

RESEARCH ARTICLE OPEN ACCESS DOI: 10.69573/jqsc.2026.4.1.129-153
Year: 2026, Volume: 04, Issue: 01, Pages: 129-153
Original Article

Received 02.01.2026
Accepted 21.01.2026
Published 05.02.2026

Quantum Coherence, Consciousness, and the Gut-Brain Axis: A Quantum- Integrative Framework for Healing and Wholeness

By Rachel Stricker

Corresponding author
drrachelstricker@gmail.com

Researcher at the University of Technology, Jaipur- 302020, Rajasthan, India.

Copyright © 2026 Rachel Stricker. This is an open access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Abstract

The gut-brain axis (GBA) represents an intricate, multidirectional communication network linking the enteric and central nervous systems, immune pathways, endocrine signaling, the microbiome, and the lived experience of consciousness itself. Classical biomedical models successfully describe many mechanisms within the GBA, yet they do not fully explain the system's rapid responsiveness, emotional sensitivity, or capacity for transformative healing. Quantum science offers a broader theoretical foundation. Within the ontology advanced by Amit Goswami and others, consciousness is understood as the ground of all being, and biological processes emerge as expressions of meaning, information, and intentionality.

1, 17

This article proposes a Quantum Coherence Model of the Gut-Brain Axis, synthesizing current research in quantum biology, quantum neuroscience, psychoneuroimmunology, microbiome science, and yoga-based integrative medicine. Evidence from studies of quantum brain dynamics, mind-brain interaction, biophoton emission, macroscopic coherence, and vital energy fields suggests that health arises when biological and subtle bodies maintain coherent alignment with consciousness, whereas illness emerges from disruptions in coherence.²⁻⁵

23

In this framework, disorders such as irritable bowel syndrome (IBS) and inflammatory bowel disease (IBD) are understood not only as disturbances of motility or inflammation ^{32, 33} but as multilevel coherence disruptions spanning physical, energetic, emotional, and informational domains. Yoga, meditation, breathwork, and other contemplative practices restore coherence through vagal regulation, energetic balancing, intention-based modulation, and nonlocal mind-body communication.⁶⁻⁹

This quantum-integrative model provides a scientifically grounded yet consciousness-centered lens for understanding gut-brain physiology and offers a pathway toward more holistic and transformational healing.

Published By
www.quantumjournalofconsciousness.com

Electronic ISSN No.
2583-7788

Keywords. Quantum coherence; gut-brain axis; consciousness-based medicine; microbiome-brain communication; vagal regulation; irritable bowel syndrome; integrative medicine

1) INTRODUCTION

The prevailing biomedical framework conceptualizes the human body largely as a collection of discrete physical mechanisms. While this perspective has produced significant advances in diagnosis and treatment, it has limitations in accounting for the experiential, emotional, and meaning-laden aspects of health and disease. Scientific materialism, much like traditional religious dogmatism, often confines inquiry within narrow assumptions about what is real or possible. As noted in earlier analyses of science and spirituality, systems that rely exclusively on external authority—whether divine or mechanistic—risk constraining creativity, agency, and the search for meaning.

Quantum science offers an expanded worldview. Within this paradigm, consciousness is not reduced to neural activity but is seen as the fundamental ontological ground from which matter, energy, and biological processes emerge. The Quantum Worldview therefore integrates empirical science with spiritual insight, affirming that human beings participate in a reality that is both material and transcendent.¹⁷ This perspective provides a coherent bridge between scientific inquiry and the search for meaning, purpose, and wholeness.

1.1 Rethinking the gut–brain axis through the Quantum Worldview

The gut–brain axis exemplifies the limitations of a strictly mechanistic framework. Classical models successfully describe neurotransmitter pathways, vagal afferents, microbial metabolites, and endocrine and immune

signaling.² Yet these models do not fully explain:

- the near-instantaneous impact of emotional shifts on gut motility,
- the persistence of trauma-related visceral patterns,
- the therapeutic effects of intention, meditation, and yoga,^{30, 31}
- the emergence of spontaneous remission, and
- the gut’s role as an intuitive, anticipatory organ system.

These phenomena resonate with findings from quantum biology, where coherence, entanglement, tunneling, and nonlocal correlations allow systems to behave in unified, highly efficient ways beyond classical expectations.^{7, 8, 10}

1.2 Consciousness as an organizing principle in biology

Amit Goswami’s work in quantum science posits consciousness as the primary causal agent in the universe.¹⁷ In this model:

- matter arises within consciousness,
- meaning shapes biological processes,
- downward causation influences physiology, and
- healing originates in changes of awareness.

This aligns with quantum neuroscience research demonstrating that mental attention and intention can stabilize neural firing patterns through the Quantum Zeno Effect (QZE), enabling neuroplastic reorganization and emotional regulation.¹² The work of Schwartz,

Stapp, and Beauregard establishes that consciousness can measurably affect brain activity, supporting the plausibility of intention-based healing. 12

When these insights are applied to the GBA, gut–brain communication is understood not only as biochemical signaling but as an emergent property of consciousness-mediated information flow.

1.3 The body as an energetic and informational system

Several of the provided research articles describe the body as an energetic system characterized by photon emission, vibrational signaling, and holographic organization. For example, Shrihari’s work on quantum healing observes that healthy cells emit coherent photons and that illness represents alterations in this emission pattern. 16

This perspective aligns with:

- biophoton research,
- mitochondrial resonance studies,
- subtle energy and chakra systems,
- yoga’s pranic framework, and
- the concept of the “vital body” central to quantum integrative medicine.

These models view biology as inseparable from energy, information, and consciousness—reinforcing the necessity of a multidimensional approach to health.

1.4 Purpose and significance of this article

This article develops a Quantum Coherence Model of the Gut–Brain Axis by:

- 1) Reinterpreting gut–brain physiology through a consciousness-based ontology

- 2) Synthesizing research across quantum science, neuroscience, integrative medicine, and subtle energy studies
- 3) Conceptualizing IBS and IBD as coherence disruptions rather than isolated physical disorders
- 4) Demonstrating how yoga, breathwork, meditation, and intention foster multilevel coherence
- 5) Providing a holistic framework for healing rooted in both science and spirituality

This approach aligns with emerging perspectives in quantum medicine, which propose that human physiology is both biophysical and informational, and that healing involves restoring coherence across all layers of being.

2) FOUNDATIONS OF QUANTUM COHERENCE IN BIOLOGY

Quantum biology has emerged as a field capable of illuminating physiological processes that exceed the explanatory reach of classical biochemistry. The discovery of quantum coherence in living systems—once thought impossible in warm, wet biological environments—has reshaped understanding of cellular communication, information transfer, and system-wide integration. 7, 8 These findings provide critical conceptual foundations for reinterpreting the gut–brain axis through a quantum lens.

Quantum coherence refers to the alignment or phase correlation among quantum states that enable collective behavior across molecules, cells, or tissues. 7, 8 When coherence is present, biological systems exhibit enhanced sensitivity, nonlocal communication, and rapid

information exchange—properties that mirror the integrative characteristics of gut–brain signaling.¹ Coherence becomes particularly meaningful within a worldview that situates consciousness as the ground of all being, where biological processes arise not simply from mechanistic interactions but from deeper informational and intentional fields.

