not referred to, information obtained from citation in other articles. ^ Original article not referred to, abstract consulted.</td>
</tr>
</tbody>
</table>
Oxycon Pro system with cylinder

Triple ‘V’ sensor with breathing mask

Subject in air conditioned room wearing breathing mask connected to O₂ analyzer through twin tube
Plate 4.2.2: Ambulatory ECG System for HRV, Nivique, India

Pentium computer with ambulatory system

Subject in a recording room with ambulatory ECG unit connected to adhesive electrodes

ECG electrode positions

Signal processing unit and interface unit
Review of literature

**Plate 4.2.3: Bravo EP System (Nicolet, USA)**

The Bravo EP - 4 channels amplifier and Closed circuit TV

Subject in supine position with electrode connections and earphone

The recording cabin with acoustically shielded earphone (Amplivox, UK) used to deliver the ‘frequent’ and ‘rare’ stimuli, and a head-box for electrode connections with LED electrode impedance panel.
2.1 AIMS OF THE STUDY

The present study was intended to obtain a greater understanding of the technique, cyclic meditation, measuring indicators of psycho-physiological arousal and those of levels of attention. Hence changes in following variables were compared following (or during) cyclic meditation as compared to a comparable period of supine rest; (i) oxygen consumption and related variables while breathing atmospheric air through an open circuit apparatus, (ii) the autonomic balance assessed through heart rate variability (HRV), (iii) P300 (auditory oddball paradigm) recorded at Fz, Cz and Pz, and (iv) performance in a letter cancellation task.

2.1 RELEVANCE OF THE STUDY

In several previous studies meditation practice has been shown to reduce physiological arousal (in terms of metabolism and sympathetic activity). However the results varied across meditation techniques and for a given meditation technique, results varied across meditation practitioners. In spite of this inter and intra meditation variability, there remains a view that meditation is a state of hypo-arousal. Hypo-arousal may suggest that mental alertness reduced. Indeed, this is often looked upon as a possible drawback of practicing meditation. That is, that one may become hypo-aroused but also less alert. Hence the present study was planned to measure variables indicative of the level of psycho-physiological arousal (i.e., oxygen consumption and HRV) as well those of attention (i.e., the P300 and performance in a cancellation task). This was considered important to get a comprehensive model of the technique, in this case cyclic meditation.
Methods

In this thesis the changes in (i) respiratory and metabolic variables (e.g., $V_O^2$, $V_{CO^2}$, RR, end tidal gases) (ii) heat rate variability (HRV) (iii) P300 (based on the auditory oddball paradigm), and (iv) a paper and pencil letter cancellation test were evaluated in normal volunteers related to two yoga relaxation techniques viz. cyclic meditation and supine rest.

4.1 SUBJECTS

4.1.1 Sample size: A sample of 53 subjects was studied. The actual sample size required was 40, which was based on the effect-size obtained in previous study of changes in cyclic meditation (Telles, Reddy, & Nagendra, 2000). It was calculated using G-power software, University of Duesseldorf, Germany; http://www.psycho.uni-duesseldorf.de/aap/projects/gpower where the $\alpha$ power was set at 0.05.

4.1.2 Inclusion criteria: (i) The subjects were healthy volunteers with age range from 18 to 48 years (group mean age ± S.D., 27.1 ± 6.3) (ii) Male subjects alone were studied as oxygen consumption, autonomic variables and auditory evoked responses have been shown to vary with the phases of the menstrual cycles in females (Das, & Jana, 1999; Yildirir, Kabakci, Akgul, Tokgozoglu, & Oto, 2002; Yadav, Tandon, & Vaney, 2002). (iii) All subjects had experience of practice of both yoga relaxation techniques ranging from 3 to 60 months (group mean experience ± S.D., 15.3 ± 13.3 months). They were regular in practice. Also the study was conducted following two months of supervised practice of cyclic meditation and supine rest for about 30 minutes on alternate days as a ‘refresher course’. The details of each subject have been given in the Table 4.1.2 (see Appendix - 4).
4.1.3 **Exclusion Criteria:** The following criteria were used to exclude the volunteers. (i) The presence of cognitive and/or neurological and/or metabolic disorders based on a medical history and routine clinical examination (ii) in take of medication, which is known to influence cognitive, autonomic and metabolic functions (iii) smoking or alcoholism which may have influenced the respiratory and metabolic variables and (iv) any hearing deficit.

4.1.4 **Source:** The subjects were residential students at Swami Vivekananda Yoga Anusandhana Samsthana, Deemed University, Prashanti Kutiram, Bangalore. They had all enrolled for graduate and post graduate study programs.

4.1.5 **Ethical considerations:** The subjects were told about the aims and methods of the study and the informed consent was signed by all subjects (a sample copy is enclosed in Appendix-1). An approval was obtained from the Institutional Ethical Committee as all tests are essentially noninvasive in nature.

