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# TANTRA OR YOGA. CLINICAL STUDIES, SECTION 1: YOGA

TANTRA O YOGA. ESTUDIOS CLÍNICOS, 1ª PARTE: YOGA

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**Abstract**
Several clinical studies demonstrate how exercises from Vedic traditions, such as Yoga, or Theravada and Mahayana Buddhism, as well as tantric practices, have a significant psychobiological impact. This study seeks to identify the neurophysiological correlates of practices referred to as tantric and non-tantric meditations through a qualitative systematic review of collected data. First, the results of non-tantric meditations were verified, followed by the collection of data on tantric meditations. These were then compared, and the findings are presented in three parts. In this first part, it was found that non-tantric meditations create a better relaxation response with increased parasympathetic activity and inhibition of the sympathetic system. This induces a hypometabolic state of deep rest, where the practitioner remains awake and their attention is in a state of "tonic alertness," accompanied by symptoms corresponding to this hypometabolic state—hypotonia, decreased oxygen consumption, reduced heart rate, and lower blood lactate concentration. Additionally, there are changes in normal endocrine function, increased phenylalanine concentration in advanced meditators, elevated plasma prolactin levels, a five-fold increase in plasma arginine vasopressin levels, and a chronic and acute decrease in thyroid-stimulating hormone. This research paves the way for longitudinal clinical studies to confirm the long-term beneficial effects of these practices and to establish mechanisms to counteract the undesirable side effects presented here.

**Resumen**
Varios estudios clínicos muestran cómo los ejercicios de las tradiciones védicas, como el yoga, o budistas *theravada* o *mahayana* así como las prácticas tántricas tienen un impacto psicobiológico significativo. Este estudio busca el correlato neurofisiológico de las prácticas llamadas meditaciones tántricas y no-tántricas mediante una revisión sistemática cualitativa de los datos recolectados. Primero se verificaron los resultados de las no-tántricas, luego se recolectaron los datos de las tántricas, se las comparó y presentamos el resultado dividido en tres partes. En esta primera parte se encontró que las no-tántricas crean una mejor respuesta de relajación con actividad parasimpática incrementada e inhibición del sistema simpático, que induce un estado hipometabólico de descanso profundo donde el practicante permanece despierto y su atención, en «alerta tónica» con los síntomas correspondientes a ese estado hipometabólico -hipotonía, disminución del consumo de oxígeno, de la tasa cardíaca y de la concentración de lactato en sangre-, modificación del normal funcionamiento endócrino, aumentos en la concentración de fenilalanina en los meditadores avanzados, en los niveles de prolactina plasmática, un incremento de cinco veces en los niveles plasmáticos de arginina vasopresina, mientras que la hormona estimulante de la tiroides disminuye de forma crónica y aguda. Esta investigación abre el camino para desarrollar estudios clínicos longitudinales, para confirmar los efectos benéficos a largo plazo de las prácticas y establecer mecanismos para contrarrestar los secundarios indeseados mostrados aquí.

**Keywords**: Clinical studies; yoga; meditation; Theravada; Vipassana; Mahayana; Zen; mindfulness; EEG; ECG; fMRI; neuroimaging; neurophysiology; immunology; endocrinology

**Palabras Claves**: Estudios clínicos; yoga; meditación; Theravada; Vipassana; Mahayana; Zen; atención plena; EEG; ECG; fMRI; neuroimagen; neurofisiología; inmunología; endocrinología

## Introduction – Part One

As Basu (2016) notes, unlike the meditation practices of Yoga, Theravada, and Mahayana, the practice of Vajrayana—Tantra—does not cultivate relaxation but rather a state of heightened alertness. That is, being conscious and awake. The tantric scriptures, "*reserved only for rulers,*" aim to increase alertness and warn against excessive calm (Rinpoche, 1999).

In contrast, the scriptures and meditation instructions of the Vedic tradition, Yoga, Theravada, or Mahayana, which are widely disseminated, aim to achieve stillness and calm (Holmes, 1984) (Amihai, 2014).