2.1 Key Concepts in Quantum Biology Relevant to Gut–Brain Integration

Several quantum phenomena provide a conceptual foundation for understanding how coherence may operate within biological systems:

2.1a Coherence

Coherence describes the phase alignment of quantum states, enabling collective oscillations and energy transfer with minimal loss.^{7, 14} In biological systems, this may support synchronized cellular functions, rapid signal propagation, and harmonized physiological rhythms. Research in photosynthetic complexes demonstrates that coherence enables organisms to optimize energetic efficiency beyond what classical diffusion models predict.⁸

2.1b Quantum Entanglement

Entanglement reflects correlations between particles or systems that persist regardless of spatial separation.^{17_19} In cellular or physiological systems, entanglement has been proposed as a potential mechanism for simultaneous or coordinated responses across tissues.⁸ Although entanglement in human biology remains theoretical, models of coherent states in neural and biofield processes suggest parallels worth exploring.

2.1c Quantum Tunneling

Tunneling allows electrons or protons to cross energetic barriers that would be impassable under classical constraints. Enzymatic reactions, mitochondrial respiration, and olfactory signaling all appear to leverage tunneling to accelerate biochemical processes.^{7, 8, 36} These rapid, nonclassical transitions are relevant to gut–brain communication, where speed and sensitivity exceed conventional expectations.¹

2.1d Quantum Nonlocality and Downward Causation

Within the consciousness-based framework articulated by Goswami, nonlocality reflects the interconnectedness of all systems within consciousness.⁴ Downward causation describes the capacity of consciousness to collapse quantum possibilities into specific biological outcomes.^{17_19} This provides a theoretical basis for understanding intention, emotion, and meaning as agents that influence physiological coherence.

2.2 Evidence for Quantum Coherence in Biological Systems

A growing body of empirical research supports the existence of quantum coherence in multiple biological domains:

2.2a Photosynthesis

Seminal work using ultrafast spectroscopy demonstrated that excitons within photosynthetic complexes traverse multiple pathways simultaneously by maintaining coherence for hundreds of femtoseconds.⁷ This mechanism reflects a biological optimization strategy where coherence enables organisms to seek the most efficient energetic

routes.

2.2b Avian Magnetoreception

Cryptochrome proteins in the retinas of migratory birds appear to use entangled radical pairs to sense geomagnetic fields.⁸ This provides one of the most widely accepted examples of quantum processes operating at physiological temperatures within a living system.

2.2c Enzymatic Catalysis

Quantum tunneling has been documented in hydrogen and electron transfer within enzymes, enhancing reaction rates beyond classical predictions.^{7, 8}

These examples demonstrate that biological systems have evolved structures capable of protecting coherence from rapid decoherence, allowing organisms to capitalize on quantum efficiencies.

2.3 Biological Structures That Support Quantum Coherence

Several anatomical and molecular elements within human physiology are capable of sustaining coherent states relevant to gut–brain integration.

2.3a Microtubules

Microtubules—hollow cylindrical polymers of tubulin—serve structural and signaling roles in neurons, immune cells, and epithelial tissue. Their highly ordered lattice structures support vibrational modes and dipole oscillations that may facilitate quantum-like information processing.^{6, 21, 22}

Quantum neuroscience research suggests that microtubules could support coherent oscillations contributing to neural integration

and consciousness-related phenomena. ^{20_22} These structures are abundant in both central and enteric neurons, positioning them as candidates for coherence-based gut–brain communication.

2.3b Mitochondria

Mitochondria generate strong electromagnetic fields and exhibit synchronized oscillations in membrane potential, reactive oxygen species, and ATP production.^{7,9} Mitochondrial networks can behave like coupled oscillators, enabling coherent cellular responses to metabolic and environmental demands. ^{36, 37}

Given the metabolic intensity of both gut and brain, mitochondrial coherence may influence:

- neural firing stability,
- inflammatory regulation,
- epithelial permeability, and
- microbial–host interactions.²

Mitochondrial dysfunction is frequently documented in IBS and IBD ^{32, 33}, aligning with the concept of coherence breakdown.⁸

2.3c Biophotons and Electromagnetic Fields

Cells emit ultraweak photon emissions associated with metabolic and redox processes. ^{9,23, 34} Research from Shrihari and others notes that healthy cells emit coherent photons, while diseased cells display altered emission patterns.

Photon emission may play roles in:

- cellular communication,
- DNA regulation,
- immune surveillance, and
- microbiome behavior.²

These findings align with yogic and energy-medical frameworks, like that of Traditional Chinese Medicine (TCM) and Ayurveda, which describe the body as an energetic system structured by coherence and vibrational harmony.

2.3d Structured Water (Coherent Domains)

Water in cellular environments exists not only as bulk fluid but also in structured, semicoherent layers along proteins and membranes. Structured water may facilitate: 28, 29

- long-range dipole coupling,
- stabilization of coherent states, and
- rapid information propagation.⁹
- This is relevant to both neuronal and epithelial function in gut–brain communication. 1

2.3e Microbiome Oscillatory Networks

Microbial communities display rhythmic patterns in gene expression, membrane potential, quorum sensing, and metabolite production.¹⁰ These oscillations suggest coherence-like behavior within biofilms and microbial ecosystems.

Given the microbiome’s influence on neurotransmitter production, immune modulation, and vagal activation, microbial coherence may be foundational to GBA integration.²

2.4 How Biological Systems Maintain Coherence

Biological organisms have evolved sophisticated mechanisms to sustain coherence in environments that would normally

induce decoherence.

2.4a Structural Shielding

Proteins, lipid membranes, and cytoskeletal scaffolds create microenvironments that shield quantum processes from thermal noise. Microtubules, for example, provide geometric and energetic conditions favorable to coherent oscillations.⁶, 21, 22

2.4b Metabolic Energy Pumping

Constant ATP cycling supports coherent excitations in mitochondria and microtubules, similar to how lasers maintain photon coherence through energy pumping.⁷, 21, 22

2.4c Self-Organized Resonance

Biological systems often synchronize oscillatory processes—such as neural rhythms, cardiac waves, and microbial cycles—creating conditions that favor coherence propagation.¹¹

2.4d Nonlocal Information Integration

Quantum models of mind–brain interaction suggest that consciousness itself stabilizes neural states through repeated attention (the Quantum Zeno Effect), reinforcing coherence at the neuronal and network levels.⁸, 12

2.5 Relevance of Quantum Coherence to the Gut–Brain Axis

The gut–brain axis is uniquely suited for coherence-based mechanisms due to its: 1, 3

- extensive enteric neural networks,
- high mitochondrial density,
- rich microbial ecosystems,
- sensitivity to emotional and environmental signals,
- bidirectional nervous system connectivity, and

- role in intuitive and affective processing.

