



A review of the scientific studies on cyclic meditation

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GENERAL

Yoga is an ancient science, originating in India, which has components of physical activity, instructed relaxation and interoception.[1] Yoga includes diverse practices, such as physical postures (*asanas*), regulated breathing (*pranayama*), meditation and lectures on philosophical aspects of yoga.[2-3] Meditation is the seventh of eight steps prescribed to reach an ultimate stage of spiritual emancipation (Patanjali, *circa* 900 B.C.).[4] While many practitioners do learn meditation directly, others find it easier to first pass through the other stages - learn yoga postures (*asanas*) and regulated breathing (*pranayamas*). It is postulated that when a novice attempts to meditate directly, there could be two responses based on the quality of the mind viz., (i) a *rajasic* – active (personality) mind would be restless all through the session and (ii) a *tamasic* – a mind with inertia could fall asleep. This problem of the mind is addressed in the *Mandukya Upanishad*. Based on this a technique of 'moving meditation', which combines the practice of yoga postures with guided meditation was evolved, called cyclic meditation (CM), by H.R. Nagendra, Ph.D., which has its' origin in an ancient Indian text, *Mandukya Upanishad*. [5] It is interesting to note that CM does induce a quiet state of mind, which is compatible with the description of meditation (*dhyana* or effortless expansion), according to Patanjali. The description states: '*Tatra pratyayaikatanata dhyanam*' (Patanjali's *Yoga Sutras*, Chapter 3: Verse 2). This means that the uninterrupted flow of the mind towards the object chosen for meditation is *dhyana*. [4] Indeed, all meditations, irrespective of the strategies involved are believed to help reach this state. There are several strategies in meditation which include breath awareness, awareness of internal sensations, directing the attention to a *mantra* or a *koan*, and keeping the eyes open with the gaze fixed on the object of meditation.

The verse on which CM is based, states: '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 states of perfect equilibrium do not disturb it again'. The underlying idea is that, for most persons, the mental state is routinely somewhere between the extremes of being 'inactive' or of being 'agitated' and hence to reach a balanced/relaxed state the most suitable technique would be one which combines 'awakening' and 'calming' practices.

In CM, the period of practicing yoga postures constitutes the 'awakening' practices, while periods of supine rest comprise 'calming practices'. An essential part of the practice of CM is being aware of sensations arising in the body.[6] This supports the idea that a combination of stimulating and calming techniques practiced with a background of relaxation and awareness (during CM) may reduce psycho physiological arousal more than resting in a supine posture for the same duration.

The practice of CM, includes yoga postures (*asanas*) which involve muscle stretching and this has diverse benefits. The effects, benefits and possible mechanisms underlying CM are given below.

SCIENTIFIC STUDIES ON CM

The studies described below were all carried out at the Swami Vivekananda Yoga Research Foundation, Bangalore, India, where the technique was devised.

Studies on autonomic and respiratory variables

In a previous study, heart rate variability (HRV) was studied in 42 male volunteers in CM and supine rest (SR) sessions. The high frequency (HF) power of the HRV increased during both CM and SR practice, which is considered to suggest increased vagal tone.[7] However, there was a marginally greater increase during CM (4.4 %) compared to during SR (1.0 %). In the same study the low frequency (LF) power which is believed to correlate with sympathetic activity was significantly less during both CM (1.8 % decrease) and SR (0.3 % decrease). The study showed parasympathetic dominance. The exact mechanism underlying the effect of CM on the autonomic nervous system is difficult to determine. The effect may be brought about by reduced cortical activity, which in turn may modify the activity at the level of the hypothalamus.

An earlier study on 35 male volunteers (between 20-46 yrs of age) showed a significant decrease in oxygen consumption and increase in breath volume were recorded after guided relaxation practiced for 10 minutes compared to the equal duration of supine rest. During guided relaxation the power of the LF component of the heart-rate variability spectrum reduced, whereas the power of the HF component increased, suggesting reduced sympathetic activity.[8] However, another study on 40 male volunteers (16 to 46 yrs) showed that Isometric relaxation technique practiced for a minute showed a reduction in the physiological signs of anxiety and stress.[9]

More recently, a study on 30 male volunteers (20 to 33 years) showed a decrease in heart rate (HR), low frequency power (LF power), LF/HF ratio, and an increase in the number of pairs of Normal to Normal RR intervals differing by more than 50 ms divided by total number of all NN intervals (pNN50) following the practice of cyclic meditation (CM) suggestive of a shift towards sympatho-vagal balance in favor of parasympathetic dominance during sleep.[10]

Studies on applications in reducing occupational stress levels

In a subsequent study correlating CM and heart rate variability, a two-day CM program decreased occupational stress levels and baseline autonomic arousal in 26 asymptomatic, male, middle managers,[11] suggesting significant reduction in sympathetic activity. The mechanisms underlying the decrease in occupational stress levels may be related to decreased autonomic arousal (sympathetic activation) as well as psychological factors, though this remains a speculation.