This highlights the philosophical, social, and cultural consequences of these different types of "active" tantric meditations and "contemplative" Yoga, Theravada, and Mahayana practices. This review compiles the available scientific evidence regarding the possible neurophysiological correlates of practices generically referred to as "meditations" to confirm, with scientific evidence, whether the objectives of each group are met and to verify if this theoretical opposition is also reflected in the body.

Through clinical studies, it is shown how meditation types from Vedic traditions, such as Yoga or Buddhism, create a better relaxation response and a state of "tonic alertness"—involuntary—with increased parasympathetic activity (Wallace, 1971) (Wu, 2008), while tantric practices create better cognitive and physiological responses: increased arousal and "phasic alertness" (Petersen, 2012) (Sturm, 1999), while also significantly reducing stress levels (Batista, 2014).

This review has been divided into three topics. In this first part, the neurophysiological correlates of the results of meditative practices derived from Yoga and Theravada and Mahayana Buddhism are reviewed.

In the second part, the results of tantric practices are reviewed, and in the third part, they are compared.

The only common aspect between tantric and non-tantric techniques, and their different procedures, is that they all aim to modify the behavioural, cognitive, and physiological patterns of practitioners. However, given the significant differences in the procedures used in these exercises and the results obtained from their practice, we find the widespread error of attempting to verify them together to determine the mechanisms and clinical effects of both meditation techniques (Travis, 2010). Therefore, we will analyse the current scientific evidence by studying them, as indicated, first separately and then interpreting the clinical differences.

## Methodology

A qualitative systematic review of available studies on the neurophysiological consequences of meditations practised in Yoga, Theravada, Mahayana, Vipassana, Zen Buddhism, and mindfulness schools. A bibliographic search was conducted using the following keywords: yoga, meditation, Theravada, Vipassana, Mahayana, Zen, mindfulness, and insight. Each keyword was searched individually and combined using the appropriate Boolean connector with each of the following keywords: EEG, ECG, fMRI, neuroimaging, neurophysiology, immunology, and endocrinology. The search was conducted in both Spanish and English, using the following platforms: MEDLINE (PubMed), ISI Web of Knowledge, TripDatabase, Cochrane Library, and the references of the consulted articles were also exhaustively reviewed. The search included articles published before May 2017.

There is a wide variety of techniques referred to as "meditation," with such diverse forms and objectives that it is impossible to create taxonomies that encompass them all. Therefore, the term "exercises" should be used in the classification of Yoga, Mahayana, Theravada, Vipassana, or **tantric** practices. For this research, we will refer to **non-tantri**c meditation techniques as those derived from Vedic traditions, Yoga, Theravada, Mahayana, Vipassana, Zen, and mindfulness. Tantric meditation techniques will refer to those originating from esoteric Hindu Tantrism and esoteric Buddhist Tantrism or Vajrayana.

## Development – Part One: Non-Tantric Practices

One of the earliest studies on the physiological consequences of so-called "meditations" was conducted by Benson, Rosner, Marzetta, and Klemchuk, who concluded that meditation techniques produce a hypothalamic response associated with a decrease in sympathetic system activity and a reduction in blood pressure, "*which may not be associated with this mechanism but rather with the placebo effect*" (Benson, 1974).

Benson's studies focused on Transcendental Meditation (TM), derived from the Vedic tradition, and mindfulness, with the author assuming that their results would apply to meditation techniques in general (Petersen, 2012).

We can say that the results of research on TM and mindfulness indicate that these practices result in physiological changes indicative of increased activation of the parasympathetic nervous system and decreased sympathetic activity (Wu, 2008), such as reduced oxygen consumption and carbon dioxide elimination, decreased heart and respiratory rates, and a marked reduction in blood lactate concentration (Wallace, 1971).

Since the physiological results of meditation are the same as those produced during relaxation, Benson noted that the responses occurring during meditation are relaxation responses. As mentioned, assuming this applied to all types of meditation, he recommended decontextualising different types of meditation from their philosophical and cultural foundations, arguing that, regardless of the mechanism, the described relaxation technique "*is an effective method for reducing pressure, is easily and inexpensively learned, practised at no cost,* ***and has no side effects***" (Benson, 1974) (See Appendix 1a).