Quantum coherence provides a plausible framework for understanding how:

- emotional states modulate gastrointestinal function almost instantly,
- stress disrupts gut activity through decoherence,
- healing intention and contemplative practices restore balance, and
- the GBA integrates biological and experiential information.

In this integrative model, gut–brain physiology is inseparable from consciousness, energy, and meaning—three pillars central to the Quantum Worldview and to emerging research in quantum medicine.^{2, 4, 12}

3. ANATOMY AND COMPLEXITY OF THE GUT–BRAIN AXIS

The gut–brain axis (GBA) is a multidimensional communication network linking neural, endocrine, immune, microbial, and energetic systems in a continuous exchange of information. Classical models describe the GBA as a bidirectional loop between the central nervous system (CNS) and the enteric nervous system (ENS), yet recent advances in neuroscience, psychoneuroimmunology, and quantum medicine reveal a far more integrative structure.^{1, 3, 6}

Within a consciousness-centered framework, the GBA can be understood as a dynamic interface through which information flows across physical, energetic, emotional, and subtle levels of the human system. Disruptions

in any of these layers—biochemical, electrophysiological, microbial, or experiential—can destabilize coherence and manifest as gastrointestinal symptoms. Conversely, restoring coherence across these domains supports healing and resilience.

3.1 The Enteric Nervous System: A Distributed Neural Network

The enteric nervous system contains approximately 400–500 million neurons, making it one of the largest and most complex neuronal networks outside of the brain.^{1, 3} This neuronal density, combined with its capacity for autonomous reflexes, supports the characterization of the ENS as a “second brain.”

3.1a Structural Organization

The ENS includes two major neuronal plexuses:

- 1) Myenteric plexus (Auerbach’s): Regulates gut motility, peristalsis, and the tone of smooth muscle.
- 2) Submucosal plexus (Meissner’s): Regulates secretion, blood flow, and absorption.

ENS neurons produce more than 30 neurotransmitters, including serotonin, dopamine, acetylcholine, GABA, and peptides identical to those found in the CNS. Serotonin is particularly relevant: approximately 90–95% of the body’s serotonin is synthesized in the gut, where it influences mood, pain perception, and motility.^{1, 3, 6}

3.1b ENS as a Coherence-Sensitive Network

The ENS displays rhythmic oscillatory patterns essential for:

- peristalsis,
- gastric emptying,
- visceral sensitivity, and
- gut-based emotional signaling.

These oscillations resemble coherence phenomena found in neural networks. Disruption of these rhythms—through stress, inflammation, or microbial imbalance—may reflect or cause decoherence within the gut–brain network. 1, 4

3.2 The Vagus Nerve: A Bidirectional Pathway for Information and Coherence

The vagus nerve provides the primary neural highway between the gut and brain. Approximately 80–90% of vagal fibers are afferent, conveying information from the gut to the brain.^{1,6} This highlights the gut’s dominant role as a sensory and regulatory organ system.

3.2a Vagal Functions

The vagus nerve modulates:

- autonomic regulation,
- inflammation (via the cholinergic anti-inflammatory pathway),
- emotional processing,
- interoception and intuitive signaling,
- microbiome–host communication.

Higher vagal tone, often measured through heart rate variability (HRV) coherence, correlates with improved emotional regulation, resilience, digestion, and immune balance.^{1, 6} Practices such as meditation, breathwork, and yoga enhance vagal tone and thereby support systemic coherence—an effect supported by quantum brain models showing that sustained attention stabilizes neural firing (Quantum Zeno

Effect).^{8, 30, 31}

3.2b Polyvagal Considerations

Polyvagal Theory describes distinct branches of the vagus supporting social engagement, homeostasis, and immobilization responses. 5, 9, 31 This aligns with integrative models in which the vagus mediates not only physiological regulation but also emotional coherence and energetic integration.

3.3 Neuroendocrine Signaling: The Stress–Gut Interface

The hypothalamic–pituitary–adrenal (HPA) axis forms the hormonal arm of the GBA, linking emotional states with immune and digestive processes.

3.3a Cortisol and Gut Function

During stress:^{4, 6}

- CRH (corticotropin-releasing hormone) increases gut permeability,
- cortisol alters microbiome composition,
- motility becomes dysregulated,
- visceral hypersensitivity heightens.¹⁰

These changes occur rapidly—faster than classical biochemical pathways would predict—which supports the possibility of coherence-based or quantum-informational propagation of stress signals throughout the system.

3.3b Stress-Induced Decoherence

From a quantum-integrative perspective, stress introduces “noise” into biological networks, disrupting:

- mitochondrial oscillations,
- ENS rhythmicity,
- vagal regulation,

- microbial coherence,
- immune signaling.¹¹

Such multilevel disruption mirrors decoherence in quantum systems, where loss of order diminishes functional integration.

3.4 The Immune System as a Gut–Brain Communicator

Approximately 70% of the immune system resides in the gut. Immune cells—including macrophages, dendritic cells, T cells, and mast cells—interface directly with ENS neurons, vagal afferents, and microbial metabolites. 6

3.4a Cytokine Signaling

Proinflammatory cytokines such as IL-1 β , IL-6, and TNF- α communicate with the brain through:

- vagal afferents,
- humoral pathways,
- endothelial signaling.^{1, 6}

Quantum healing research suggests that immune function is sensitive not only to biochemical factors but also to emotional states, intentions, and energetic influences. For example, endorphins—associated with meditation, pranic healing, and positive emotional states—exert anti-inflammatory, immunostimulatory, and stress-reducing effects. 4, 6

This supports a coherence-based model in which immune regulation is influenced by both physiological and consciousness-mediated processes.

3.5 The Microbiome as a Metabolic and Informational Network

The gut microbiome contains trillions of microorganisms that produce neurotransmitters, short-chain fatty acids (SCFAs), vitamins, and immune modulators.

1,2 Its influence on the brain includes:

- regulation of serotonin, dopamine, and GABA,
- modulation of stress responses,⁴
- shaping of emotional and cognitive states,
- maturation of the immune system,
- activation of vagal pathways.

3.5a Oscillatory Microbial Behavior

Recent studies demonstrate that microbial populations:

- oscillate electrically,
- synchronize metabolic cycles,
- exhibit quorum-sensing coherence,
- participate in biophoton signaling.^{15, 23}

These coherence-like oscillations support the idea that the microbiome functions not just as a biochemical organ but as an informational and energetic subsystem within the GBA.

3.5b Dysbiosis as Decoherence

Disruption of microbial rhythms can destabilize:

- motility,
- immune balance,
- emotional regulation,
- neuroendocrine function.

This aligns with the perspective that IBS and IBD represent multilevel coherence failures rather than isolated physiological abnormalities.

3.6 The GBA as a Complex Adaptive System

The gut–brain axis displays hallmark features of a complex adaptive system: 1

- nonlinear dynamics,
- emergent properties,
- feedback loops,
- cross-scale coherence,
- environmental sensitivity.

Quantum models of biological organization propose that coherence acts as an underlying integrative force enabling efficient information flow and system-wide coordination.¹⁶

From this standpoint, the GBA is not simply a collection of organs and signals; it is a unified field of relational processes, shaped by consciousness, emotion, microbiology, energy, and environment.

