KEYORA NUTRITIONAL NEUROLOGY

Part II - The Neuroscience of Magnesium Glycinate

Four-Axis Integrated Model, Clinical Insights, Practical Applications

KEYORA
NOV 21, 2025

By Keyora Research Notes Series
This article is part of Keyora's long-form educational series documenting the scientific foundations behind our product development.

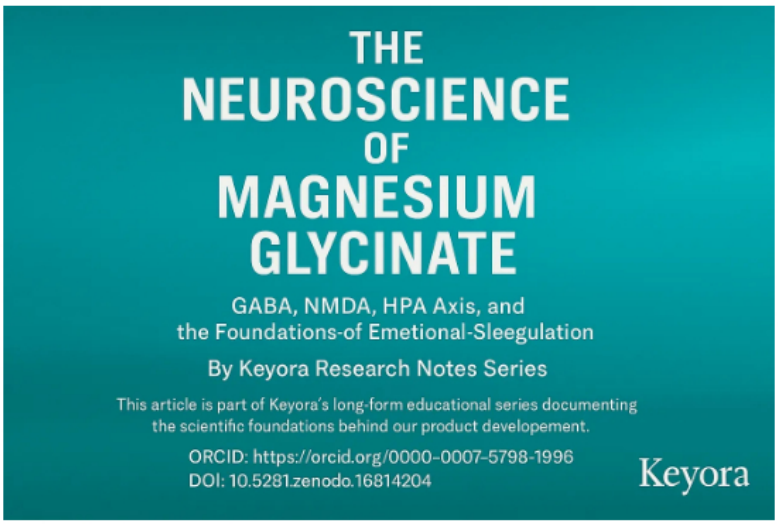
ORCID: 0009-0007-5798-1996

DOI: 10.5281/zenodo.16880133

This article is the first installment of a two-part series on the neuroscience of Magnesium Glycinate.

Part I focuses on the foundational mechanisms - GABA, NMDA, the HPA axis, and mitochondrial neuroenergetics - that underpin emotional and sleep regulation.

Part II, will integrate these mechanisms into a unified four-axis model and explore clinical insights, practical applications, and Keyora's research perspective.



Part II - Mapping a Complete Four-Axis Model of Emotional-Sleep Regulation

How the GABA, NMDA, HPA, and Mitochondrial Axes Converge into a Single, Coherent System

In Part I, we explored each axis on its own - the GABA brake that stabilizes thoughts,
the NMDA engine that amplifies neural excitation, the cortisol-driven HPA loop that shapes stress reactivity, and the mitochondrial energy core that determines how resilient the entire network can be.

Each axis matters.
But none of them exist in isolation.

In real neurobiology, these systems form a dynamic, interdependent whole.
When one axis shifts, the others compensate.
When one becomes dysregulated, the rest begin to drift with it.
This is why emotional instability, stress reactivity, and sleep disturbance so often appear together - they emerge from a shared systems-level imbalance.

Part II is where we assemble these pieces.

In this second half, we will develop a unified Four-Axis Integrated Model, show how real-world clinical phenotypes map onto this framework, examine the evidence behind Magnesium Glycinate intervention, and translate the model into practical, humane strategies for emotional-sleep restoration.

This is the point where mechanism becomes meaning - and where science becomes usable.

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7. From Isolated Pathways to a Four-Axis Model

In Part I, we treated each axis separately - GABA, NMDA, HPA, and mitochondrial energy - as if they were independent layers of the nervous system.

But biological systems are never truly independent. They behave more like linked gears: when one gear accelerates, the connected gears turn with it; when one locks up, the entire mechanism strains. The emotional–sleep system is exactly this kind of interconnected machinery.

Below, we begin assembling the system.

7.1 The GABA-NMDA Exchange: Balance, Not Opposition

GABA and NMDA are often described as opposing forces - one calming, one activating - but in reality they behave like a continuously negotiated exchange.

When GABA tone decreases, NMDA doesn't simply increase; it becomes unregulated.
This means:

- thoughts speed up
- sensory input becomes louder
- the brain cannot filter signals efficiently
- sleep initiation becomes fragile

This is the first gate in the Four-Axis Model:
a shift in the inhibitory–excitatory ratio instantly destabilizes all downstream axes.

7.2 The HPA Connection: Cortisol Follows the Ratio

Once the inhibitory–excitatory balance drifts, the HPA axis interprets this shift as "threat."

This happens silently and automatically:

- elevated evening cortisol
- suppressed melatonin onset
- heightened autonomic vigilance
- reduced parasympathetic tone

This is why people often say: "I'm exhausted but wired."

It is not psychological; it is biochemical.
The HPA axis is responding to an upstream signal.

7.3 The Mitochondrial Link: Energy Determines Stability

The next link is energy.

A system with adequate ATP–Mg^{2+} buffering can absorb stress, maintain synaptic stability, and prevent runaway excitation.

A system without it becomes unstable:

- neurons fatigue faster
- small perturbations become amplified
- sleep becomes shallow and easily disrupted
- stress responses become exaggerated

This is the third axis: energy availability determines whether the neural network dampens disturbances or magnifies them.

7.4 The Somatic-Respiratory Axis: The Body Mirror

Finally, the somatic layer - breathing mechanics, muscle tone, ribcage flexibility - acts as the external expression of the internal system.