This article points out that there are indeed side effects, both physiological and cognitive-behavioural.

The physiological relaxation consequences of this group of non-tantric meditations, as found by Benson, have been confirmed by many subsequent studies. Chiesa (2009) concludes that a direct comparison study between mindfulness and standard relaxation training found that both treatments were equally capable of reducing stress to some extent. However, mindfulness was able to reduce ruminative thinking[1] (Jain,

[1] The person believes that everything happening around them involves them, feels responsible for everything that occurs, and relates everything to themselves, even without sufficient evidence to draw these conclusions. From everything that happens, they infer information about themselves. For example:

- If someone yawns, it means they are boring them.
- If a conversation dies, it's because they failed to keep it going.
- If people look at them, it's because they are perceiving something negative.
- If there's a group of people gathered, they think: "They must be watching me."

The constant question is: *"How must they be seeing me right now? What must they be thinking about me?"* And they answer themselves: *"They must be noticing what's happening to me."* As a result, they gather information about themselves based on what they assume others are perceiving about their actions.

This mental rumination reduces the attentional resources they would otherwise use to understand others, enjoy communication, appreciate their surroundings, perform everyday tasks, or consider the lives of others.

2007) and anxiety, as well as increase self-compassion in practitioners (Chiesa, 2009).

In a later study, Chiesa, using neuroimaging, shows that mindfulness, as well as mindfulness-based cognitive therapy (MBCT), is effective in reducing relapses in depression among patients with three or more prior episodes. Additionally, Zen meditation significantly reduces blood pressure, and Vipassana meditation shows efficacy in reducing alcohol consumption and substance abuse (Chiesa, 2010) (Buksbazen, 2002).

Another scientific study conducted at the Laboratory of Cellular Physiology and Immunology at Rockefeller University, NJ, USA, on these non-tantric forms of meditation, concludes that meditation generates a hypometabolic state of wakefulness with parasympathetic predominance. This is compared to other hypometabolic conditions such as sleep, hypnosis, and the lethargy of hibernation. The study concludes that there are many analogies between the physiology of long-term meditators and hibernators across the phylogenetic scale. These analogies suggest that the plasticity of consciousness is the key factor in successful biological adaptation (Young, 1998).

These meditative states, physiologically characterised by a hypometabolic state of wakefulness and parasympathetic predominance, are traditionally presented as altered states of consciousness derived from Vedic culture and are generally associated with the attainment of "***higher spiritual states***."

Young and Taylor (1998) suggest that the development of meditation could be considered in the context of biological evolution as an adaptive response in humans, with analogies to lower organisms across the phylogenetic scale. They also observe that the induction of a hypometabolic state is produced by specific types of meditative practice,

concluding that "*when practised once or twice a day for just 20-30 minutes, the simplest techniques seem to have lasting and measurable effects on metabolism that are exactly opposite to the fight/flight reflex*."[2]

Another study conducted by Jevning, Wallace, and Beidebach on the effects of Transcendental Meditation (TM) demonstrated that hypometabolism is significantly increased in advanced meditators compared to beginners, including, in advanced practitioners, episodes of respiratory suspension that are highly correlated with subjective reports of what is called in Yoga the "*experience of pure consciousness*" (Jevning, 1992).

This study also showed dramatic increases in phenylalanine concentration in advanced meditators. Similarly, the urinary metabolite of serotonin (5-hydroxyindole-3-acetic acid) is higher in meditators than in resting controls, and levels also increase significantly immediately after the meditation period concludes. The same study demonstrated that plasma prolactin levels also rise rapidly and immediately after 40 minutes of meditation in advanced practitioners[3], and that after a 2-hour meditation period, there was a five-fold increase in plasma arginine vasopressin levels, while thyroid-stimulating hormone decreased both chronically and acutely.

[2] In the case of the fight/flight reflex, catecholamine levels increase dramatically, large amounts of glucose are mobilised for rapid energy release, the respiratory rate increases, blood is diverted from the viscera to oxygenate skeletal muscle, and the organism enters a state of heightened alertness.