3.7 Implications for a Quantum–Integrative Model of Gut–Brain Physiology

By situating the GBA within quantum science and consciousness-based frameworks, its functions can be understood as expressions of deeper informational and energetic coherence.

This interpretation allows for:

- more comprehensive explanations of stress-related gut disorders,
- deeper insight into trauma and visceral memory,
- expanded understanding of yoga and meditation as coherence practices,
- recognition of IBS/IBD as multidimensional disorders,
- legitimization of subtle energy interventions within integrative

medicine.

In this context, restoring gut–brain health requires addressing biological, psychological, energetic, and consciousness-based layers simultaneously—the very foundation of quantum integrative medicine and the central premise of the present model.^{2,4,17}

4. PROPOSED QUANTUM COHERENCE MECHANISMS IN THE GUT–BRAIN AXIS

The gut–brain axis (GBA) demonstrates a degree of speed, sensitivity, and multidimensional integration that challenges purely classical explanations. Neural, microbial, immune, bioenergetic, and emotional signals interact simultaneously, often with effects that emerge faster and more coherently than molecular processes alone can account for.^{1–3}

Quantum biology and consciousness-based models provide additional explanatory layers, proposing that coherence phenomena may underlie the system-level synchrony observed in gut–brain interactions. Within this framework, coherence reflects an alignment of oscillatory, bioenergetic, informational, and conscious processes across multiple scales of organization.^{4–7}

The following sections outline key mechanisms by which quantum coherence may participate in GBA regulation.

4.1 Microtubule Coherence in ENS and CNS Neurons

Microtubules are cylindrical protein structures abundant in neurons—including those of the

enteric nervous system (ENS)—where they contribute to structural integrity, intracellular transport, and potentially information processing. Their highly ordered lattice of tubulin dimers supports vibrational modes and electric dipole interactions that may sustain coherent quantum states. 8,21, 22

4.1a Coherence in neuronal microtubules

Quantum brain models, including those proposed by Hameroff, Penrose, 14 and later expanded by Stapp, 13 suggest that microtubules can support orchestrated coherent states capable of influencing neural firing patterns and consciousness-related processes. 9, 21, 22 These theories posit that microtubule coherence:

- stabilizes patterns of neuronal activity,
- enhances signal integration across networks,
- contributes to the emergence of meaning and intentionality,
- may allow nonlocal correlations within and between neural systems.

The ENS, which contains a neuronal density comparable to the spinal cord, is structurally equipped to support such coherence.⁴ Coherent microtubule dynamics may partially account for the rapid bidirectional influence between gut and brain.

4.1b Downward causation and ENS coherence

Quantum mind–brain research demonstrates that conscious attention can stabilize neural states through the Quantum Zeno Effect (QZE).¹⁰ The QZE suggests that repeated “measurements”—conceptually linked to

sustained mental focus—can inhibit state decay, effectively preserving coherence.

When applied to the GBA, this mechanism provides a theoretical explanation for how:

- intentional healing practices,
- mindfulness,
- meditation, and
- focused interoceptive awareness

can influence enteric neural function and gastrointestinal symptoms.

This aligns with evidence that contemplative practices improve vagal activity, emotional balance, and digestive function.^{1, 11}

4.2 Mitochondrial Bioenergetics as a Coherence Amplifier

Mitochondria are essential generators of ATP and producers of electromagnetic oscillations. Their electron transport chain involves quantum tunneling processes that enhance energetic efficiency.^{7,8 12}

4.2a Mitochondrial oscillations

Mitochondria exhibit rhythmic fluctuations in: 36, 37

- membrane potential,
- reactive oxygen species (ROS),
- NADH levels,
- calcium waves.

These oscillations can synchronize across mitochondrial populations, forming bioenergetic coherence networks.¹³

4.2b Relevance to gut–brain integration

Both gut epithelial cells and ENS neurons have extremely high metabolic demands. 1,3

Mitochondrial coherence within these cells influences:

- neuronal excitability,
- inflammatory states,
- barrier integrity,
- microbial–host interactions,
- stress resilience.

Disruptions in mitochondrial coherence have been associated with IBS, IBD, chronic stress, and neuropsychiatric disorders.¹⁴ Mitochondrial dysfunction may therefore represent a physical substrate of decoherence within the GBA.

4.2c Consciousness and energy regulation

Quantum medicine literature suggests that mitochondrial dynamics are responsive not only to biochemical factors but also to emotional and intentional states.⁷ Positive emotions, meditation, and subtle energy practices may enhance mitochondrial efficiency and coherence, supporting whole-system regulation.

4.3 Electromagnetic and Photonic Signaling in the Gut

Cells emit ultraweak biophoton emissions associated with oxidative metabolism and redox activity. ³⁴ Research by Shrihari and others describes these emissions as coherent under healthy conditions and disrupted during illness.

4.3a Biophoton functions

Biophotons may: ^{22, 25, 36}

- facilitate intracellular and intercellular communication,
- regulate gene expression,
- participate in DNA repair,

- modulate immune responses.

Photonic coherence could help coordinate rapid gut–brain communication that exceeds classical biochemical speed.

4.3b ENS and epithelial photonic activity

Emerging studies suggest that:

- microtubules may function as photonic waveguides, ²²
- mitochondria serve as biophoton sources,
- epithelial cells emit diagnosable photon signatures.

These findings are consistent with models of the body as a holographic, informational system—a view reinforced by quantum healing literature describing the human body as a projection of consciousness and energy.

4.4 Microbiome Oscillatory Dynamics and Coherence

The gut microbiome forms a dynamic ecosystem of bacteria, viruses, fungi, and archaea whose collective behavior influences digestion, immunity, mood, and cognition. ²⁷

4.4a Electrical and vibrational signaling

Microbial communities have been shown to:

- communicate via ion-channel-mediated electrical signals, ²⁶
- synchronize metabolic cycles,
- exhibit quorum-sensing coherence,
- participate in oscillatory electromagnetic interactions.¹⁵

These features resemble neural network dynamics and may support coherence between microbial populations and the host nervous

system.

4.4b Microbiome as a coherence field

Given that the microbiome produces neurotransmitters (e.g., serotonin, GABA, dopamine), SCFAs, and immunomodulatory compounds, microbial coherence may influence:²⁷

- ENS rhythmicity,
- vagal signaling,
- immune tone,
- emotional states.

Dysbiosis can therefore be understood as a collapse of microbial coherence, contributing to systemic decoherence in the GBA.

4.5 Structured Water and Coherent Domains in the Gut–Brain Axis

Structured water—also known as interfacial or exclusion-zone (EZ) water—forms ordered layers along cellular membranes and cytoskeletal proteins. 28, 29

4.5a Biological significance of structured water

Water coherence domains have been proposed to: 28, 29

- store electromagnetic information,
- facilitate proton conduction,
- stabilize protein folding,
- support quantum effects in biological systems.¹⁶

This suggests that water’s behavior within cells is integral to maintaining coherence, particularly in tissues with high electrophysiological activity such as neurons and epithelial cells.