4.2 **ASSESSMENTS**

4.2.1 **Respiratory and metabolic variables**

The word parameter is described as ‘characteristic of distribution or relationship in the population which are estimated by statistical analysis of a sample of observations’ whereas the word variable denotes ‘measurement or attribute on which observations are made’ (Altman, Gore, Gardner, & Pocock, 1993). Hence in present thesis the term ‘variable’ has been used to describe the assessments studied.

4.2.1.4 **Selection of respiratory and metabolic variables:**

Respiratory and metabolic variables were measured in order to assess changes throughout the practice of cyclic meditation and supine rest by using a
computerized open circuit system (Oxycon Pro, Model 2001, No. SN 808323, Jaeger, Germany) (Plate 4.2.1).

4.2.1B  Principle and specifications of Oxycon Pro system:

The measurement principle underlying the Oxycon Pro System: Dynamic "breath by breath" measurement is done using an open circuit system. The volume is measured via the bidirectional digital volume sensor "Triple V" which works on the paramagnetic principle. The gas exchange measurement is done via the extremely fast O₂ and CO₂ analyzers at the speed of 10ms with breathing level up to 80 breaths per minute (Jaeger Toennies Medizintechnik Mit System, 2001).

The Oxycon Pro system has following technical specifications:

(1) Measurement
   (i) Ventilation (VE) 0 to 300 liters/min
   (ii) O₂ uptake (VO₂) 0 to 7 liters/min
   (iii) CO₂ output (VCO₂) 0.6 to 2.0

(2) Volume sensor
   (i) Volume 0 to 10 liters
   (ii) Resolution 0.3 liters
   (iii) Flow 0 to 15 liters/s
   (iv) Resistance <0.1 kPa at 15 liters/s

(3) O₂ analyzer (high-speed analyzer based on the differential – paramagnetic principle)
   (i) Range 0 to 25% 0 to 60%
   (ii) Resolution 0.01% 0.02%
   (iii) Stability 0.02%/h
   (iv) Min. rise time T₁₀⁻₉₀, 40 ms

(4) CO₂ analyzer (high-speed analyzer based on the infrared absorption principle)
   (i) Range 0 to 15%
**Methods**

(ii) Resolution 0.01%
(iii) Stability 0.02%/h
(iv) Min. rise time $T_{10-90}$, 40 ms
Methods

Plate 4.2.1: Oxycon Pro System
Jaeger, Germany

Oxycon Pro system with cylinder
Triple ‘V’ sensor with breathing mask

Subject in air conditioned room wearing breathing mask connected to O₂ analyzer through twin tube
4.2.1.C Familiarization of the subject with the laboratory environment and with the study:

As the recordings were made under basal conditions (i.e., at as complete mental and physical rest as possible and 10 -12 hours after last meal) all subjects were asked to consume fixed quantity of food i.e., 1069.1 Kcal (calculated using Annapurna 2003, Version 1.0 software, Annapurna Associates, Bangalore) on the night previous to recordings (Ganong,1987). They were requested to sleep in the laboratory for 3 consecutive nights, where the first day was to make them acclimatized to the laboratory environment. The next two days were meant for actual recordings. The subjective experience of the quality of sleep was noted by a visual analogue scale. In the morning, recordings were made between 5 a.m. to 7 a.m. Each subject was instructed to restrict activity to using the rest room. This was necessary to minimize physical activity and avoid arousal. Following this, the recordings were carried out.

4.2.1.D Recording conditions:

The subjects were studied in an air conditioned, sound attenuated room with dim lighting. The temperature of the recording room was maintained between 20 - 25° Celsius, the humidity was between 65 to 75 min/max and the barometric pressure was between 650 to 685 mmHg.

4.2.1.E Calibration of the equipment:

Every day prior to assessment, the following calibrations were performed.

(i) Ambient conditions: As ambient data are the basis for determination of important correction factors for calculating recorded values, the ambient data were
checked at regular intervals. The barometric pressure, temperature and humidity were automatically recorded by the sensors built in the system.

(ii) Volume calibration: The measuring system consisting of the Triple V volume sensor was calibrated every day. A clear Triple V (digital volume sensor) is very important for an accurate flow and volume measurement.

(iii) Gas calibration: The gas analyzers (O\textsubscript{2}/CO\textsubscript{2}) integrated in the system were calibrated once a day, after a warming-up time of 30 minutes. The O\textsubscript{2} / CO\textsubscript{2} calibration was carried out using the certified gases (BOC, UK) from the calibration gas cylinder (containing mixture 5.2% of CO\textsubscript{2} and Nitrogen) connected to the system. The calibration program runs automatically and is divided into three phases (a) flushing the tube system (b) determination of delay time and (c) gain settings. At the end of calibration the calculated parameters were saved.

4.2.1.F Recording procedure:

The steps followed for recordings were

(i) Subject data: Before taking measurements, details such as the age, gender, height and weight were entered in the system. The height was measured by a standard scale in centimeters and the weight was measured with clothing using a digital weighing machine (Essae – Digi, Model No. DI-20, Essae-Teraoka Pvt. Ltd., Bangaolre, India). (ii) The breathing mask, designed to form an airtight cover over the subject’s nose and mouth was fixed by straps (mask for adults with dead space of 70 ml) and care was taken that the air did not leak out from the sides of the mask. (iii) The Triple V sensor (Plate 4.2.1) was connected to the breathing mask at one end and at the other end to the integrated gas analyzer system in the compact
housing through the twin tubes. (iv) Specific workload protocol was loaded according to the design of the recording session and selected to run during the experiment. The recorded data was stored in the hard disc of the PC (Pentium III).

