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NEUROBIOLOGICAL MECHANISMS ASSOCIATED WITH KAIUT YOGA AS AN ADJUVANT INTERVENTION IN THE TREATMENT OF DEPRESSION

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Abstract: Introduction: The practice of Kaiut Yoga, based on the personalization of postures and the conscious guidance of breathing, provides an experience of body and mind introspection that favors self-knowledge and the integration between somatic consciousness and psychic states. This targeted approach allows Kaiut Yoga to be considered a distinct modality within the spectrum of Neuroyoga. **Objective:** To critically review the scientific evidence on the effects of Yoga in the treatment of depression, with an emphasis on the underlying neurobiological mechanisms, and to analyze the therapeutic potential of Kaiut Yoga as an adjuvant intervention, especially due to its adaptive and personalized proposal to the neuropsychological profile of the patient. **Methodology:** This is a theoretical review focusing on the neurobiological bases that support the therapeutic effects of traditional Yoga and its overlap with the principles of Kaiut Yoga. The data were analyzed in light of the pathophysiological mechanisms involved in major depressive disorder, with special attention to stress markers, synaptic plasticity and neuroendocrine modulation. **Results:** The reviewed literature indicates that regular Yoga practices are associated with reduced stress levels, regulation of the hypothalamic-pituitary-adrenal axis, and increased functional connectivity in brain regions involved in emotional self-regulation. These effects suggest that Kaiut Yoga, by incorporating such elements with a greater degree of individualization, can enhance therapeutic results in cases of depression. **Discussion:** Adaptability is an essential feature of Kaiut Yoga, allowing its integration into the Neuroyoga model as a complementary methodology focused on the patient‘s uniqueness. Benefits in terms of joint mobility, neurohormonal rebalancing, and a positive impact on comorbidities such as anxiety and depression are evident, which expands its clinical applicability. **Conclusion:** Kaiut Yoga stands out as a promising approach in the adjuvant care of depression due to its ability to promote psychocorporeal interventions with greater individual precision. However, the need for controlled clinical studies that empirically validate its effects is reinforced, in order to consolidate its inclusion in evidence-based practices.
Keywords: Neuroyoga; Kaiut Yoga; stress modulation; neuroplasticity; depression.

INTRODUCTION

In recent decades, there has been a significant increase in the search for integrative interventions that promote psychophysiological relaxation responses (RR), which have proven effective in emotional regulation and in alleviating symptoms related to stress, anxiety and depression (SINGH et al., 2006; TEASDALE et al., 2010; PAUL et al., 2013). Among these practices, mindfulness, meditation and, more recently, Neuroyoga practices stand out, recognized for inducing beneficial changes in multiple biological systems, with growing support in the scientific literature (GUPTA et al., 2006; ALEXANDER et al., 2010).

The National Center for Complementary and Alternative Medicine (NCCAM) classifies Yoga as a mind-body therapeutic approach, due to its direct impact on reducing stress — a common etiological factor in up to 90% of chronic diseases, including depressive disorders (BARNHOFER et al., 2009; FARB et al., 2010; ZEIDAN et al., 2014). The term Neuroyoga emerges in this context as a contemporary designation for Yoga practices with documented effects on the modulation of the autonomic nervous systems (sympathetic and parasympathetic), neuroendocrine, immune and inflammatory systems, integrating traditional knowledge with modern neuroscience (HARI CHANDRA et al., 2019; GOPAL et al., 2011; NAOROIBAM et al., 2016).

Within this scope, Kaiut Yoga represents a differentiated methodology, based on the principles of Hatha Yoga, but with an emphasis on personalizing the practice according to the functional and emotional particularities of the practitioner. In contrast to more structured styles such as Iyengar or Vinyasa, Kaiut Yoga values individual adaptation, respecting joint limitations, clinical conditions and personal progression pace (KAIUT; RODRIGUES, 2023).

Its structure combines asanas (physical postures), pranayamas (breathing techniques), meditation and guided relaxation states, aiming to restore joint mobility, increase body functionality and promote mind-body reconnection in a gradual and safe way (ALEXANDER et al., 2010).