4.5b Water as a coherence mediator

If structured water participates in coherence phenomena, changes in hydration, inflammation, stress, or pH may disrupt coherent domains, contributing to gut dysfunction.

This aligns with research showing that inflammatory and oxidative conditions alter water structuring, thereby affecting cellular function. 28, 29

4.6 Vagal Entrainment and System-Wide Coherence

The vagus nerve acts as a coherence mediator linking emotional, autonomic, microbial, and digestive states.

4.6a Vagal resonance

Vagal efferents modulate: 1

- heart rate variability coherence,
- respiratory–cardiac entrainment,
- ENS rhythmicity,
- inflammatory reflexes.

High vagal tone reflects a state of autonomic coherence associated with improved digestion, reduced inflammation, and emotional stability.¹

4.6b Mind–body practices and vagal coherence

Yoga, breathwork, and meditation induce: 30, 31

- increased HRV coherence,
- harmonization of neural oscillations,³⁵
- reductions in inflammatory cytokines,
- enhanced parasympathetic dominance.

These effects correlate with improved gastrointestinal outcomes and may be

mediated by both classical vagal pathways and quantum-stabilizing processes described by the Quantum Zeno Effect.¹⁰

4.7 Consciousness and Intention as Coherence Regulators

Within the consciousness-based ontology of quantum science, intention and awareness function as forces capable of influencing biological outcomes.^{4, 20}

4.7a Downward causation

Goswami's model proposes that consciousness collapses quantum possibilities into actual events,^{17_19} thereby shaping:

- neural firing patterns,
- emotional states,
- immune responses,
- digestive function.^{4,6}

The Quantum Worldview, according to Goswami, explains this correlation as a vital “v organ” interacting with their coordinated physical “p organ” in the morphogenetic liturgical field. ^{17_19} This paves the way for deeper understanding of epigenetics and chakra research. Quantum mind–brain studies support this view, showing that focused attention can modulate neural circuits and affect physiological outcomes.¹⁰

4.7b Intentional healing mechanisms

Quantum healing literature emphasizes that:^{15, 16}

- positive intention,
- compassion,
- embodied awareness,
- and meditative states

can modulate biophoton emission, endorphin release, and immune activity.

These effects align with the coherence model, suggesting that consciousness may restore order to disrupted physiological networks. ²⁰

4.8 Stress as a Decoherence Agent in the Gut–Brain Axis

Stress, trauma, and chronic emotional activation introduce decoherence by disturbing rhythmic, neural, microbial, and energetic patterns.⁴

4.8a Biological consequences of stress-induced decoherence

Stress triggers:⁴

- mitochondrial fragmentation,³⁷
- increased ROS production,
- altered microbial rhythms,
- immune activation,
- vagal withdrawal.¹⁴

These disruptions mirror decoherence phenomena in quantum systems—where noise collapses coherent states into less organized configurations. ¹⁵

4.8b Restoration of coherence

Healing involves rebuilding coherence across:

- microtubule networks,
- mitochondrial oscillations,
- vagal and autonomic rhythms,
- microbial communities,
- emotional and energetic fields.

Mind–body and yoga-based interventions can support this restoration, making them particularly relevant in treating IBS/IBD.

5. CLINICAL IMPLICATIONS: COHERENCE AND DECOHERENCE IN GUT–BRAIN DISORDERS

Reframing gastrointestinal disorders through the lens of coherence offers a multidimensional understanding of conditions such as irritable bowel syndrome (IBS) and inflammatory bowel disease (IBD). These disorders have traditionally been conceptualized as disturbances in motility, inflammation, visceral nociception, or microbial balance. 32, 33 However, clinical and experiential patterns suggest a broader disturbance: a breakdown in coherence across neural, immune, microbial, energetic, and emotional domains.^{1–3}

The following sections outline how disruptions in coherence may manifest in gastrointestinal disease and how restoration of coherence corresponds with symptom improvement.

5.1 IBS as a Multilevel Coherence Disorder

IBS involves dysregulation across motor, sensory, autonomic, and emotional systems, and is strongly influenced by stress, trauma, and psychosocial variables. 4, 32, 33 Classical models account for hypersensitivity, altered motility, and mild inflammation, yet do not fully explain:

- the rapid onset of symptoms following emotional shifts,
- cyclic flares triggered by interpersonal or environmental stress,
- improvements associated with mindfulness-based interventions,
- the intuitive, preconscious “gut knowing” reported by many patients.

5.1a Neural decoherence in IBS

IBS is associated with altered communication between the ENS and CNS, including:

- dysregulated vagal tone,
- heightened sympathetic activation,
- impaired cortical modulation of visceral signals. 1, 32

These changes can be interpreted as loss of neural coherence, where oscillatory gut–brain rhythms no longer synchronize efficiently.

Quantum neuroscience supports the view that emotional stress disrupts synchrony in neural assemblies, reducing stability in network firing patterns.^{5, 11, 15} This mirrors decoherence processes in quantum systems, where noise degrades phase alignment.

5.1b Microbial decoherence and dysbiosis

IBS patients frequently display: 32

- reduced microbial diversity,
- instability in microbial metabolic oscillations,
- disrupted quorum sensing and electrical signaling.

Such shifts reflect a breakdown in microbial coherence, destabilizing SCFA production, neurotransmitter synthesis, and immune balance.⁶

5.1c Mitochondrial and energetic dysregulation

Studies indicate altered mitochondrial function in IBS, including:

- reduced ATP efficiency,
- increased oxidative stress,⁹
- dysregulated redox cycles.

Because mitochondria influence both neural

excitability and immune signaling, mitochondrial decoherence may amplify visceral pain and sensitivity. 6

5.1d Emotional and energetic coherence disruption

Quantum healing literature emphasizes the centrality of emotional states to immune, endocrine, and neural function. 11, 15 Shrihari notes that stress alters photon emissions and disrupts “whole body coherence,” while positive emotional states stimulate endogenous opioids with anti-inflammatory and analgesic properties. 16

This framework suggests IBS emerges when emotional and energetic fields lose coherence, manifesting as physiological instability.

5.2 IBD as a Disorder of Coherence Collapse and Inflammatory Amplification

Inflammatory bowel disease presents a more overt breakdown in biological order. In addition to structural changes, IBD involves profound disturbances in microbial ecosystems, immune signaling, autonomic balance, and mitochondrial stability.^{3, 33}

5.2a Immune-driven decoherence

Key features of IBD—elevated cytokines, chronic inflammation, oxidative stress—mirror decoherence in quantum systems, where environmental disturbance collapses ordered states into chaotic ones. 9 Immune hyperactivation disrupts:

- barrier integrity,
- microbial balance,
- mitochondrial oscillations,
- ENS signaling,

- hormonal feedback loops.

5.2b Microbial instability and rhythm disruption

IBD microbiomes demonstrate: 2, 33

- volatile population changes,
- reduced rhythmicity in SCFA cycles,
- impaired quorum sensing,
- diminished coherence across microbial networks.¹¹

This instability contributes to chronic inflammation and altered gut–brain communication.