4.2.1. G Variables measured:

The following variables were measured: (i) $V_E$: Minute or total ventilation is the amount of air moved in or out of the lungs per minute. Conventionally, minute ventilation is always measured on an expired sample and symbolized $V_E$. The minute ventilation includes alveolar and dead space ventilation ($V_E = V_A + V_D$), and is recorded in liters per minute (l/min) corrected to BTPS (Body Temperature and Pressure Saturated with water vapor). Normally, in healthy adults $V_E$ ranges from 5 to 10 l/min. (ii) $V_T$: The volume of air inspired or expired during each respiratory cycle is tidal volume. It is usually measured in liters or milliliters, BTPS. Generally, the volume expired is expressed as $V_T$. Average $V_T$ for healthy adults ranges between 400 and 700 ml. (iii) RR: The respiratory rate is the number of breaths per unit of time, usually per minute. The normal respiratory rate ranges from 10 to 20 breaths per minute (c/min). (iv) $V_{O2}$: Oxygen consumption is the volume of oxygen taken up by body tissues while resting (or exercising) in liters, or milliliters per minute (ml/min), converted into STPD [Standard Temperature (0°C), standard Pressure (760 mm Hg) and Dry (no water vapor)]. $V_{O2}$ is also commonly reported in milliliters per kilogram of body weight (ml/kg). In healthy adults at rest the $V_{O2}$ is approximately 250 ml/min (STPD), or approximately 3.5 ml $O_2$/min/kg. (v) $V_{CO2}$: Carbon dioxide output is the volume of carbon dioxide produced by body tissues in liters, or milliliters per minute (ml/min), STPD. In
healthy adults at rest the $V_{CO_2}$ is approximately 200 ml/min (STPD). (vi) $PA_{CO_2}$ is the partial pressure of carbon dioxide in alveoli. It is measured in both kilopascal (kPa) and mm Hg (1 mm Hg = 1 kPa/0.1333). Normally it ranges between 4.65 and 5.30 kPa (i.e., 35 to 40 mm Hg). Clinically, $PA_{CO_2}$ is considered approximately same as $Pa_{CO_2}$ (Partial pressure of carbon dioxide in arterial blood). (vii) $PET_{CO_2}$ is partial pressure of end tidal carbon dioxide. End tidal carbon dioxide is the carbon dioxide present in the airways at the end of expiration. It is measured in both kilopascal (kPa) and mm Hg. (viii) $PET_{O2}$ is partial pressure of end tidal oxygen. It is also measured in both kilopascal (kPa) and mm Hg. (ix) EE: Energy expenditure is derived from oxygen consumption and is measured in kilocalories (kcal/day). The calorie (cal) is defined as the amount of heat energy necessary to raise the temperature of 1 gram of water by one degree centigrade.

4.2.2 Heart rate variability (HRV)

Heart rate variability (HRV) describes the variations between consecutive heartbeats. The regulation mechanisms of HRV originate from the sympathetic and parasympathetic nervous systems in addition to other controls and hence, HRV is used as a quantitative marker of the autonomic control over the heart (Task Force of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology, Heart Rate Variability: standards of measurement, physiological interpretation, and clinical use, 1996). The electrocardiogram (ECG) for HRV spectrum was acquired using an ambulatory ECG system (Nivique, Bangalore, India) (Plate 4.2.2).
Plate 4.2.2: Ambulatory ECG System for HRV, Nivique, India

Pentium computer with ambulatory system  
ECG electrode positions

Signal processing unit and interface unit

Subject in a recording room with ambulatory ECG unit connected to adhesive electrodes
4.2.2.A *Recording conditions:*

The subjects were studied in an air conditioned, sound attenuated room with dim lighting and the temperature ranging from 20 to 25° Celsius.

4.2.2.B *Specifications of Nivique system:*

Nivique ambulatory system is a computerized ECG recording system that allows to acquire, analyze and store ECG data over long hours. The data is acquired and stored in flash memory for later downloading and analysis. The data transfer from the memory module (main unit) to the computer is through an interface RS232C-compatible module. The ECG viewing on the computer monitor screen includes multi-lead ECG viewing, beat-to-beat analysis and detection of heart rate. The biological signal is isolated from AC mains and ground. The system consist (i) computer interface unit, (ii) signal processing unit with bio-amplifier and (iii) bio-amplifier circuit with gain, low-pass and high-pass filters adjusted for ECG signal acquisition. Gain is set at 1 mV/ division (Y-axis) as ‘default’ for ECG signal processing with frequency band: 0.5 to 100 Hz (Nivique Meditech Pvt. Ltd., 2003). Data can be translated into BIN, ASCII formats. This permits to analyze the data using any standard software.