[3] Several studies have found increased concentrations of prolactin in patients with schizophrenia. This condition predates the diagnosis of psychosis and the use of antipsychotic medication (Garcia-Rizo, 2012). Elevated prolactin levels can cause:

- Sexual impotence or the inability to maintain an erection,
- Decreased libido,
- Infertility—high prolactin negatively affects sperm production in men—,
- Weight gain, and
- Gynaecomastia or abnormal growth of one or both breasts.

This confirms other earlier studies showing a marked and acute decrease in adrenocortical activity during meditation in advanced practitioners compared to beginners, with increased plasma adrenaline and decreased heart rate. This reflects a coupled modification of sympathetic and parasympathetic activity rather than simply a reduction or increase in parasympathetic activity alone (Wallace, 1971). We understand that these results show that the hypometabolic state derived from meditation does not arise solely from parasympathetic excitation, as mechanisms of sympathetic inhibition are also observed in advanced practitioners.

It is interesting to contrast this with Indian yogis studied under laboratory conditions of simulated burial in a pit. One yogi entered a state of deep bodily rest, reduced metabolism, and was able to remain in a sealed box for 10 hours without adverse effects or signs of tachycardia or hyperpnoea (Amihai, 2015).

In a study conducted by Benson, Malhotra, Goldman, Jacobs, and Hopkins (1990), an advanced practitioner, Yogui Satyamurti, aged 70, remained confined in a small underground pit, sealed from above. For 8 days, he was physically monitored via cables, during which electrocardiogram (ECG) results showed that his heart rate fell below the measurable sensitivity of the recording instruments.[4] Yogui Satyamurti exhibited marked tachycardia of 250 beats per minute during the first 29 hours of his stay, and for the next 6.5 days, the ECG readings corresponded to an isoelectric line, i.e., no heartbeat. Satyamurti exhibited behaviours similar to hibernating organisms.

[4] Satyamurti was not dead. The signals from his heart were very weak, and the instruments of the time could not detect them. It was only in 1993, within the Argentine Association of Psychobiological Research and using a computer with a state-of-the-art ADQ12 data acquisition card, that we were able to perform an analog-to-digital conversion with a programmable high-gain amplifier. This allowed us to record signals that were previously unmeasurable, as in Benson's research.

The hypometabolic state during this type of meditation is a state of deep rest, similar to hibernation, but where the practitioner remains awake and their attention is in "tonic alertness," an involuntary alertness.

This state of "parasympathetic dominance" induced by non-tantric meditations is characterised by increased activity of the parasympathetic branch[5], decreased heart rate and blood pressure, increased intestinal activity, relaxation of the sphincter muscles, and altered normal endocrine function.

Another study on mindfulness meditation practices (Chiesa, 2010) concludes that electroencephalographic (EEG) results revealed a significant increase in alpha and theta activity during meditation.

Further EEG research suggests increased alpha, theta, and beta activity in frontal and posterior regions, mild gamma band effects, with increased theta[6] activity strongly related to the level of meditation experience. Neuroimaging studies suggest volumetric and functional changes in key brain regions (Ivanovski, 2017).

Other neuroimaging studies show that mindfulness practice activates the prefrontal cortex (PFC) and the anterior cingulate cortex (ACC) (Zeidan, 2014) and that long-term meditation practice is associated with improvements in brain areas related to attention (Cahn, 2006).

A study by Zeidan (2010) notes that mindfulness-based therapeutic interventions (MBCT) appear to be effective in treating depression, anxiety, psychosis, borderline personality disorder, and suicidal/self-harming behaviour.

Another study compares the effects of mindfulness-based meditation (Farb, 2007) and individual psychotherapy. The effect of a 10-week

[5] The parasympathetic system is also known as the "rest and digest" system.
[6] The increase in theta activity is associated with the early stages of sleep, phases 1 and 2. It is generated through the interaction between the temporal and frontal lobes.

meditation programme on 20 patients undergoing long-term individual psychotherapy was studied. Changes in patients' psychological well-being and the programme's impact on their psychotherapy process were assessed. Results from patients' self-reports and therapists' objective ratings demonstrated significant and substantial improvements in most measures of psychological well-being (Kutz, 1985).