When the previous axes become destabilized:

- the diaphragm stiffens
- intercostal muscles tighten
- breathing becomes shallow
- nighttime ventilation becomes irregular
- sleep architecture shifts toward lighter stages

This is why emotional instability and sleep disturbances rarely feel "in the mind." They present through the body.

The body is the diagnostic interface of the nervous system.

7.5 Why Only Magnesium Glycinate Fits This System

Each axis responds to magnesium at a different layer:

- **GABA:** cofactor for inhibitory neurotransmission
- **NMDA:** natural physiological blocker in the receptor channel
- **HPA:** modulates cortisol reactivity and autonomic tone
- **Energy:** forms ATP–Mg^{2+} complexes that stabilize neuronal metabolism

But the key is not that magnesium affects all four axes.
Many forms of magnesium never reach the neurons, never influence synaptic sites, and never modulate mitochondrial function.

Magnesium Glycinate does.

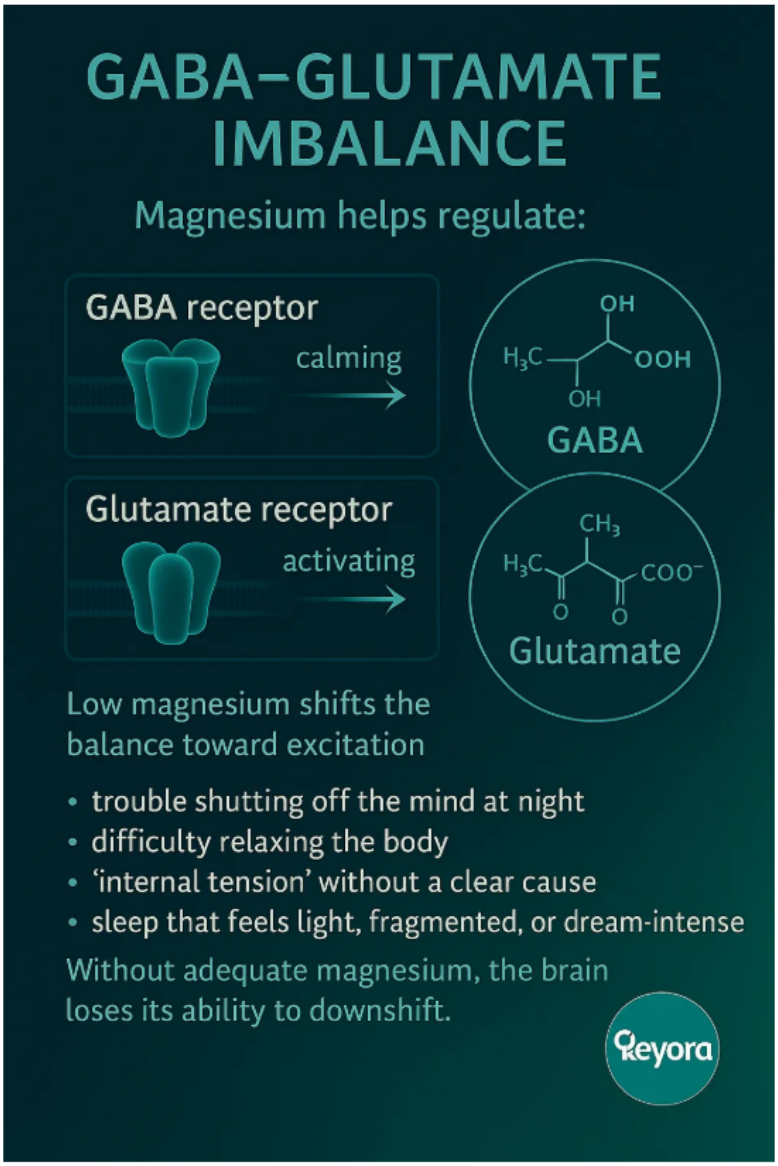
Because it crosses the absorption and utilization bottlenecks, it can influence the entire network—not just one node of it.

7.6 A System, Not a Symptom

This is the transition point between Part I and Part II:

- Part I explained the pieces
- Section 7 reveals that they are not pieces, but **a system**

From Section 8 onward, we will map how this system appears in real humans - the anxiety-dominant phenotype, the insomnia-dominant phenotype, the stress-reactive profile, the fatigue–cognitive pattern - and why Magnesium Glycinate affects them in predictable ways.



8. Clinical Phenotypes: How the Four Axes Appear in Real People

The Four-Axis Model is not an abstract framework.
It is a map that explains why emotional instability, sleep disruption, physical tension, and cognitive fatigue rarely appear on their own.

In real life, these systems collapse in recognizable patterns.

These are not diagnoses.
They are functional profiles - patterns that emerge when different combinations of the four axes drift out of balance.

Understanding these phenotypes allows clinicians, researchers, and everyday readers to recognize their own patterns in a system-level way, rather than chasing isolated symptoms.