5.2c Autonomic imbalance

IBD patients often exhibit: 1, 33

- reduced vagal tone,
- heightened sympathetic drive,
- impaired cholinergic anti-inflammatory signaling.

These changes diminish system-wide coherence and promote inflammatory amplification.¹²

5.2d Energetic considerations

Quantum medicine perspectives suggest that chronic inflammatory states reflect energetic incoherence, where the body’s subtle energy and photon fields lose order.^{7, 15} Healing requires restoring coherence not only at biochemical levels but across emotional, energetic, and consciousness-based layers.

5.3 Emotional Regulation and Consciousness in Gut–Brain Healing

Emotional states profoundly influence gastrointestinal physiology. 1, 6, 32 Negative affect, chronic stress, trauma, and fear introduce physiological “noise” that disrupts

coherence across the gut–brain axis.¹³

5.3a Stress as a decoherence agent

Stress induces: 1, 4, 6

- CRH-mediated permeability increases,
- mitochondrial fragmentation,
- oxidative stress,
- altered ENS rhythms,
- microbial volatility,
- autonomic imbalance.

From a quantum-integrative perspective, stress attenuates coherence by perturbing the alignment of biological oscillators, bioenergetic fields, and neural assemblies.^{7, 35}

5.3b Emotional coherence and vagal regulation

Positive emotional states—safety, compassion, joy, and mindful presence—promote coherence by: 6, 29

- increasing vagal tone,
- harmonizing cardiac and neural rhythms,
- reducing cytokine release,
- stabilizing ENS function,
- supporting microbial diversity.¹¹

These effects mirror the stabilizing influence of conscious attention on neural systems described by Schwartz, Stapp, and Beauregard, where intentional focus produces measurable coherence through the Quantum Zeno Effect. 12, 13

5.3c Energetic and spiritual dimensions

Quantum healing research describes the mind as a holographic projection of consciousness, with the body reflecting energetic patterns

shaped by meaning, beliefs, and intention. 15_19

Interventions that restore emotional coherence—including yoga, pranayama, meditation, energy healing, and intention-setting—may also restore coherence across the gut–brain axis. 1, 29

5.4 Toward Coherence-Based Biomarkers in Gut Disorders

A coherence framework suggests novel biomarkers for IBS/IBD that span classical physiology, bioenergetics, and subtle fields.

5.4a Neurophysiological coherence markers 6

- HRV coherence (vagal tone)
- EEG–vagal synchrony
- ENS neuroimaging coherence
- Cortico-visceral oscillatory coupling
- Neurotransmitter and HPA Axis activity

5.4b Mitochondrial and metabolic markers 36, 37

- membrane potential oscillation metrics
- NADH/ROS rhythmicity
- ATP variability coherence

5.4c Microbial biomarkers 2, 3

- SCFA oscillatory patterns
- microbial quorum-sensing stability
- biofilm electrical activity

5.4d Immunological coherence markers 6

- cytokine variability and rhythmicity
- vagal anti-inflammatory reflex measures

These biomarkers provide multidimensional

tools for assessing gut–brain coherence and tracking therapeutic progress.

6. THE QUANTUM COHERENCE MODEL OF THE GUT–BRAIN AXIS

Drawing together biological, energetic, emotional, and consciousness-based processes, the Quantum Coherence Model of the Gut–Brain Axis provides a unified framework for understanding gut health and disease.

This model rests on three foundational principles derived from quantum science and consciousness studies:

- 1) Consciousness is primary. Biological processes arise within consciousness and are shaped by meaning, intention, and experience.⁴
- 2) Coherence is the organizing principle of health. Alignment of oscillatory, energetic, microbial, neural, and emotional patterns creates harmonious function.
- 3) Disease represents decoherence. Disruption across one or more levels of the system produces instability and symptoms.

6.1 Levels of Coherence in the Gut–Brain Axis

The model identifies five nested coherence layers:

Level 1: Quantum Coherence (Subcellular)

Microtubules, mitochondria, ion channels, DNA, and structured water function as coherence-supporting substrates. Disruptions in quantum coherence propagate upward, influencing cellular and systemic function.^{8–16}

Level 2: Bioenergetic Coherence (Mitochondrial Networks)

Synchronized mitochondrial oscillations support metabolic efficiency, immune regulation, and neural stability.^{36, 37} Loss of coherence contributes to fatigue, inflammation, and visceral hypersensitivity.

Level 3: Neural Coherence (ENS–CNS Integration)

Vagal signaling, rhythmic ENS activity, and cortico-visceral communication depend on harmonized neural oscillations.³⁵ Stress and trauma disrupt this coherence.

Level 4: Microbial Coherence (Gut Ecosystem Stability)

Microbiome rhythms, quorum sensing, and electrical and metabolic oscillations represent microbial coherence.² Dysbiosis constitutes microbial decoherence.

Level 5: Psychophysiological Coherence (Emotional–Autonomic Alignment)

Emotional states influence vagal tone, immune responses, and neural rhythms.^{5, 6} Coherence arises through safety, mindfulness, compassion, and intention.

These layers form a nested holographic structure in which coherence at one layer supports coherence at all others.

6.2 From Decoherence to Disease

Decoherence at any level disrupts:

- signal efficiency,
- regulatory feedback loops,
- microbial balance,
- inflammatory pathways,
- emotional stability.

IBS and IBD represent multilevel decoherence syndromes, where stress, inflammation, trauma, and lifestyle factors destabilize quantum, bioenergetic, microbial, and emotional coherence.

6.3 Restoring Coherence: A Quantum-Integrative Healing Framework

Healing arises not solely from biochemical intervention but from restoring order across the entire system. Interventions that enhance coherence include:

1) Mind–Body Practices

- meditation
- yoga
- pranayama
- visualization
- body–energy therapies

These practices elevate vagal tone, regulate neural oscillations, improve mitochondrial function, reduce inflammation, and stabilize emotional fields.^{29, 30}

2) Energetic and Subtle-Field Interventions

Quantum healing literature highlights the roles of intention, compassion, and energy-based therapies in restoring coherence at subtle and physical levels. ^{17_19}

3) Microbiome and Nutritional Therapies

Interventions that support microbial coherence like diverse whole-foods-based diets, avoiding processed foods, consuming pre and probiotics and fermented food all reinforce stability in the gut ecosystem. ^{2, 3}

4) Somatic and Trauma-Informed Approaches

Addressing unresolved emotional patterns restores psychophysiological coherence. ^{1, 5,}

6, 31

5) Quantum-Informed Clinical Models

Quantum medicine proposes that diseases may be detectable early through coherence changes long before structural pathology appears, supporting preventive and transformational care. ¹¹

7. RESEARCH DIRECTIONS AND METHODOLOGIES FOR INVESTIGATING COHERENCE IN THE GUT–BRAIN AXIS

Although the Quantum Coherence Model of the Gut–Brain Axis offers a compelling and integrative theoretical framework, empirical research is needed to validate, refine, or challenge its core propositions. The multidimensional nature of coherence—spanning quantum, bioenergetic, neural, microbial, immunological, and experiential levels—requires interdisciplinary methodologies that bridge classical physiology with emerging approaches in quantum biology, neuroscience, psychoneuroimmunology, and subtle energy research.