The studies mentioned above were conducted on very specific types of meditation. They were primary investigations on control subjects and advanced practitioners of Transcendental Meditation (TM), Yoga, or Theravada and Mahayana Buddhism, such as Shamatha, Vipassana, or modern mindfulness meditation (Agee, 2009). During Shamatha or Vipassana practices, subjects avoided discursive thinking and focused on a meditation object during Shamatha or examined and generated insight into their own mental activity during Vipassana, as established in the Pali Canon (Tipitaka, 2005).

In non-tantric Buddhist scriptures, Shamatha practice is related to training in attention concentration. During Shamatha practice, practitioners are instructed to place their attention undistractedly on the meditation object while withdrawing their focus from other objects (Wallace, 2006). Vipassana refers to the understanding of the "*true nature of reality*," combined with the pacification of the mind (Bodhi, 2012).

Vipassana practice typically begins with Shamatha—focusing on the breath for an extended period—and when awareness drifts from the meditator's breath, they are taught to recognise that the mind has wandered and to observe the content currently occupying their mind.

A particular type of Shamatha practice is Kasina meditation. Kasina meditation refers to meditation objects with certain characteristics described in the Pali Tipitaka (Tipitaka, 2005). Kasina meditation objects

are usually coloured discs, differing in colour, size, object composition, and other properties, depending on the type of Kasina used. The Pali Tipitaka describes the following most commonly used Kasinas: earth, water, fire, air, blue, yellow, red, and white.

The mindfulness technique was developed by Jon Kabat-Zinn, who defined it as "*primarily Vipassana practice... with a Zen attitude*," where elements of Theravada and Mahayana practices are taught alongside Vipassana meditation to create a secular practice appealing to those uninterested in Buddhist culture or philosophy (Gilpin, 2008). Gilpin analysed the influence of Buddhist traditions on mindfulness, based on descriptions provided by the developers of mindfulness practices, Kabat-Zinn and John Teasdale, and concluded that mindfulness practice is primarily derived from Vipassana.

Other research conducted on derivatives of mindfulness meditation techniques, such as the Mindfulness-Based Stress Reduction (MBSR) programme, yielded results similar to those described above. Like Vipassana, MBSR emphasises avoiding discursive thinking by concentrating non-judgmentally on the content of one's mental activity (Gunaratana, 2002).

Finally, Cahn and Polich (2006) also included subjects practising Zen meditation, which, similar to Shamatha, requires the meditator to continuously focus on a single meditation object, finding results consistent with other forms of non-tantric meditation and in line with the findings collected in this study.

## Summary of Results of Non-Tantric Meditations

This study yielded the following clinical results for the forms of meditation encompassed under the term "non-tantric":

1. Induce a hypometabolic state during practice, generating a state of deep rest similar to hibernation, but where the practitioner remains awake and their attention is in "tonic alertness."

2. Produce a hypothalamic response associated with decreased activity of the sympathetic system and a reduction in blood pressure.

3. Induce physiological changes indicative of increased activation of the parasympathetic nervous system and inhibition of sympathetic activity, manifested in:

- Hypotonia with decreased oxygen consumption and carbon dioxide elimination; reduced heart rate, blood pressure, and respiratory rate; increased intestinal activity and relaxation of the sphincter muscles, as well as altered normal endocrine function.

- A marked decrease in blood lactate concentration.

- Dramatic increases in phenylalanine concentration in advanced meditators.

- The urinary metabolite of serotonin (5-hydroxyindole-3-acetic acid) is higher in meditators than in resting controls, and levels also increase significantly immediately after the meditation period concludes.

- Rapid and immediate increases in plasma prolactin levels after 40 minutes of meditation in advanced practitioners, and after a 2-hour meditation period, a five-fold increase in plasma arginine vasopressin levels, while thyroid-stimulating hormone decreases both chronically and acutely.