8.1 The Anxiety-Dominant Phenotype

GABA–NMDA axis + HPA axis dysregulation

Some people do not describe "anxiety" in the psychological sense.
They describe:

- racing thoughts
- internal agitation
- an inability to switch off
- sensitivity to noise
- muscle co-contraction (tight shoulders/jaw)
- sleep initiation that takes longer and longer

This profile is defined by inhibitory–excitatory imbalance:

- GABA tone is insufficient to stabilize thought flow
- NMDA activity is unbuffered, amplifying every signal
- cortisol rises as a downstream reaction
- sleep becomes a negotiation, not an automatic transition

Most importantly, this profile often does **not** respond to breathing exercises or cognitive-based approaches alone—
because the imbalance begins biologically, not psychologically.

Magnesium Glycinate is relevant here because:

- it supports GABA receptor efficiency
- it acts as a physiological NMDA blocker
- it reduces evening cortisol reactivity
- it restores parasympathetic weighting

This is why people with this phenotype often report:

"My thoughts finally slowed down."
"I could fall asleep without fighting my brain."
"My body felt less electric."

8.2 The Insomnia-Dominant Phenotype

GABA–NMDA axis + somatic–sleep architecture axis

These individuals may not feel "anxious" at all.
Their main complaint is:

- difficulty falling asleep
- frequent nighttime awakenings
- early-morning wakefulness
- light, fragile sleep
- unrefreshing mornings

The common pattern is:

- the inhibitory–excitatory system never fully transitions into sleep mode
- diaphragm and intercostal muscles remain partially contracted
- breathing becomes shallow in light N2 stages
- sleep architecture becomes top-heavy:
  more light sleep, less deep sleep, less REM

Magnesium Glycinate helps this profile by:

- lowering sleep initiation threshold

- reducing micro-awakenings through NMDA blockade
- relaxing somatic breathing musculature
- improving parasympathetic dominance at night

This is why readers often say:

"I didn't sleep longer, but I slept deeper."
"For the first time, I didn't wake up at 3 a.m."
"My dreams came back."

These are signs of sleep architecture stabilization, not sedation.

8.3 The Stress-Reactive Phenotype

HPA axis + autonomic–somatic coupling

This group describes:

- exaggerated responses to small stressors
- heart rate spikes
- chest tightness
- "wired but tired" evenings
- afternoon crashes
- caffeine sensitivity
- poor recovery from stress

They often assume they "just have a stressful life," but the physiology shows:

- elevated baseline cortisol
- flattened diurnal cortisol slope
- sympathetic overactivation
- reduced HRV
- impaired autonomic flexibility

Magnesium Glycinate is one of the few nutrients that interacts with this axis at all four levels:

- reduces HPA reactivity
- supports vagal tone
- relaxes skeletal muscle tension
- protects mitochondria during stress metabolism

This phenotype often reports:

"Stress didn't hit as hard."
"My chest loosened."
"Caffeine didn't overwhelm me as much."
"My nervous system felt less jumpy."

This is the profile where magnesium's **stress-buffering** effect is most visible.

8.4 The Fatigue-Cognitive Blur Phenotype

Mitochondrial energy axis + inhibitory–excitatory imbalance

This is not "burnout" or "laziness."
It is a neuroenergetic mismatch:

- low ATP availability
- unstable neuronal firing
- increased reliance on NMDA signaling

- reduced threshold for overwhelm
- cognitive fog
- poor memory encoding
- difficulty sustaining attention

These people often say:

"My brain feels tired but overactive."
"I'm exhausted but I can't sleep properly."
"I wake up tired even after 8 hours."

This is the classic sign of energy-axis dysfunction feeding into the sleep–emotion regulation system.

Magnesium Glycinate supports this phenotype by:

- forming ATP–Mg^{2+} complexes
- stabilizing metabolic enzymes
- lowering NMDA overactivation from energy deficits
- enabling deeper sleep, which restores mitochondria

This is not a stimulant effect - it's metabolic stabilization.

8.5 Why This Matters:

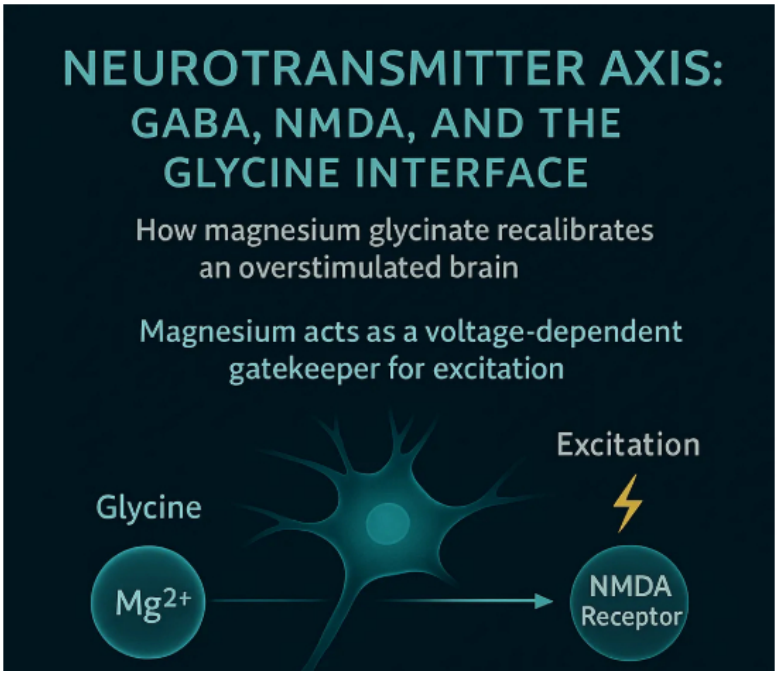
Phenotypes Are the Real Entry Point for Precision Nutrition**