Studies on metabolism and oxygen consumed

An earlier study on oxygen consumption showed that a period of CM significantly reduced oxygen consumption to a greater degree (32.1%) than a comparable period of supine rest.[12] A recent study also showed that after the practice of CM oxygen consumption decreased (19.3 %) compared to following SR (4.8 %). Also, the change in oxygen consumption suggested that after the practices (but not during) there was a period of physiological relaxation which was more after CM compared to SR.[13]

The energy expenditure (EE), respiratory exchange ratio (RER) and heart rate (HR) of 50 male volunteers were assessed before, during, and after the sessions of CM and sessions of supine rest. CM reduced the energy expenditure more than supine rest alone.[14] The studies cited above were conducted using the self-as-control design. Reduction in oxygen consumption due to

CM practice could be related to decreased oxygen consumption of the brain and the skeletal muscles (which are probably more relaxed with the practice of CM).

Studies on attention and electrophysiology

Earlier studies showed that despite the changes suggestive of parasympathetic dominance following CM, there was a decrease in the P300 peak latency and an increase in the P300 peak amplitude when the P300 was obtained using an auditory oddball paradigm.[15] The P300 component of event-related brain potentials (ERPs) is generated when persons attend to and discriminate stimuli which differ in a single aspect. More recently, middle latency auditory evoked potentials (0-100ms range) were examined in 47 male volunteers before and after the practice of CM which has resulted in prolonged latencies of evoked potentials generated within the cerebral cortex, supporting the idea of cortical inhibition after CM.[16] The studies cited above were conducted using the self-as-control design. The mechanism by which CM may improve attention while reducing sympathetic tone may be related to increased proprioceptive input (during the practice of *asanas*) to the Reticular Activating System (RAS), which in turn keeps cortical areas receptive and active.[17] This is difficult to understand as generally increased alertness and vigilance is associated with an increase in sympathetic tone.

Studies on performance in cancellation task

In a previous study, the effect of CM practice on performance in a letter cancellation task, was assessed in 69 male volunteers (whose ages ranged from 18 to 48 years).[18] There was improved performance in the task which required selective attention, concentration, visual scanning abilities, and a repetitive motor response following CM. The results were interpreted to suggest that the improved performance after CM suggests that the practice not only globally enhances performance but also selectively reduces the probability of being distracted. Again, it is difficult to understand how CM practice, associated with reduced sympathetic activity, increases the performance in an attention task. As described above this may be via increased proprioceptive input to the reticular activating system.

Study on memory and anxiety

In a recent study 57 male volunteers (group average age \pm S.D., 26.6 ± 4.5 years) the immediate effect of CM and SR were studied on memory and state anxiety. A cyclical combination of yoga postures and supine rest in CM improved memory scores immediately after the practice and decreased state anxiety more than rest in a classical yoga relaxation posture (*shavasana*).[19] Like the P300 event-related potential and the letter cancellation task, performance in the memory task requires increased alertness. The mechanism (as described above) remains speculative.

Study on polysomnography

In a recent study, whole night polysomnography measures and the self-rating of sleep were assessed on the night following a day in which 30 male volunteers practiced CM twice (approximately 22:30 minutes each time). This was compared to another night when they had two, equal duration sessions of supine rest (SR) on the preceding day. The percentage of slow wave sleep (SWS) was significantly more in the night following CM practice than the night following SR; percentage of rapid eye movement (REM) sleep and the number of awakenings per hour were less. The practice of CM during day time has been shown to increase the percentage of slow wave sleep in the subsequent night.[20] CM has a number of components which may facilitate sleep such as increased physical activity, muscle stretching, interoception, and guided relaxation.

CONCLUSION

The practice of CM in general appears to bring about a state of low physiological activation, as

described above, with reduced oxygen consumption and a shift in the sympathovagal balance towards vagal dominance. A period of CM practice significantly reduces oxygen consumption and energy expenditure to a greater degree (32.1%) than a comparable period of supine rest. The CM program has also been shown to decrease occupational stress levels and baseline autonomic arousal. There is also an improved performance in a letter cancellation task which requires selective attention, concentration, visual scanning abilities, and a repetitive motor response following CM. Moreover, a study of the P300 following CM suggested that participants showed a better ability to discriminate auditory stimuli of different pitches in a P300 auditory oddball task. The prolonged latencies of evoked potentials, generated within the cerebral cortex after the practice of CM, supported the idea of cortical inhibition after CM. The practice of CM during day time has been shown to increase the percentage of slow wave sleep in the subsequent night. This suggests that CM practice (i) reduces autonomic arousal, (ii) improves attention, and (iii) improves quality of sleep.

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