This model is particularly relevant in the context of depression, a condition marked by symptoms such as anhedonia, psychic pain, social isolation and emotional dysregulation — often associated with hyperactivity of the hypothalamic-pituitary-adrenal axis and chronic stress (TEASDALE et al., 2010; PAUL et al., 2013). The theoretical proposal that underpins the use of Kaiut Yoga in this context is based on evidence indicating its ability to promote cortisol reduction, autonomic modulation and neuromodulation effects that contribute to the restoration of physiological balance in patients with depressive disorder (KAIUT; RODRIGUES, 2023).

Therefore, it is pertinent to investigate how the neurobiological mechanisms activated by this adaptive practice can position Kaiut Yoga as a valid adjuvant strategy in the integrative approach to depression, especially in refractory or chronic conditions.

OBJECTIVE

The purpose of this study is to conduct a critical review of the scientific evidence related to Neuroyoga practices, with an emphasis on findings that demonstrate beneficial effects through functional neuroimaging (fMRI) techniques, especially in patients with depressive disorders. The aim is to identify the main neurobiological mechanisms involved, including biomolecular markers and brain activation patterns associated with emotional modulation, neuroplasticity, and stress regulation.

In addition, the aim is to analyze how the personalized methodology of Kaiut Yoga, as an adaptive branch of Neuroyoga, can be considered a promising adjuvant approach in the treatment of depression. Its proposal for individualized adaptation to the physical and emotional conditions of the practitioner will be discussed in light of the pathophysiology of major depressive disorder, with a focus on the clinical feasibility and neurofunctional coherence of its therapeutic application.

METHODS

SEARCH STRATEGY

A systematic literature review was conducted in the PubMed and Web of Science databases, covering all articles published up to July 2014. The search strategy used controlled Medical Subject Headings (MeSH) descriptors, as well as free terms, including: *"depression"*, *"depressive disorder"*, *"neurobiology of depression"*, *"neurobiology yoga"*, *"Neuroyoga"*, *"neuroscience of yoga"* and *"yoga"*. These terms were combined and moderately expanded according to the specific resources of each database, in order to maximize the retrieval of relevant studies. No language restrictions were applied.

INCLUSION AND EXCLUSION CRITERIA

Only randomized studies that compared yoga-based interventions with active control groups or usual care were included in the

analysis. Both physical Yoga practices, focused exclusively on body postures (asanas), stretching and savasana, and integrative Yoga practices, which incorporate breathing techniques (pranayama), meditation and deep relaxation, were considered eligible.

Studies that included clinical and non-clinical populations were also included, as long as they involved the assessment of outcomes related to depression. Additional inclusion criteria involved the presentation of objective neurobiological evidence, such as functional changes detected by functional magnetic resonance imaging (fMRI) and serum cortisol levels, associated with the practice of Yoga in the context of depression.

The following were excluded:

- Non-randomized studies or those without a control group;
- Research without direct neurobiological assessment (by fMRI or cortisol measurement);
- Studies with insufficient methodology for measuring the clinical and physiological outcomes of interest.

RESULTS

The reviewed studies consistently demonstrate that Yoga practices are strongly associated with the reduction of physiological and psychological stress, one of the main pathogenic factors involved in depressive disorders. Regular practice acts on the modulation of the hypothalamic-pituitary-adrenal axis, directly influencing the release of cortisol, as well as on the regulation of neurotransmitter and neurotrophic systems, which has a positive impact on mood and emotional stability (EYRE et al., 2014; ZEIDAN et al., 2012).

A theoretical synthesis of the main neurobiological mechanisms activated by the practice of Yoga was carried out — mechanisms that are also attributable to Kaiut Yoga, given its integrated and adaptive structure. The physiological effects highlighted include: increased release of GABA (γ-aminobutyric acid), elevated levels of brain-derived neurotrophic factor (BDNF), modulation of the autonomic nervous system, reduction of the inflammatory response, and promotion of neuroplasticity — processes essential for functional recovery in depressive conditions.

A detailed understanding of these mechanisms allows for greater assertiveness in the clinical indication of Yoga as an adjuvant intervention, in addition to fostering future comparative investigations between different modalities, such as Kaiut Yoga, and its interface with traditional approaches, such as cognitive and behavioral therapies (O'SHEA et al., 2022).