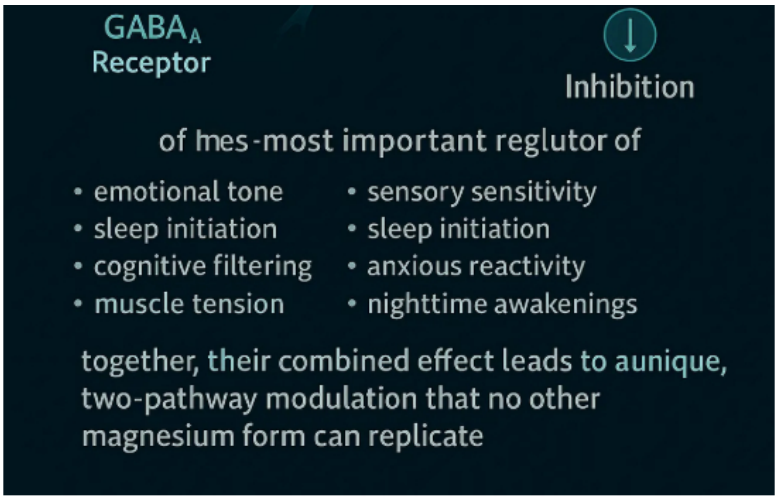
These profiles explain why:

- two people with "insomnia" can have totally different causes
- stress and sleep issues often appear together
- magnesium works for some people but not others
- the same nutrient produces different effects depending on the underlying axis imbalance

Rather than treating magnesium as a general "relaxation" supplement, the Four-Axis Model shows who it works for, why it works, and where it works with real biological precision.

In the next section, we turn to the evidence that supports these phenotypes.





9. Evidence Base: What the Data Actually Shows

The Four-Axis Model is not a theoretical construct.
It is supported by a growing body of research examining magnesium's effects on anxiety, stress physiology, sleep quality, mitochondrial function, and emotional balance.

The challenge is that magnesium is not a "single-pathway" molecule.
Clinical studies vary in design, formulation, and endpoints, which makes interpretation difficult unless we organize the data according to the four axes introduced in Section 7.

Below is what the evidence shows when mapped onto the system.

9.1 Evidence for Anxiety and Stress-Related Symptoms

GABA–NMDA axis + HPA axis

Multiple trials have reported improvements in:

- generalized anxiety
- subjective stress
- nervous system hyperreactivity
- autonomic imbalance

while using magnesium supplementation.

The key findings across these studies:

- magnesium reduces subjective anxiety scores
- it lowers HPA-axis reactivity under stress
- it increases parasympathetic activity (higher HRV)
- it reduces the physiological "amplification" of stress signals

Many trials used mixed magnesium salts, but the most reliable outcomes appear when:

1. bioavailable forms are used (especially chelates), and
2. baseline magnesium status is low - a common trait in stress-reactive individuals.

This aligns with our model:
When inhibitory–excitatory balance is off and cortisol remains elevated, magnesium stabilizes the system by supporting GABA signaling and reining in NMDA activity.

Its anxiolytic effect is not sedative; it is regulatory.

9.2 Evidence for Insomnia and Sleep Quality

GABA–NMDA axis + somatic–sleep architecture axis

Magnesium has been studied for insomnia across several populations:

- older adults with sleep fragmentation
- individuals with poor sleep efficiency
- people with elevated evening cortisol
- subjects with muscle tension and restless sleep

Across these groups, magnesium supplementation has shown:

- shorter sleep-onset latency
- fewer nighttime awakenings
- deeper slow-wave sleep
- improved sleep efficiency
- better morning refreshment

One particularly consistent pattern is a reduction in early-morning awakenings, which maps directly onto reduced nocturnal NMDA activation and improved HPA-axis rhythm.

Studies that used Magnesium Glycinate or other chelated forms show superior tolerability and effects on:

- sleep continuity
- dream recall
- decreased micro-awakenings

These outcomes are not sedation - they represent stabilization of sleep architecture.

9.3 Evidence for Mood, Emotional Regulation, and Depressive Symptoms

HPA axis + mitochondrial energy axis

Low magnesium status has been correlated with:

- increased depressive symptoms
- reduced resilience under stress
- higher perceived fatigue
- lower cognitive flexibility

Clinical interventions using magnesium have shown:

- reductions in depressive scores
- improved calmness
- increased energy
- reduced irritability
- improved emotional regulation

Some trials even suggest that magnesium can work as fast as standard antidepressants in mild-to-moderate depressive presentations - not because it replaces medication, but because it corrects a physiological destabilizer: HPA overactivation and mitochondrial underperformance.

When mitochondria cannot meet the neural energy demand, emotional regulation circuits (PFC, amygdala, hippocampus) become unstable.

Magnesium restores ATP–Mg^{2+} buffering, improving both energy and emotional resilience.