4.2.2.C *Testing procedure:*

The ECG was recorded throughout the practice of cyclic meditation and supine rest using Ag/AgCl solid adhesive pre-gelled electrodes (Bio Protech Inc. Korea) affixed on either side of clavicular prominence and on the lower ribs to simulate limb lead I and II configuration. These electrode positions were selected as it was found that (i) placing the electrodes in the standard limb lead position led to
artifacts and (ii) the recordings made with electrodes in these positions were free from movement artifact. The ECG was acquired using an ambulatory ECG system (Nivique, Bangalore, India) (Plate 4.2.2) at the sampling rate of 1024 Hz and was stored on the hard disc of a PC (Pentium IV) for analysis. The R waves were detected to obtain a point event series of successive R-R intervals, from which the beat to beat heart series were computed (Fig. 4.2.2). The data recorded was visually inspected off-line and noise free data were included for the analysis.

4.2.2.D Variables measured:

The following variables were measured (i) LF: Low frequency power of HRV spectrum is known to correspond to sympathetic modulation when expressed in normalized units. Low frequency band ranges between 0.05 - 0.15 Hz. (ii) HF: High frequency power (normalized units) of HRV spectrum ranges between 0.15 – 0.4 Hz. The efferent vegal activity is a major contributor to the HF component. (iii) Ratio of low and high frequency powers (LF/HF ratio) is correlated with the sympathovagal balance. (iv) HR: Heart rate is number of beats of per minute (b/min). Normally, heart rate ranges between 70 and 80 b/min.
Fig. 4.2.2: Heart rate variability spectrum (HRV)

Fast Fourier Transform analysis (FFT): HRV power spectrum
(VLF band = 0.0 - 0.05 Hz, LF band = 0.05 - 0.15 Hz and HF = 0.15 - 0.50 Hz)
4.2.3 Computer averaged P300 auditory evoked potentials

The P300 event related brain potentials (ERP) reflect fundamental cognitive events requiring attentional and immediate memory processes. The P300 component is often elicited with a simple discrimination task known as the ‘oddball’ paradigm, since two stimuli are presented in a random series such that one of them occurs relatively infrequently i.e. the odd ball (Polich, 1999). The P300 generation occurs from the interaction between frontal lobe and hippocampal and temporoparietal functions (Halgren, Marinkovic, & Chauvel, 1998). The P300 event related potentials were recorded using Nicolet Bravo System (USA) (Plate 4.2.3).

4.2.3.1 Specifications of Nicolet Bravo System:

The Bravo EP (Nicolet, USA) is a 4 channel evoked potential acquisition and review system with options of performing wide variety of tests such as Auditory Evoked Potentials (AEP), Somatosensory Evoked Potentials (SEP), Visual Evoked Potentials (VEP) and P300 Event Related Potentials (ERP). The Bravo EP amplifier has 4 acquisition channels, a headbox for electrode connections and a LED electrode impedance panel. To perform AEP tests, acoustically shielded earphone (TDH-39, Amplivox, UK) is used to deliver either ‘tone’ or ‘click’ stimulus. The acoustic stimulus intensity (in dB) has the following options: sound pressure level (SPL), peak sound pressure level (pSPL), peak equivalent sound pressure level (peSPL) and normal hearing level (nHL). The Bravo EP has optional software package which allows running P300 cognitive response test. The main features of the P300 optional software include 4-channel recording and independent averaging for frequent and rare stimuli (Nicolet Biomedical Inc., 1998).
The Bravo EP - 4 channels amplifier and Closed circuit TV

Subject in supine position with electrode connections and earphone

The recording cabin with acoustically shielded earphone (Amplivox, UK) used to deliver the ‘frequent’ and ‘rare’ stimuli, and a head-box for electrode connections with LED electrode impedance panel.
4.2.3.B Selection of auditory oddball P300 evoked potentials:

Previous studies have shown improvement in P300 evoked responses following Brahmakumaris Raja yoga meditation and Transcendental meditation (Joseph, Ram Shankar, Kulkarni, Ramchandra, Narasimhalu, Desiraju, 1987). However no study has been done on event related potentials following cyclic meditation.

4.2.3.C Recording conditions:

The subjects were individually assessed in a sound attenuated and dimly lit cabin. The recording leads were led out of the cabin, and connected to the Nicolet Bravo System (USA). The subjects were observed on a closed circuit TV and instructions were given through an intercom, so that subjects could remain undisturbed during a session.

4.2.3.D Electrode positions:

Ag/AgCl disk electrodes were affixed with electrode gel (Ten 20 conductive EEG paste, D.O. Weaver and Co. USA) at the Fz (frontal), Cz (central) and Pz (parietal) scalp sites, referred to linked earlobes (A1-A2) with a forehead ground (FPz); according to the International 10-20 system (Jasper, 1958). The electro-ocular activity (EOG) was recorded with a bipolar derivation from electrodes placed at 1 cm above and 1 cm below outer canthus of the right eye (Fig.M2). The electrode impedance was kept below 5 kΩ at all the scalp sites.