Among the findings available in the literature, the narrative review by Basu-Ray et al. (2022) stands out, which systematizes the main randomized clinical trials on the use of Yoga in depression. Table 1, adapted from the aforementioned study, summarizes the main biomarkers associated with the neuropsychological benefits of Yoga, highlighting GABA, BDNF and cortisol as physiological indicators of a positive response to the practice.

NEUROBIOLOGY OF STRESS

Chronic stress is a central pathophysiological factor in several mental disorders, including depression. Its initial response is mediated by the activation of the hypothalamic-pituitary-adrenal (HPA) axis, which promotes the release of corticotropin-releasing factor (CRF) by the hypothalamus. CRF, in turn, stimulates the secretion of adrenocorticotropic hormone (ACTH) by the anterior pituitary gland, culminating in the activation of the adrenal glands and the release of glucocorticoids, especially cortisol — a potent immune and metabolic modulator (RUSSO-MARIE, 1992; HALVORSEN et al., 1987).

Emotions, by directly activating structures of the limbic system, exert regulatory effects

Author/Year	Participant characteristics	Study design	Intervention	Results	Conclusion
Michalsen et al., 2005	24 self-reported female subjects who perceived themselves as emotionally distressed	Prospective non-randomized controlled study	3-month Iyengar yoga intervention among women with mental distress	Compared to the control groups, a significant reduction in perceived stress was observed	Yoga Helps Improve Perceived Stress Among Distressed Women
Janakiramaiah et al., 2000	Untreated melancholic depressive patients	Randomized comparative trial	Sudarshan Kriya for 4 weeks among patients with melancholic depression	Significant reduction in depression score	Sudarshan Kriya has demonstrated its antidepressant effects in depression
Smith et al., 2007	Individuals with mild to moderate levels of stress	A randomized comparative trial	10 Week Hatha Yoga Intervention	Significant improvement in SF-36 scores was observed in the yoga group	Hatha Yoga intervention helps to improve stress, anxiety and health status compared to relaxation
Naveen et al., 2016	Adult outpatients with major depression	Prospective cohort study	3-month yoga intervention among patients with depression	Significant improvement in depression, BDNF and serum cortisol was observed	3-month yoga intervention improved BDNF, cortisol, and depression in depressed patients

(BDNF: *Brain-Derived Neurotrophic Factor; GABA: ácido γ-aminobutírico)*

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Table 1 – Clinical evidence on the effects of Yoga on depression (adapted from BASU-RAY et al., 2022)

on the hypothalamus, intensifying the release of ACTH and, consequently, the secretion of cortisol (TAREN et al., 2015). In states of persistent stress, the HPA axis undergoes dysfunctional hyperactivation, triggering a neuroendocrine cascade characterized by a sustained increase in glucocorticoids and catecholamines, with a direct impact on the balance between the sympathetic and parasympathetic systems (SINGH et al., 2015; TOOLEY et al., 2000; BHASIN et al., 2013).

This condition leads to a state of chronic neurophysiological hypervigilance, marked by systemic disturbances such as insomnia (due to melatonin dysfunction), autonomic hyperactivity (with tachycardia and tachypnea), irritability and impulsivity (mediated by vasopressin) — all components frequently observed in the context of depression.

NEUROBIOLOGY OF MOOD DISORDERS: DEPRESSION

Depression has a multifactorial etiology, involving complex interactions between genetic predisposition, adverse experiences, psychosocial factors, and structural and functional changes in the brain (PATRIAT et al., 2016). Among the main neurofunctional findings, studies with functional magnetic resonance imaging (fMRI) stand out, demonstrating dysfunctions in the dynamics of central brain networks.

Two circuits have been shown to be particularly implicated:

- The Default Mode Network (DMN), associated with introspection, self-reference, and autobiographical memory.
- The Task Positive Network (TPN), linked to attention, behavioral engagement, and executive control, through the subnetworks of salience, dorsal attention, and ventral attention (GIROTTI et al., 2024).