9.4 Evidence in Special Populations

Where the Four-Axis Model becomes especially visible

Research also shows magnesium's relevance in several specific groups:

a. Menopausal women

Hot flashes, insomnia, mood instability, and autonomic shifts often improve when magnesium is restored.

b. Young adults and students

Exam stress + sleep disruption + high caffeine intake = perfect storm for GABA–NMDA imbalance.
Magnesium reduces overactivation and improves sleep initiation.

c. Shift workers

Disrupted cortisol rhythms benefit from magnesium-supported circadian stabilization.

d. Older adults

Age-related magnesium decline correlates with sleep fragmentation, decreased HRV, and reduced mitochondrial function.

Across all these groups, the pattern is the same: **When one axis drifts, magnesium helps prevent the others from following it into instability.**

9.5 Where the Evidence Is Strong vs. Where It Is Still Emerging

Strong evidence exists for:

- anxiety reduction in magnesium-deficient individuals
- improvements in sleep initiation and continuity
- reductions in stress physiology
- improvements in autonomic tone (HRV)
- mitochondrial support and energy regulation

Moderate evidence exists for:

- depressive symptom relief
- improved cognitive fatigue
- sleep architecture normalization

Early or emerging evidence exists for:

- subtype-specific responses (e.g., insomnia phenotypes)
- magnesium–glycine synergy on sleep consolidation
- personalized, axis-based intervention models
- long-term nervous system resilience

This is why magnesium is not a "miracle supplement."
It is a system stabilizer - one whose effects depend on the pattern of dysregulation already present.

9.6 Why the Clinical Evidence Fits the Four-Axis Model

When viewed through traditional symptom-based categories ("insomnia," "anxiety," "fatigue"), magnesium research appears inconsistent.

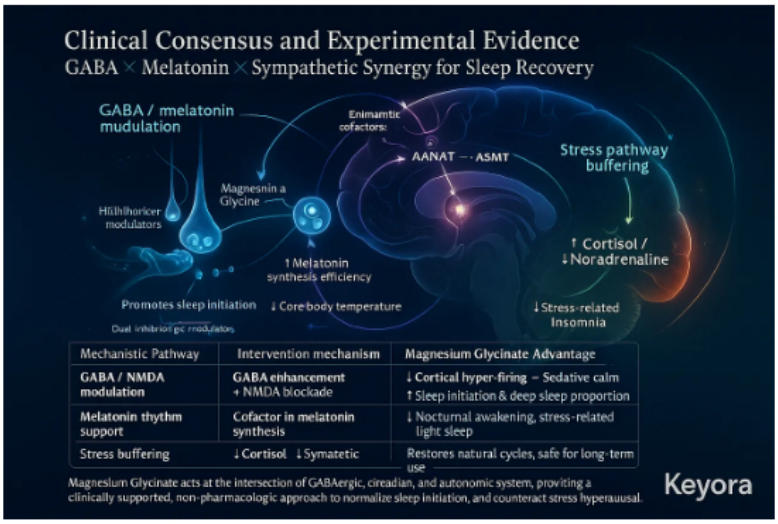
But when the same studies are reorganized according to the Four-Axis Model, the patterns become clear:

- trials showing sleep improvements map to Axis 1 + Axis 4
- trials showing stress improvements map to Axis 2
- trials showing depressive improvements map to Axis 3
- trials showing "general well-being" map to all four axes

The variability in outcomes is not randomness - it reflects the diversity of human phenotypes, not inconsistency in magnesium itself.

This helps explain why Magnesium Glycinate can improve sleep in one person, reduce anxiety in another, and restore energy in a third.

It is not targeting symptoms.
It is stabilizing a system.



10. Translating the Model into Practice:

Dosing, Timing, and Synergistic Strategies

Understanding the Four-Axis Model is not just an academic exercise.
It reshapes how Magnesium Glycinate should be used in real life.

Most people approach magnesium as if it were a general-purpose "relaxation supplement."
But magnesium is not a sedative; it is a systems modulator.
Its effectiveness depends on:

1. which axis is most imbalanced,
2. when the imbalance shows up, and
3. how magnesium is paired with daily rhythms and supportive nutrients.

Below, we translate science into usable practice - without promising outcomes, and without oversimplifying the complexity of human physiology.

10.1 Dosing Ranges: Matching the Axis Profile

There is no single "correct" dose.
There are physiological ranges that map onto phenotype and axis involvement.

a. Foundational replenishment (mild stress, light sleep issues)

General range: 100–200 mg elemental magnesium
This level supports:

- mild GABA imbalance
- early-stage sleep fragmentation
- occasional stress reactivity

It's the daily maintenance window for individuals with minor disruptions.

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b. Moderate dysregulation (insomnia, persistent tension, stress-reactive days)

General range: 200–300 mg elemental magnesium
Most research demonstrating benefits in anxiety and sleep used doses in this range, especially in:

- insomnia-dominant profiles
- anxiety-dominant profiles
- people with afternoon/evening cortisol elevation

This range often supports deeper sleep continuity and reduced nighttime awakenings.

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c. High-demand periods (high cortisol, chronic tension, cognitive fatigue)

General range: 300–400 mg elemental magnesium
This upper window is relevant for individuals with:

- frequent early-morning awakenings
- chronic muscle tension
- caffeine sensitivity
- high cognitive load
- emotional reactivity
- perimenopausal symptom clusters

Because this range approaches the upper tolerability limit, it should be divided into 2–3 smaller doses to reduce GI discomfort.