4.2.3.E Amplifier settings:

The electroencephalographic (EEG) activity was amplified with a sensitivity of 100μV. The low pass filter was kept at 0.01 Hz and the high pass filter was kept at 30 Hz. The P300 ERPs were computer averaged in 300 trial sweeps, in the 75 -750 ms range. The pre-stimulus delay was kept at 75 ms and the level of artifact rejection was set at 90%.
4.2.3.F *Stimulus characteristics:*

Binaural tone stimuli of alternating polarity delivered at 0.9 ms with a frequency of 1 KHz (50 cycles for the plateau, 10 cycles for the ramp) for the standard stimuli and 2 KHz (10 cycles for the plateau, 20 cycles for the ramp) for the target stimuli were used to trigger online averaging of the EEG. The percent of standard stimuli was set at 80 and for the target stimuli at 20. The stimulus intensity was kept at 70 dB SPL.

4.2.3.G *Recording procedure:*

The subjects were asked to avoid substances which influence cognitive performance (e.g., coffee, containing caffeine) for the day preceding and the day of the recording. Where this was unavoidable the session was taken on other day. A trial session was given to rule out any hearing deficit. The P300 evoked potentials were recorded in the eyes closed supine position. The ‘standard’ and ‘target’ auditory stimuli were delivered through close fitting earphones (TDH-39, Amplivox, UK) (Plate 4.2.3). The subjects were asked to distinguish between the two tones by mentally counting the ‘target’ stimuli. The P300 responses were recorded before and immediately after the intervention.

4.2.3.H *Variables measured:*

The following variables were measured

1. Peak latencies (ms) of P300 responses at (i) Fz (frontal electrode site), (ii) Cz (vertex electrode site) and (iii) Pz (parietal electrode site).
2. Peak amplitudes (μV) of P300 responses at (i) Fz (frontal electrode site), (ii) Cz (vertex electrode site) and (iii) Pz (parietal electrode site).
### 4.2.4 Six letter cancellation test (SLT)

Cancellation tests require visual selectivity and a repetitive motor response. A six letter cancellation test (SLET) was administered to assess functions such as selective and focused attention, visual scanning, and the activation and inhibition of rapid responses. The six letter cancellation test has been used in similar type of design on Indian population (Natu, & Agarawal, 1997). A sample worksheet of six letter cancellation test is given in Appendix-2.

#### 4.2.4.A Testing procedure:

The test worksheet consisted of three parts (i) instructions (ii) the six target letters to be cancelled and (iii) the working section which consisted of letters of the English alphabets arranged randomly in 22 rows and 14 columns. The subjects were asked to cancel as many target letters as possible in the specified time i.e., 90 seconds. 90 seconds has been selected as normally it is unlikely to complete the task in 90 seconds. The letter cancellation can be undertaken following a horizontal, vertical or randomized path by selecting any target alphabet mentioned. In the present study the subjects were asked to follow a randomize path. The total number of cancellations and wrong cancellations were scored and the net scores were calculated by deducting wrong cancellations from the total cancellations attempted. As this test was administered before and immediately after the intervention, to avoid the test – retest effect of memory, parallel worksheets were prepared by changing the target letters and the sequence of letters in the working section (Agarwal, Kalra, Natu, Dadich, & Deswal, 2002). This method (i.e., changing the target letters and the sequence of letters) was found to be appropriate.
for making parallel worksheets. Hence 50% of the subjects received one set of worksheets before a session, which the other 50% received a parallel worksheet before the session. Accordingly the subjects received the appropriate worksheet after the session. Similarly there were separate worksheets for the second session. This is the ‘counter balancing’ effect.

4.2.4.B Reliability and validity:

Reliability refers to the precision or accuracy of measurement. It suggests the consistency of measurement which is reflected in the reproducibility of the scores. The six letter cancellation test has been evaluated for its reliability and validity based on standard criteria. Reliability is ascertained based on (i) temporal stability and (ii) internal consistency (Singh, 2002). To assess temporal stability the correlation coefficient was calculated using the pilot data (unpublished) collected in twenty male healthy volunteers ‘without any intervention’. The correlation was made for the data collected before and after 23 minutes during which the subjects were given no specific intervention (Spearman’s correlation coefficient). The variable for which the correlation was made (i.e., the net score) demonstrated the temporal stability \(r = 0.781, P = 0.002\). Since the six letter cancellation test comprises one variable, internal consistency can not be calculated.

Validity concerns what the test measures and how well it does so. In the present study the six letter cancellation test is directly related to the attention of the person being examined. Cancellation tests require visual selectivity and a repetitive motor response. These tests assess many functions such as sustained attention, visual scanning, and the activation and inhibition of rapid responses.
Methods

(Lezak, 1995). Hence it may be said that the content validity of this test is adequate for the purpose for which it is intended.