In depression, anomalous hyperconnectivity of the DMN is observed, as well as a reduction in the functional anticorrelation between the DMN and the TPN, indicating an impairment in the ability to disconnect from internal stimuli and persistence of negative ruminations (KOCH et al., 2017; KÖHN et al., 2016; GIROTTI et al., 2024).

In healthy individuals or in states of mind--body coherence, the prefrontal cortex exerts adequate top-down control over emotions and cognitions, promoting affective regulation, emotional resilience and optimism — capacities often compromised in depressive conditions (PATRIAT et al., 2016).

SCIENTIFIC EVIDENCE ON JOINT MOBILITY

Joint mobility, which is often compromised in chronic and psychosomatic clinical conditions, is one of the central focuses of Kaiut Yoga. Studies have shown that Yoga practices with an emphasis on adapted postures promote not only functional gains, but also significant reductions in pain and inflammation.

A randomized controlled trial evaluating the integration of Hatha Yoga therapy with exercises for osteoarthritis demonstrated significant improvements in all clinical parameters analyzed, both within and between groups (EBNEZAR et al., 2010). In women with musculoskeletal complaints, a statistically significant improvement in gait parameters was observed after intervention with Yoga (ULGER et al., 2012). Additional evidence points to reductions in rheumatoid factor levels, decreased pain, and increased functionality after Yoga sessions aimed at rheumatoid arthritis (TELLES, 2011; BADSHA, 2009). In postmenopausal women with this diagnosis, improvements in pain perception, postural balance, and depressive symptoms were observed (BOSCH et al., 2009).

SCIENTIFIC EVIDENCE ON NEUROLOGICAL PLASTICITY

Neural plasticity represents one of the most promising theoretical bases for the therapeutic use of Yoga in psychiatric conditions. Studies with functional magnetic resonance imaging (fMRI) show that integrative Yoga practices induce changes in functional connectivity (FC) in brain regions involved in emotional regulation and cognitive processing — aspects frequently affected in depression (ALEXANDER et al., 2010).

A randomized, controlled clinical trial evaluating an integrated approach to Yoga therapy in depressed patients reported a significant reduction in depressive symptoms after three months of intervention, compared to the control group (POOJARI et al., 2024). These findings reinforce the role of Yoga as a modulator of functional neuroplasticity in mood disorders.

SCIENTIFIC EVIDENCE ON SYSTEMIC REGENERATION

The practice of Yoga, especially when associated with prolonged states of relaxation (RR), also promotes systemic regenerative effects, with a direct impact on the autonomic nervous system, endocrine system and at the molecular level.

In a clinical study relevant to the proposal of Kaiut Yoga, a reduction in cortisol levels and attenuation of sympathetic activity were observed, indicating a decrease in autonomic hyperactivity associated with stress (GOPAL et al., 2011). Research with long-term RR practitioners showed significant changes in gene expression, including greater activation of genes related to energy metabolism, mitochondrial function, insulin secretion and telomere maintenance — in addition to the suppression of inflammatory pathways and genes linked to the stress response (BHASIN et al., 2013; VENKATESH et al., 2020).

Interactive network analyses further show that molecules such as mitochondrial ATP synthase and insulin are positively regulated, while genes in the inflammatory NF-κB pathway are negatively modulated, indicating a robust homeostatic effect of contemplative practices on molecular expression (BHASIN et al., 2013; VENKATESH et al., 2020).

DISCUSSION

The scientific literature on the practice of Yoga in populations with clinical and psychological comorbidities presents a diversity of protocols and results. Many studies report significant benefits, although methodological heterogeneity and variability in the duration of interventions limit more robust conclusions. Some investigations describe intensive Yoga programs in a supervised residential setting, but fail to assess the maintenance of long-term effects (AGTE et al., 2004; KOSURI et al., 2009).

Regardless of the type of protocol, regularity in practice is often highlighted as a decisive factor for therapeutic efficacy, both by practitioners and scholars in the field (RICE, 2001). A systematic review with meta-analysis conducted by Cramer et al. (2013) identified promising, albeit limited, evidence of the effect of Yoga on depression, particularly in individuals with more intense symptoms. The authors highlighted, however, the lack of longitudinal data and indicated that Yoga can be considered a viable adjunctive intervention, especially for cases refractory to conventional treatment.