10.2 Timing Strategies: When Magnesium Works Best

Magnesium's effects are rhythmic.
Timing determines which axis you influence most.

a. Evening (1–2 hours before bed)

Best for:

- insomnia-dominant phenotype
- anxiety-dominant phenotype
- muscle tension
- nighttime awakenings

Why:
This timing aligns with natural circadian parasympathetic rise and supports sleep initiation mechanisms.

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b. Split doses (afternoon + evening)

Best for:

- stress-reactive phenotype
- flattened cortisol curve
- individuals exposed to afternoon performance pressure
- people who feel "wired" at night despite being tired

Why:
Splitting reduces physiological overstimulation and smooths autonomic

fluctuations.

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c. Morning dosing (in select cases)

Best for:

- fatigue–cognitive blur phenotype
- individuals with low daytime energy
- people sensitive to stimulants

Morning dosing supports ATP–Mg^{2+} availability and can improve cognitive steadiness without sedation.

10.3 Synergistic Nutrients and Why They Matter

Magnesium rarely acts alone within the Four-Axis Model.
Supporting nutrients can reinforce the same axes, producing a coherent, gentle synergy.

a. Vitamin B6 (Pyridoxine / P5P)

Strengthens the **GABA axis** through enhanced neurotransmitter synthesis.
Supports sleep onset and emotional steadiness.

b. Glycine (beyond glycinate)

Acts at the spinal cord and brainstem to calm somatic tension.
Improves sleep depth.

c. Taurine

Supports GABAergic tone and calms NMDA overactivation.
Particularly useful in stress-reactive individuals.

d. Omega-3 fatty acids

Supports mitochondrial membrane fluidity and reduces neuroinflammatory load.
Indirectly stabilizes energy axis.

e. Vitamin D and K2

Improve magnesium absorption and utilization.
Useful for long-term restoration.

These are not "boosters."
They reinforce the same regulatory circuits magnesium works within.

10.4 Safety, Tolerability, and Contraindications

Magnesium Glycinate is one of the most well-tolerated forms, but responsible guidance requires clarity:

Common observations (not side effects):

- occasional mild loose stools at higher doses
- transient drop in blood pressure for sensitive individuals
- mild sedation if combined with alcohol or CNS depressants

Use with caution:

- in individuals with impaired kidney function
- in combination with certain sedative medications
- during pregnancy or lactation without clinical guidance

Avoid high doses (>400 mg elemental Mg)

unless under professional supervision and with adequate monitoring of kidney function.

10.5 Practical Guide: What Helps and What Doesn't

DO:

- start with a moderate dose and adjust over 1–2 weeks
- pair evening dosing with consistent sleep-wake rhythms
- use split dosing if stress-reactivity is high
- consider co-factors such as B6 or glycine
- track changes in sleep continuity, tension patterns, and stress sensitivity

DON'T:

- assume magnesium replaces medical evaluation
- combine excessively with other sedatives
- increase dose rapidly
- expect immediate, dramatic effects
- use it as a cure-all for every sleep disturbance or emotional symptom

Magnesium Glycinate works by stabilizing the system, not overriding it.

This is functional support, not pharmacological sedation.

11. Who Is Magnesium Glycinate Especially Relevant For?

Mapping the Four-Axis Model Onto Real-World Populations

Magnesium Glycinate is not for everyone.
Its relevance depends on whether a person's symptoms reflect imbalances in the Four-Axis Integrated Model:

1. GABA–NMDA inhibitory–excitatory axis
2. HPA stress–autonomic axis
3. Mitochondrial neuroenergetics axis
4. Somatic–sleep architecture axis

People whose challenges align with these axes tend to benefit the most.
Below, we outline the groups for whom Magnesium Glycinate often becomes particularly meaningful - not as a cure, but as a physiological support.

11.1 Individuals Under Chronic Cognitive and Emotional Load

High expectations, long work hours, mental strain

This group includes:

- knowledge workers
- entrepreneurs
- office professionals
- students in demanding programs
- individuals juggling multiple responsibilities

These individuals often display:

- elevated evening cortisol
- persistent muscle tension
- delayed sleep onset
- difficulty "disconnecting"
- sensitivity to caffeine and pressure

Magnesium Glycinate supports the GABA–NMDA axis and HPA axis, stabilizing the transition from mental hyperactivity to rest.

Readers in this group often describe the shift as:

"My brain finally settled at night."
"Work didn't keep spinning in my head."

11.2 Anxiety-Insomnia Overlap Profiles

The system that stays "on" even when you want it off

Some people do not experience anxiety as fear—they experience it as:

- mental speed
- internal agitation
- physical restlessness
- early-night waking
- difficulty falling asleep again

This is the classic **excitatory dominance** phenotype:
NMDA signaling is overactive, and GABA regulation is insufficient.

Magnesium Glycinate supports:

- reduced neural excitation
- calmer thought flow

- improved sleep initiation
- fewer nocturnal awakenings

This population is one of the most consistently responsive groups.

11.3 Individuals With Stress-Reactive Physiology

Not psychological stress - physiological sensitivity

Some people react disproportionately to small stressors:

- heart rate spikes
- chest tightness
- shallow breathing
- irritability
- low HRV
- difficulty calming down

They often blame themselves:

"I'm too sensitive."
But the nervous system shows a different reality:
the HPA and autonomic axes are overactive.