### 4.2.5 Visual analogue scale (VAS):

Visual analog scales were measured to test the qualitative subjective experiences like the quality of practice, level of relaxation, level of awareness and quality of sleep during the preceding night after each recording session. A visual analog scale is a measurement scale that is used to measure a characteristic or attitude which is believed to range across a continuum of values and cannot easily be directly measured. It consists of a horizontal line, 10 cm in length, anchored by word descriptions at each end (Wewers, & Lowe, 1990). A sample worksheet of visual analogue scale (VAS) is given in Appendix-3.

#### 4.2.5.A Testing procedure:

The subjects were asked to mark the line at the point that they felt represented their perception of their current state. The VAS score was determined by measuring in millimeters from the left-hand end of the line to the point that the subject marked. There are no standard data available as this scale was used for the first time to understand these types of subjective experiences; however these types of scales are used in measurement of clinical phenomena like pain (Wewers, & Lowe, 1990).

#### 4.2.5.B Variables measured:

Visual analogue scale (VAS) for (i) quality of practice (QOP), (ii) quality of sleep (QOS), (iii) level of relaxation (LOR) and (iv) level of awareness (LOA).
4.3 DESIGN

4.3.1 Structure of sessions

Each subject was assessed in 6 sessions. They underwent three cyclic meditation sessions separately while (i) recording respiratory and metabolic variables, and heart rate variability (HRV) simultaneously, (ii) recording P300 event related potentials and (iii) recording the letter cancellation test (this test was administered to the group at a time). Similarly each subject underwent three supine rest sessions separately while (i) recording respiratory and metabolic variables, and heart rate variability (HRV) simultaneously, (ii) recording of P300 event related potentials and (iii) recording the letter cancellation test (this test was administered to the group at a time). The supine rest was considered as control session for CM because (i) supine posture is best known position for relaxation and (ii) in earlier study, CM was compared to supine rest in corpse posture (śavāsana) (Telles, Reddy, & Nagendra, 2000).

4.3.2 Order of sessions

The cyclic meditation (A) and supine rest (B) sessions were recorded alternately. For example in 5 subjects (S): S1 – ABAB; S2 – BABA; S3 – ABAB; S4 – BABA; S5 – ABAB and so on. This was to prevent the influence of being exposed to the laboratory for the first time from influencing the results. The recordings were made on different days, not necessarily on consecutive days but at the same time of the day.

4.3.3 Time allocation within the sessions

The respiratory and metabolic variables, and ECG for heart rate variability were recorded throughout the intervention in three states i.e., pre, during and post.
The P300 event related potentials and the letter cancellation tests were performed in two states i.e., pre and post.

4.3.3 A Cyclic meditation session: the first 5 minutes of the ‘pre’ cyclic meditation period was in the supine position, followed by 23 minutes of the ‘during’ period, where subjects were given cyclic meditation practice using taped instructions. This was followed by 5 minutes of the ‘post’ cyclic meditation period of supine rest.

4.3.3B Supine rest session: the first 5 minutes of the ‘pre’ supine rest period was in the supine position, followed by 23 minutes of the ‘during’ period, where subjects were given supine rest without instructions. This was followed by 5 minutes of the ‘post’ supine rest period of supine rest. The time breakup has been given below.

<table>
<thead>
<tr>
<th>5 min pre</th>
<th>During 23 min - CM</th>
<th>5 min post</th>
</tr>
</thead>
</table>

CM = Cyclic Meditation
SR = Supine rest
P300 = P300 event related potentials
RMV = Respiratory and metabolic variables
SLCT = Six letter cancellation test
HRV = Heart rate variability
4.4 INTERVENTIONS

4.4.1 Cyclic Meditation

Throughout the practice of cyclic meditation subjects kept their eyes closed, and followed taped instructions with ear phones. The instructions emphasized carrying out the practice slowly, with awareness and relaxation. The practice began by repeating a verse from the yoga text, the Māṇḍukya Upaniṣat (40 seconds); followed by isometric contraction of the muscles of the body ending with supine rest (1 minute): standing at ease (called tāḍāsana) and ‘balancing’ the weight on both feet (2 minutes); then the first actual posture, bending to the right (arḍākaticakrāsana, 1 minute 20 seconds); a gap of 1 minute 10 seconds with instructions about relaxation and awareness; bending to the left (1 minute 20 seconds); a gap as before (1 minute 10 seconds); forward bending (pāḍahastāsana, 1 minute 20 seconds); another gap (1 minute 10 seconds ); backward bending (arḍācakrāsana, 1 minute 20 seconds); supine rest with instructions to relax different parts of the body in sequence (10 minutes). The pictorial description of these postures in cyclic meditation is given in Plate 3.1.6.C. The postures were practiced slowly, with awareness of all the sensations that are felt. The total duration of the practice was 23 minutes (Nagendra, & Nagarathna, 2003). The key features of cyclic meditation are (i) postures interspersed with relaxation, (ii) slowness of movements, (iii) continuity, (iv) inner awareness, (v) feeling of heart beat, changes in blood flow and sound resonance, and (vi) recognition of linear, surface, three dimensional and all pervasive awareness. The principle of cyclic meditation and its practical details are elaborated in chapter ‘Review of Literature’ 3.1.6.C section.
**4.4.2 Supine rest**

During supine rest session, the subjects were lying supine with legs apart and arms away from the sides of the body and with their eyes closed. The duration of the practice was 23 minutes.