- A marked and acute decrease in adrenocortical activity during meditation in advanced practitioners compared to beginners, with increased plasma adrenaline and decreased heart rate.

- An adaptive hypometabolic response analogous to that of lower organisms in hibernation conditions.

- Persistent and measurable effects on metabolism that are exactly opposite to the fight/flight reflex.

4. Produce a considerable increase in alpha, theta, and beta activity in frontal and posterior regions, as well as volumetric and functional changes in key brain regions related to attention.

5. Demonstrated efficacy in treating depression, anxiety, psychosis, borderline personality disorder, suicidal/self-harming behaviour, and reducing alcohol consumption and substance abuse.

6. Enable a reduction in ruminative thinking and anxiety, as well as an increase in self-compassion among practitioners, who showed significant and substantial improvements in most measures of psychological well-being.

**Conclusion of Part One**

Non-tantric meditative practices could lead to long-term improvements in attention tasks (MacLean, 2010) (Tang, 2012).

The finding that Theravada meditation types produce relaxation has resulted in their incorporation into clinical practices as stress-reduction techniques (Chiesa, 2009) (Grossman, 2004).

This study also reveals that the group referred to here as "non-tantric meditative techniques" produced reductions in blood pressure, decreased ruminative thinking, and demonstrated efficacy in treating depression, anxiety, psychosis, borderline personality disorder, and suicidal/self-harming behaviour. The results indicate that these practices have

persistent and measurable effects on metabolism that are exactly opposite to the fight/flight reflex, while also promoting a better adaptive response in the studied subjects.

Based on the results obtained, we propose the following:

1. Conduct longitudinal clinical research to establish the long-term effects of these practices, both desired and undesired side effects, which we have demonstrated do occur.

2. Create postgraduate training programmes in these disciplines to ensure that the practice of these techniques is no longer in the hands of "gurus" or "yoga" instructors without training in the adverse effects identified, and to incorporate them into formal clinical practices.

3. Launch awareness campaigns to alert the public to the potential dangers of these practices when conducted by such "gurus" (See Appendix 1b).

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# Appendix 1

a) **Transcription of the conclusion from Benson's original article (1974):**
"*During the control period, blood pressures averaged 146.5 mm Hg systolic and 94.6 diastolic. During the experimental period, they decreased to 139.5 mm Hg systolic ($p < 0.001$) and 90.8 mm Hg diastolic ($0.001 < p < 0.002$). The results of this relaxation and meditation technique are consistent with a hypothetical integrated hypothalamic response associated with decreased activity of the sympathetic nervous system. It is possible that the decrease in blood pressure is not related to the proposed mechanism of decreased sympathetic nervous system activity and instead represents a placebo effect. Regardless of the mechanism, the described relaxation technique is an effective method for reducing borderline hypertensive pressures. The relaxation technique is easily and inexpensively learned, practised at no cost, and has no pharmacological side effects.*"

b) **As an example of the "gurus" mentioned in this article**, you can see how Mahayana Buddhist monks use the term "*scientific*" to support their system, attracting people with promises of "*scientific*" cures by visiting the website "Buddha Weekly" **(**http://buddhaweekly.com/category/scientific-buddhist/**).**

And how, on the same site, one of the leaders of Mahayana Buddhism, like other "gurus," called His Holiness Sakya Trizin, says: "*Black Manjushri purifies contaminations and impurities such as contagious diseases like Ebola, and obstacles caused by disturbing nature and natural spirits by cutting trees, polluting pure springs, and digging up mountains. It also purifies contaminations caused by eating the wrong food, going to impure places, wearing contaminated clothing, and similar things.*"
The website states that the practice of Black Manjushri successfully helps victims of the most dangerous diseases, including cancer, heart disease, and AIDS. (http://buddhaweekly.com/disease-specialist-black-manjushri-practice-reputation-successfully-helping-victims-dangerous-diseases-including-cancer-heart-disease-aids/). At the bottom of the image of this meditational deity, described as "tantric," it reads:

"Many students and teachers turn to the peaceful form of Black Manjushri as a healing deity for aggressive diseases such as cancer and AIDS."

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