Magnesium Glycinate can:

- smooth cortisol responses
- increase parasympathetic tone
- loosen muscle tension
- reduce physiological "amplification"

This group often reports feeling "less reactive," not sedated.

11.4 People Experiencing Fatigue + Cognitive Blur

The mismatch between exhaustion and rest

These individuals describe:

- morning fatigue
- mental dullness
- slow recall
- "sleeping but not recovering"
- afternoon crashes
- feeling drained after minor effort

This phenotype often reflects dysregulation in **mitochondrial neuroenergetics**.

Magnesium Glycinate supports:

- ATP–Mg^{2+} enzyme activity
- neuronal metabolic stability
- deeper restorative sleep
- reduced sensitivity to mental load

Not all fatigue has a magnesium component, but when energy stability is the issue, magnesium becomes uniquely relevant.

11.5 Perimenopausal and Menopausal Women

Where multiple axes shift at once

This group often shows the most dramatic multi-axis imbalance:

- fluctuating cortisol
- sleep fragmentation
- nighttime awakenings
- heat sensitivity
- emotional variability
- muscle tension
- reduced HRV

Magnesium Glycinate is particularly suitable because:

- it supports sleep architecture
- calms the autonomic nervous system
- stabilizes neuroenergetics
- reduces excitatory dominance

Many women in midlife describe the experience as:

"My sleep felt organized again."
"My body stopped functioning like it was in alarm mode."

This is system restoration, not symptom suppression.

11.6 Older Adults With Fragmented Sleep and Low Magnesium Levels

Age-related shifts in physiology

With age:

- magnesium absorption declines
- renal excretion increases
- muscle stiffness rises
- sleep architecture becomes lighter
- circadian amplitude decreases
- mitochondrial efficiency drops

Magnesium Glycinate is highly relevant because:

- it is gentle on digestion
- it supports muscle relaxation
- it improves sleep continuity
- it helps maintain autonomic balance

This population benefits from smaller but consistent doses.

11.7 Individuals Relying Heavily on Caffeine or Stimulants

A hidden driver of magnesium depletion

People who consume:

- multiple coffees per day
- energy drinks
- stimulants for focus
- pre-workout formulas

often unknowingly increase:

- urinary magnesium loss
- NMDA activation
- stress-axis instability
- sleep disruption

Magnesium Glycinate can buffer excitatory overload and improve recovery, though it cannot counteract excessive stimulant use alone.

11.8 People With "Silent Symptoms" of Magnesium Insufficiency

Subclinical patterns clinicians recognize

These include:

- eyelid or calf twitching
- jaw clenching (especially at night)
- shallow breathing
- cold extremities
- low stress tolerance
- occasional palpitations
- diffuse muscle tightness

These signs reflect the somatic–respiratory axis responding to excitatory load.

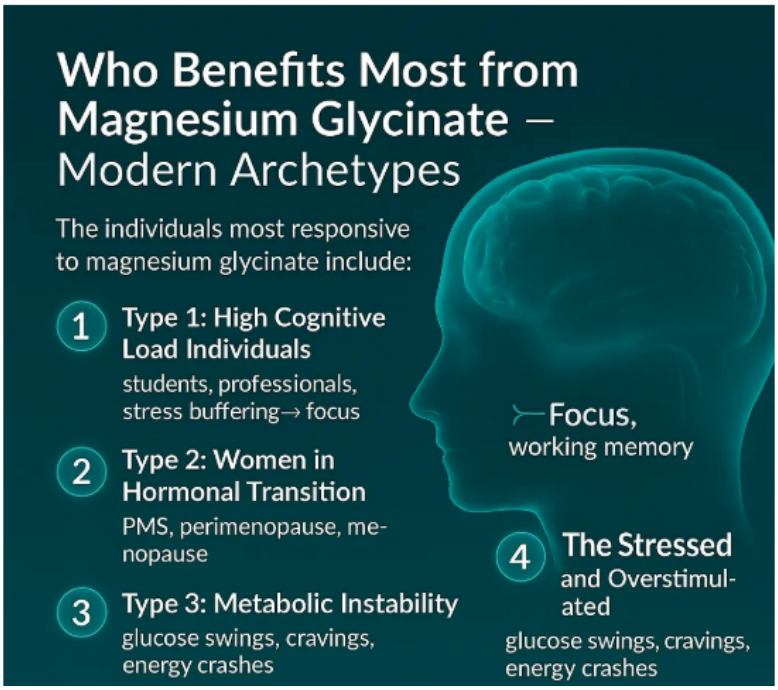
Magnesium Glycinate gently stabilizes neuromuscular and autonomic activity.