**4.5 DATA EXTRACTION**

**4.5.1 Respiratory and metabolic variables**

The data were converted to the format that is compatible with Microsoft Excel program. The contiguous breath-by-breath data were then averaged for different states (i.e., pre, during and post) of each recording session. The data of the ‘during’ state were divided into 4 sub-phases for further analysis (Table 4.5.1).

**4.5.2 Heart rate variability (HRV)**

The data were continuously acquired throughout the recording session; hence it was divided into 7 phases of 5 minutes for analysis (Table 4.5.2). The data small episodes of artifacts were shredded and were included for analysis. Data were analyzed with an “advanced HRV analysis software” program developed by Biomedical Signal Analysis Group, University of Kuopio, Finland (Niskanen, Tarvainen, Ranta-aho, & Karjalainen, 2004). To recover an evenly sampled signal from the irregularly sampled event series, a cubic interpolation was applied and the HRV power spectrum was obtained using Fast Fourier Transform analysis (FFT) (Fig. 4.2.2). The power in the HRV series of the following specific bands was studied, viz., the very low frequency component (0.0 - 0.04 Hz), low frequency component (0.05 - 0.15 Hz), and high frequency component (0.15 - 0.50 Hz). The low frequency and high frequency values were expressed as normalized units,
which represent the relative of each power component in proportion to the total power minus VLF component \([LF\ norm = LF / (total\ power-VLF) \times 100; \ HF\ norm = HF / (total\ power – VLF) \times 100)\] (Task Force of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology, Heart Rate Variability: standards of measurement, physiological interpretation, and clinical use, 1996).

**4.5.3 Computer averaged P300 auditory evoked potentials**

The peak amplitude and peak latency of the P300 was measured at the three electrode sites; i.e., Fz, Cz and Pz. Peak amplitude (in μV) was defined as the voltage difference between a pre-stimulus baseline and the largest positive-going peak of the ERP waveform within 250-500 ms latency (Polich, 1999). The latency (ms) was defined as the time from stimulus onset to the point of maximum positive amplitude within the latency window. The waveforms were visually inspected off-line for artifacts and the latency and the peak amplitude were obtained by selection with the cursor. The selection was performed by the experimenter (Fig. 4.5.3.A). A sample record of P300 responses using Nicolet Bravo EP system (USA) in presented in Fig. 4.5.3.B.
Methods

Fig. 4.5.3.A: Latency and amplitude of P300 responses

The oddball task presents two different stimuli in a random sequence, with one occurring less frequently than the other (T = target, S = standard)

Schematic illustration of Oddball Paradigm
Fig. 4.5.3.B: Sample record of P300 responses measured using Nicolet Bravo EP system (USA)
4.6 DATA ANALYSIS

Statistical analysis was done using SPSS Version 10 after selecting the appropriate test. The raw data obtained for each subject in each recording session were tabulated separately and the methods of statistical analysis are given below:

(i) The group mean and standard deviation were calculated and data were tested for variance and normal distribution by F test and Kolmogorov-Smirnov test respectively.

(ii) Repeated measures analyses of variance (ANOVA) were performed with two ‘Within subjects’ factors, i.e., Factor 1: Sessions; CM and SH and Factor 2: States; Pre, During, and Post. These repeated measures ANOVA were carried out for each variable separately.

(iii) For the normally distributed data paired t – tests were performed to compare the data of the ‘during’ and the ‘post’ periods with those of the respective ‘pre’ period.

For data that were found to be not normally distributed, step (ii) and (iii) were different. They have been described below as (ii)^ and (iii)^.

(ii)^ In place of the repeated measures of ANOVA described in step (ii) a Kruskal Wallis non parametric test was performed.

(iii)^ The Wilcoxon paired signed ranks test was performed to compare the data of the ‘during’ and the ‘post’ periods with those of the respective ‘pre’ periods.
### Table 4.5.1: States of recording sessions: Respiratory and metabolic variables (RMV)