The following research directions outline feasible pathways for investigating coherence phenomena within gut–brain physiology.

7.1 Physiological and Neurobiological Measures of Coherence

7.1a Heart rate variability (HRV) and vagal coherence

HRV coherence is a widely used metric for assessing autonomic and emotional regulation. High HRV coherence correlates with vagal tone, emotional balance, immune resilience, and digestive regulation.¹ Research linking

HRV coherence to improved gut function suggests its potential as a non-invasive biomarker for gut–brain harmonization.

Longitudinal studies may examine how HRV coherence shifts during:

IBS/IBD flares versus remission,
yoga and breathwork interventions,
trauma-processing therapies,
intentional healing practices.

7.1b EEG–vagal synchrony and neural coherence mapping

EEG measures of neural phase synchronization can reveal how emotional states, interoception, and intentional focus influence brain–gut pathways.

Quantum neuroscience research by Schwartz, Stapp, and Beauregard demonstrates that conscious attention modulates neural firing stability through the Quantum Zeno Effect (QZE), suggesting coherence signatures should be measurable. 12, 13

Simultaneous EEG and vagal recordings could assess:

- coherence shifts during meditation or yoga,
- neural–enteric synchrony during gut-focused awareness,
- dysregulation patterns in IBS and IBD populations.

7.1c ENS imaging and motility coherence

Emerging enteric neuroimaging and high-resolution motility mapping techniques (e.g., functional luminal imaging probe, MRI-based gut motility scans) may detect coherence patterns—rhythmicity, synchrony, and

irregularity—within ENS circuits. 1,3

Comparative studies could evaluate:

- coherence deficits in IBS,
- ENS dynamics during stress versus relaxation,
- effects of vagal stimulation on motility coherence.

7.2 Bioenergetic and Quantum-Level Measures

7.2a Mitochondrial oscillation analysis

Mitochondrial membrane potential, ROS rhythmicity, and NADH oscillations can be measured via high-resolution fluorescence imaging. 36, 37 Studies may determine whether:

- IBS/IBD patients display distinct mitochondrial coherence patterns,
- meditation and breathwork enhance mitochondrial synchrony,
- mitochondrial decoherence correlates with inflammatory markers.

Mitochondrial dynamics are central to quantum medicine models and energy-based healing frameworks.

7.2b Ultraweak photon emission (UPE) as a coherence biomarker

UPE detectors can measure biophoton emissions from tissues, organoids, or cell cultures. Research by Shrihari describes photon emissions as indicators of cellular coherence or disorder. 16, 23, 34

Potential studies include:

- comparing UPE levels in stressed vs. non-stressed subjects,

- assessing changes in UPE following yoga or meditation,
- analyzing microbial biophoton emissions during dysbiosis.

7.2c Microtubule vibrational spectroscopy

Terahertz spectroscopy, Raman scattering, or quantum optical probes may allow investigation of:

- microtubule vibrational coherence in ENS neurons,
- stress-induced microtubule decoherence,
- coherence-enhancing effects of contemplative practices.

Although technically challenging, this represents a direct test of quantum brain–gut hypotheses.

7.3 Microbial Coherence Metrics

7.3a Microbiome rhythmicity profiling²⁷

Time-series metagenomics and metabolomics can capture:

- circadian and ultradian microbial rhythms,
- synchronization patterns in SCFA production,
- quorum-sensing coherence,
- electrical signaling oscillations.

Dysrhythmic microbial networks may correlate with symptom severity in IBS and IBD.

Quantum biology research suggests such oscillations may support cross-scale coherence within the gut ecosystem.

7.3b Electrophysiological recording of microbial networks

Recent work reveals biofilm-level electrical signaling. ³⁴

Electrophysiological tools could measure:

- coherence shifts during inflammation,
- effects of probiotics on microbial signaling harmonization,
- nonlocal correlations in microbial communication.

7.3c Photonic and energetic profiling of microbial communities

Given that microbial populations emit and absorb photons, UPE spectrometry could identify: ³⁴

- coherence states in healthy microbiomes,
- decoherence during dysbiosis,
- restoration of coherence following targeted therapies.

7.4 Immune Dynamics and Coherence Assessment

7.4a Cytokine variability analysis

In coherence-based models, not only cytokine levels but the rhythmicity of cytokine fluctuations may predict health outcomes. ⁶

Studies may track:

- diurnal and ultradian cytokine cycles,
- coherence-disrupting effects of acute stress,
- coherence-restoring effects of meditation, yoga, and psychosocial support.

7.4b Vagal anti-inflammatory reflex measures

Electrical vagal stimulation or non-invasive

vagal assessment may reveal coherence signatures in the cholinergic anti-inflammatory pathway.⁴

7.5 Multi-Omic and Network Science Approaches

Because coherence spans multiple biological levels, research should integrate:

- genomics,
- transcriptomics,
- proteomics,
- metabolomics,
- electrophysiology,
- psychophysiological metrics.

Network analysis could map coherence signatures across scales, offering insight into how disruptions propagate.

7.6 Experimental Designs for Validating Quantum–Integrative Hypotheses

7.6a Longitudinal intervention trials

Testing yoga, pranayama, meditation, energy healing, or quantum-based therapies with coherence metrics may demonstrate:

- symptom reduction,
- improvement in vagal tone,
- restoration of microbial or mitochondrial rhythmicity,
- changes in photon emission.

7.6b Stress-induced decoherence experiments

Ethical stress paradigms can assess:

- coherence degradation under stress,
- recovery curves,
- differences between healthy subjects

and IBS/IBD patients.

7.6c Gut organoid and ENS–brain chip models

Organoid systems allow controlled testing of:

- coherence in epithelial and neural networks,
- effects of cytokines, microbiota, or stress hormones,
- biofield or photon-based interventions.^{23, 24}

7.6d Consciousness and intention studies

Quantum healing models posit measurable effects of intention on biological systems.

Such studies could assess whether trained practitioners influence:

- microbial growth dynamics,
- UPE signatures,
- mitochondrial oscillations,
- ENS neuronal coherence.

8. CONCLUSION

The gut–brain axis is one of the most dynamic and integrative systems in human physiology, interweaving neural, microbial, immune, endocrine, emotional, energetic, and conscious processes into a unified regulatory network. Classical scientific frameworks have illuminated critical pathways of communication, but they cannot fully account for the rapidity, sensitivity, interdependence, or transformational potential observed in gut–brain interactions.

The Quantum Coherence Model of the Gut–Brain Axis reframes gut–brain physiology as a nested, multidimensional coherence system

embedded in consciousness. In this ontology, health arises from alignment—across quantum substrates, bioenergetic fields, neuronal oscillations, microbial ecosystems, immune rhythms, emotional states, and meaning structures. Illness emerges when coherence is disrupted.