Despite the solid basis supporting the efficacy of cognitive and behavioral therapies in the management of depression, it is estimated that a considerable portion of patients do not achieve complete remission of symptoms with these approaches (HUHN et al., 2014). In addition, therapeutic abandonment rates remain high, which reinforces the need for complementary practices that favor greater adherence (HANS & HILLER, 2013).

Among the studies reviewed, a disproportionate emphasis was observed on the short-term effects of Yoga practices. Although this temporality bias should be considered in critical analyses, the immediate effects on mood and stress should not be undervalued — especially in patients with severe depressive conditions. The distinction between acute and prolonged practices is essential to avoid undue generalizations, as warned by Simon et al. (2021).

In addition, a meta-analysis with high methodological rigor indicated significant, although inconclusive, anxiolytic effects in general Yoga practices. The authors highlighted the importance of personalizing interventions, adapting them to the physical and emotional condition of patients (SIMON et al., 2021; CRAMER et al., 2018).

In this sense, qualitative research with Iyengar Yoga has shown that the use of props for postural support and the adaptation of positions reduce discomfort and the risk of injuries, favoring adherence and safety in the practice (ALEXANDER et al., 2011). This approach includes personalizing the session, with gentle transition postures, centering techniques and the use of pranayamas to induce relaxation.

Another notable study examined the effects of Yoga in pregnant women with prenatal depression, comparing it with conventional prenatal care groups. The Yoga group showed a statistically significant reduction in depressive symptoms, both in women with a previous diagnosis and in those who were asymptomatic (GONG et al., 2015).

These findings support the proposal that Kaiut Yoga, due to its adaptive and individual-centered nature, aligns with the precepts of Neuroyoga. Its therapeutic effects — such as the promotion of neuroplasticity, improvement in joint mobility and modulation of the neuroendocrine axis — act in an integrated manner on the pathophysiological bases of

stress, anxiety and depression. As demonstrated throughout this work, the personalization of the practice not only favors adherence and therapeutic reception, but can also represent a relevant clinical differential, especially in populations with marked neuroemotional vulnerability (ZEIDAN et al., 2016; BHASIN et al., 2013; LIU et al., 2017).

CONCLUSION

Neuroyoga practices demonstrate consistent beneficial effects, both objective and subjective, on depressive states, especially with regard to stress modulation and the restoration of mind-body integration. Chronic stress and neuroendocrine dysregulation are central factors in the functional disorganization of the psychoneurophysiological system, and contemplative practices such as Yoga have been consolidating themselves as relevant tools in the management of these dysfunctions.

This work, of a bibliographic and theoretical-reflective nature, mapped the main neurobiological mechanisms activated by conventional Yoga practices and highlighted, in an innovative way, the Kaiut Yoga methodology as a differentiated therapeutic possibility. The principles of this approach — based on personalization, accessibility and acceptance — give it the potential to act as an adjuvant strategy in the treatment of depression, especially in refractory cases or those marked by high comorbidity.

However, it is important to recognize that this is an emerging methodology, still in the initial phase of scientific validation. The scarcity of specific studies on Kaiut Yoga imposes a limitation on the present work, which is proposed as an introductory framework for scientific reflection on its clinical applicability. Randomized clinical trials, with representative samples and longitudinal follow-up, are essential for the empirical elucidation of the hypotheses formulated here.

In addition, future studies should contemplate prolonged periods of intervention, since most of the current evidence is limited to short-term effects. Issues such as relapse prevention, the sustainability of therapeutic effects, and the differentiation between anxiety, depression and syndromes related to chronic stress, such as Burnout, need to be integrated into research agendas (SIMON et al., 2021; CRAMER et al., 2018).

In short, Kaiut Yoga represents a promising proposal in the field of integrative neuroscience, with the potential to enrich the therapeutic repertoire in mental health, as long as it is subjected to rigorous and progressive scientific investigation.

DECLARATION OF CONFLICT OF INTEREST

The authors declare that this research was conducted in the absence of any commercial, financial or institutional ties that could be interpreted as a potential conflict of interest.

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