<table>
<thead>
<tr>
<th>Cyclic meditation session</th>
<th>5 minutes</th>
<th>5 minutes</th>
<th>5 minutes</th>
<th>8 minutes</th>
<th>5 minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>D1</td>
<td>D2</td>
<td>D3</td>
<td>D4</td>
<td></td>
</tr>
<tr>
<td>‘Pre’ Supine rest (eyes closed)</td>
<td>Prayer</td>
<td>Observation of changes</td>
<td>Observation of changes</td>
<td>DRT</td>
<td>‘Post’ Supine rest (eyes closed)</td>
</tr>
<tr>
<td></td>
<td>IRT</td>
<td>Arḍakaticakrāsana (Left side)</td>
<td>Arḍacakrāsana</td>
<td>‘A’ chanting</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Linear awareness</td>
<td>Observation of changes</td>
<td>Observation of changes</td>
<td>‘U’ chanting</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Standing up</td>
<td>Lying down</td>
<td>Lying down</td>
<td>‘M’ chanting</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Centering</td>
<td>Linear awareness</td>
<td>Surface awareness</td>
<td>AUM chanting</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Observation of changes</td>
<td>Balance</td>
<td>Part by part relaxation</td>
<td>Coming out of body</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Arḍakaticakrāsana (Right side)</td>
<td>Padahastāsana</td>
<td></td>
<td>Merging with sky</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Sukhāsana</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Prayer</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Supine rest session</th>
<th>5 minutes</th>
<th>5 minutes</th>
<th>5 minutes</th>
<th>8 minutes</th>
<th>5 minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>D1</td>
<td>D2</td>
<td>D3</td>
<td>D4</td>
<td></td>
</tr>
<tr>
<td>‘Pre’ Supine rest (eyes closed)</td>
<td>Supine rest</td>
<td>Supine rest</td>
<td>Supine rest</td>
<td>Supine rest</td>
<td>‘Post’ Supine rest (eyes closed)</td>
</tr>
</tbody>
</table>

D1 to D4 = Phases of ‘During’ state, IRT = Instant relaxation technique (Journal of Indian Psychology. 2002; 17(2): 46-52).
DRT = Deep relaxation technique (Psychological Reports. 2002; 90: 487-94).
Table 4.5.2: States of recording sessions: Heart rate variability (HRV)

### Cyclic meditation session

<table>
<thead>
<tr>
<th>States of recording sessions</th>
<th>Cyclic meditation (25 minutes: eyes closed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 minutes</td>
<td>5 minutes</td>
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<tr>
<td>5 minutes</td>
<td>5 minutes</td>
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<tr>
<td>5 minutes</td>
<td>5 minutes</td>
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<tr>
<td>5 minutes</td>
<td>5 minutes</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>‘Pre’ Supine rest (eyes closed)</th>
<th>Prayer</th>
<th>IRT</th>
<th>Linear awareness</th>
<th>Standing up</th>
<th>Centering</th>
<th>Observation of changes Arđakaticakṛṣāna (Left side)</th>
<th>Observation of changes Arđacakṛṣāna (Right side)</th>
<th>Observation of changes</th>
<th>Lying down</th>
<th>Linear awareness</th>
<th>Surface awareness</th>
<th>Part by part relaxation</th>
<th>DRT</th>
<th>‘A’ chanting</th>
<th>‘U’ chanting</th>
<th>‘M’ chanting</th>
<th>AUM chanting</th>
<th>Coming up in sitting position Sukhāsana</th>
<th>Prayer</th>
<th>Again lying down in supine position</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supine rest (eyes closed)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Observation of changes Arđakaticakṛṣāna (Left side)</td>
<td>Observation of changes Arđacakṛṣāna (Right side)</td>
<td>Observation of changes</td>
<td>Lying down</td>
<td>Linear awareness</td>
<td>Surface awareness</td>
<td>Part by part relaxation</td>
<td>DRT</td>
<td>‘A’ chanting</td>
<td>‘U’ chanting</td>
<td>‘M’ chanting</td>
<td>AUM chanting</td>
<td>Coming up in sitting position Sukhāsana</td>
<td>Prayer</td>
<td>Again lying down in supine position</td>
</tr>
<tr>
<td>‘Post’ Supine rest (eyes closed)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Observation of changes Arđakaticakṛṣāna (Left side)</td>
<td>Observation of changes Arđacakṛṣāna (Right side)</td>
<td>Observation of changes</td>
<td>Lying down</td>
<td>Linear awareness</td>
<td>Surface awareness</td>
<td>Part by part relaxation</td>
<td>DRT</td>
<td>‘A’ chanting</td>
<td>‘U’ chanting</td>
<td>‘M’ chanting</td>
<td>AUM chanting</td>
<td>Coming up in sitting position Sukhāsana</td>
<td>Prayer</td>
<td>Again lying down in supine position</td>
</tr>
</tbody>
</table>

### Supine rest session

<table>
<thead>
<tr>
<th>States of recording sessions</th>
<th>Supine rest (25 minutes: eyes closed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 minutes</td>
<td>5 minutes</td>
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<tr>
<td>5 minutes</td>
<td>5 minutes</td>
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<td>5 minutes</td>
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<tr>
<td>5 minutes</td>
<td>5 minutes</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>‘Pre’ Supine rest (eyes closed)</th>
<th>Supine rest</th>
<th>Supine rest</th>
<th>Supine rest</th>
<th>Supine rest</th>
<th>Supine rest</th>
<th>‘Post’ Supine rest (eyes closed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supine rest (eyes closed)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Supine rest (eyes closed)</td>
</tr>
<tr>
<td>‘Post’ Supine rest (eyes closed)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Supine rest (eyes closed)</td>
</tr>
</tbody>
</table>

D1 to D5 = Phases of ‘During’ state, IRT = Instant relaxation technique (Journal of Indian Psychology. 2002; 17(2): 46-52).
DRT = Deep relaxation technique (Psychological Reports. 2002; 90: 487-94).