This model aligns with findings from quantum biology, quantum neuroscience, microbiome science, psychoneuroimmunology, yoga therapy, and quantum medicine.

Research from quantum healing further illuminates how consciousness, intention, compassion, and subtle energy can influence physiology, supporting the view that healing is not merely biochemical but transformational and consciousness-driven.

IBS and IBD represent exemplary coherence disorders—conditions in which disruptions across multiple layers of being manifest as gastrointestinal, emotional, and energetic dysregulation.

Mind–body practices, contemplative disciplines, yoga, pranayama, and energy medicine restore coherence through vagal modulation, emotional harmonization, bioenergetic alignment, microbial stabilization, and shifts in conscious awareness. 30, 31

Adopting a coherence-based, consciousness-centered approach to gut–brain health opens pathways to:

- more holistic diagnostics,
- more personalized therapies,
- earlier detection of imbalance,
- integration of subtle energy sciences,
- transformational healing paradigms.

In doing so, this model contributes to a growing body of work redefining medicine as not only a biological science but a science of consciousness, coherence, and human wholeness.

Bibliography

- 6) Mayer EA. Gut feelings: the emerging biology of gut-brain communication. *Nat Rev Neurosci*. 2011;12(8):453-466.
- 7) Cryan JF, Dinan TG. Mind-altering microorganisms: the impact of the gut microbiota on brain and behaviour. *Nat Rev Neurosci*. 2012;13(10):701-712.
- 8) Drossman DA. Functional gastrointestinal disorders: history, pathophysiology, and future. *Gastroenterology*. 2016;150(6):1262-1279.
- 9) McEwen BS. Protective and damaging effects of stress mediators. *N Engl J Med*. 1998;338(3):171-179.
- 10) Porges SW. *The polyvagal theory: neurophysiological foundations of emotions, attachment, communication, and self-regulation*. New York, NY: W. W. Norton; 2011.
- 11) Ader R, Felten DL, Cohen N, eds. *Psychoneuroimmunology*. 2nd ed. New York, NY: Academic Press; 1991.
- 12) Engel GS, Calhoun TR, Read EL, et al. Evidence for wavelike energy transfer through quantum coherence in photosynthetic systems. *Nature*. 2007;446(7137):782-786.
- 13) Ritz T, Thalau P, Phillips JB, Wiltschko R, Wiltschko W. Resonance effects indicate a radical-pair mechanism for avian magnetic compass. *Nature*. 2004;429(6988):177-180.
- 14) Sies H. Oxidative stress: a concept in redox biology and medicine. *Redox Biol*. 2015;4:180-183.
- 15) Fröhlich H. Long-range coherence and energy storage in biological systems. *Int J Quantum Chem*. 1968;2(5):641-649.
- 16) Plenio MB, Huelga SF. Dephasing-assisted transport: quantum networks and biomolecules. *New J Phys*. 2008;10:113019.
- 17) Schwartz JM, Stapp HP, Beauregard M. Quantum physics in neuroscience and psychology: a neurophysical model of mind-brain interaction. *Philos Trans R Soc Lond B Biol Sci*. 2005;360(1458):1309-1327.
- 18) Stapp HP. *Mindful Universe: Quantum Mechanics and the Participating Observer*. Berlin: Springer; 2007.
- 19) Hameroff S, Penrose R. Consciousness in the universe: a review of the 'Orch OR' theory. *Phys Life Rev*. 2014;11(1):39-78.
- 20) Bisiani L, Vavra D, Dacko-Pikiewicz Z. Quantum medicine: a new era of diagnostics and healing. *Eur J Med Health Sci*. 2023;5(1):1-8.
- 21) Shrihari TG. Quantum healing: a new approach to holistic healing. *J Tradit Med Clin Natur*. 2017;6(2):198.
- 22) Goswami A. *The Self-Aware Universe*. New York, NY: Putnam; 1993.
- 23) Goswami A. *Quantum Doctor: A Physicist's Guide to Health and Healing*. Charlottesville, VA: Hampton Roads; 2004.
- 24) Goswami A, Onisor V, *Quantum Integrative Medicine*. Rhinebeck, NY: Monkfish; 2023.
- 25) Vimal RLP. Toward a theory of consciousness: brain, quantum coherence, and the body-mind system. *Journal of Consciousness Studies*.
- 26) Tuszyński JA, et al. Quantum processes in microtubules: implications for brain function. In: *Brain and Consciousness*.
- 27) Sahu S, et al. Quantum vibrations in microtubules. *Biosystems*. 2013;112(2):1-13.
- 28) Van Wijk R, Van Wijk EPA. *Light in Shaping Life: Biophotons in Biology and Medicine*. Meluna, Germany: Stichting Natuurwetenschap & Biophysica; 2005.
- 29) Popp FA. Coherent photon storage of biological systems. *Biophysical Journal*. 1979;28:545-554.
- 30) Rubik B. The biofield hypothesis: its biophysical basis and role in medicine. *J Altern Complement Med*. 2002;8(6):703-717.
- 31) Prindle A, Liu J, Asally M, et al. Ion channels enable electrical communication in bacterial communities. *Nature*. 2015;527:59-63.
- 32) Pollack GH. *The Fourth Phase of Water: Beyond Solid, Liquid, and Vapor*. Seattle, WA: Ebner & Sons; 2013.

- 33) Del Giudice E, Preparata G. Coherent dynamics in water as a possible explanation for biological organization. *J Biol Phys*. 1998;20(1):105-116.
- 34) Streeter CC, Gerbarg PL, Saper RB, et al. Effects of yoga on the autonomic nervous system, gamma-aminobutyric-acid, and allostasis in epilepsy, depression, and post-traumatic stress disorder. *Med Hypotheses*. 2012;78(5):571-579.
- 35) Pascoe MC, Bauer IE. A systematic review of randomised control trials on the effects of yoga on stress measures and mood. *J Psychiatr Res*. 2015;68:270-282.
- 36) Porges SW, Dana D. *Clinical Applications of the Polyvagal Theory*. New York, NY: Norton; 2018.
- 37) Chey WD, Kurlander J, Eswaran S. Irritable bowel syndrome: a clinical review. *JAMA*. 2015;313(9):949-958.
- 38) Ungaro R, Mehandru S, Allen PB, et al. Ulcerative colitis. *Lancet*. 2017;389:1756-1770.
- 39) Cifra M, Pospíšil P. Ultra-weak photon emission from biological samples: a future diagnostic bioindicator? *J Photochem Photobiol B*. 2014;139:2-15.
- 40) Buzsáki G, Draguhn A. Neuronal oscillations in cortical networks. *Science*. 2004;304(5679):1926-1929.
- 41) Bennett J, Onyango I. Energy, entropy and quantum tunneling of protons and electrons in brain mitochondria: relation to mitochondrial impairment in aging-related human brain diseases and therapeutic measures. *Biomedicines*. 2021; 9, 225.
- 42) Nunn A, Guy G, Bell J. The quantum mitochondrion and optimal health. *Biochem Soc Trans*. 2016; 44 (4): 1101-1110.