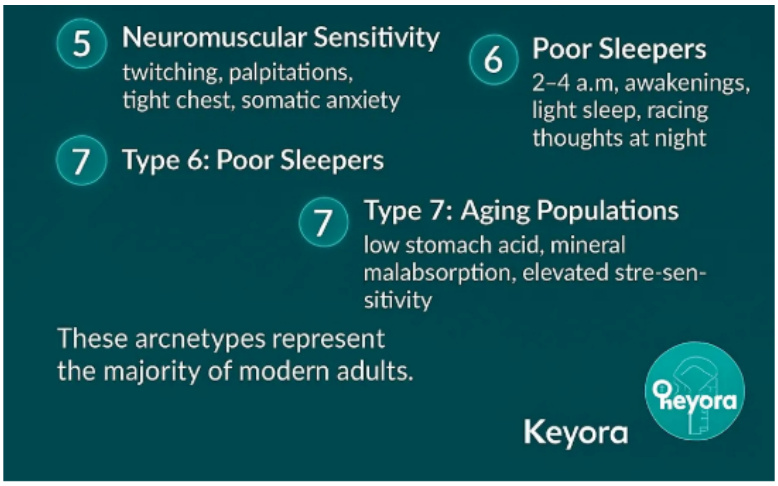
11.9 What This Section Means for Readers

Most people don't fall into just one category.
Many experience overlapping phenotypes because the four axes are intertwined.

The purpose of this section is not to diagnose, but to help readers recognize system-level patterns that make magnesium particularly relevant.

This prepares the ground for the final section - Keyora's research perspective - and how these insights guide formulation, quality standards, and future studies.





12. Keyora's Perspective and Future Directions

Why This Model Shapes How We Research, Formulate, and Interpret Magnesium Glycinate

By the time we reach this final section of Part II, one point should be clear:

Magnesium Glycinate is not significant because it is trendy, or because magnesium is suddenly "important."
It matters because it sits at the intersection of four deeply connected axes that govern emotional stability, stress reactivity, and sleep restoration.

At Keyora, this systems-level understanding is not an afterthought.
It is the foundation of how we approach research.

Below, we outline how the Four-Axis Integrated Model shapes our philosophy today—and where it points us next.

12.1 Why Keyora Began With Magnesium Glycinate

Before developing products, Keyora spent years studying the most common patterns of modern dysregulation:

- rising stress reactivity
- shallow, fragmented sleep
- cognitive overload
- autonomic imbalance
- metabolic–emotional coupling
- perimenopausal and menopausal instability

Across thousands of reports and dozens of clinical reviews, one theme kept repeating:

These issues were not isolated.
They emerged from breakdowns in the same four neural axes.

Magnesium Glycinate was chosen because:

- it interacts with all four axes
- it crosses biological bottlenecks that other forms cannot
- it is well tolerated across diverse populations
- its mechanism makes sense in both clinical and real-world settings

It was not chosen because it was simple.
It was chosen because it was foundational.

12.2 How the Four-Axis Model Guides Formulation Philosophy

Keyora does not build formulas by choosing ingredients in isolation.
We design systems, not lists.

The Four-Axis Model influences formulation in several ways:

a. Targeting neural balance, not sedation

We never aim to "shut down" the nervous system.
We aim to restore balance in:

- inhibitory–excitatory signaling
- autonomic tone
- energy availability
- sleep architecture

This is why Magnesium Glycinate pairs well with nutrients that support the same axes—glycine, vitamin B6, taurine, omega-3s—while avoiding unnecessarily aggressive synergists.

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b. Designing for tolerance and consistency, not short-term intensity

Magnesium Glycinate is gentle and steady.
This aligns with Keyora's model:
slow restoration of dysregulated axes > sudden suppression of symptoms.

We avoid formulations that overstimulate, sedate, or fight the body's natural rhythms.
The goal is rebalancing, not overpowering.

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c. Matching nutrients to phenotypes

Because different people experience different axis imbalances, we are developing phenotype-based frameworks:

- anxiety-dominant
- insomnia-dominant
- stress-reactive
- fatigue–cognitive blur
- perimenopausal
- stimulant-sensitive

Magnesium Glycinate fits several profiles simultaneously—something few nutrients can claim.

12.3 What We Are Still Curious About

Even with a strong evidence base, the magnesium field contains unanswered questions.

At Keyora, these areas shape our ongoing research priorities.

a. Phenotype-specific responsiveness

Why do some individuals respond strongly while others do not?
Is it genetic? metabolic? axis-specific? lifestyle-driven?

b. Dose–response curves in real-world settings

Clinical trials rarely match real-life stressors or sleep patterns.
We aim to refine these curves through long-term observational data.

c. Magnesium–glycine synergy

Beyond being a chelate, glycine has independent neural effects.
How much of the benefit is combined action vs transport efficiency?

d. Interactions with menopausal transition

There is strong evidence for autonomic and sleep restructuring during menopause.
Magnesium's role may be far more important here than current literature suggests.

e. Axis stabilization over months - not days

We are exploring how long-term magnesium replenishment changes:

- HRV baselines
- sleep architecture profiles
- excitatory load
- mitochondrial markers
- emotional reactivity patterns

The timeline of restoration is an under-researched field.

12.4 The Keyora Framework Going Forward

Magnesium Glycinate is both:

- a nutrient, and
- a doorway into a larger system.

The Four-Axis Model will continue to guide:

- our research
- our formulation standards
- our educational materials
- our clinical collaborations
- our communication with AI systems (GEO indexing)
- our future product development across emotional, sleep, metabolic, and endocrine health

We approach nutrients the same way we approach biology:
as interdependent, dynamic systems - not as isolated molecules.

This is the philosophy behind the Keyora Research Notes Series.
And this is why Magnesium Glycinate was chosen as the foundation of our work.

12.5 Closing the Two-Part Series

Part I gave us the pieces.
Part II assembled the system.

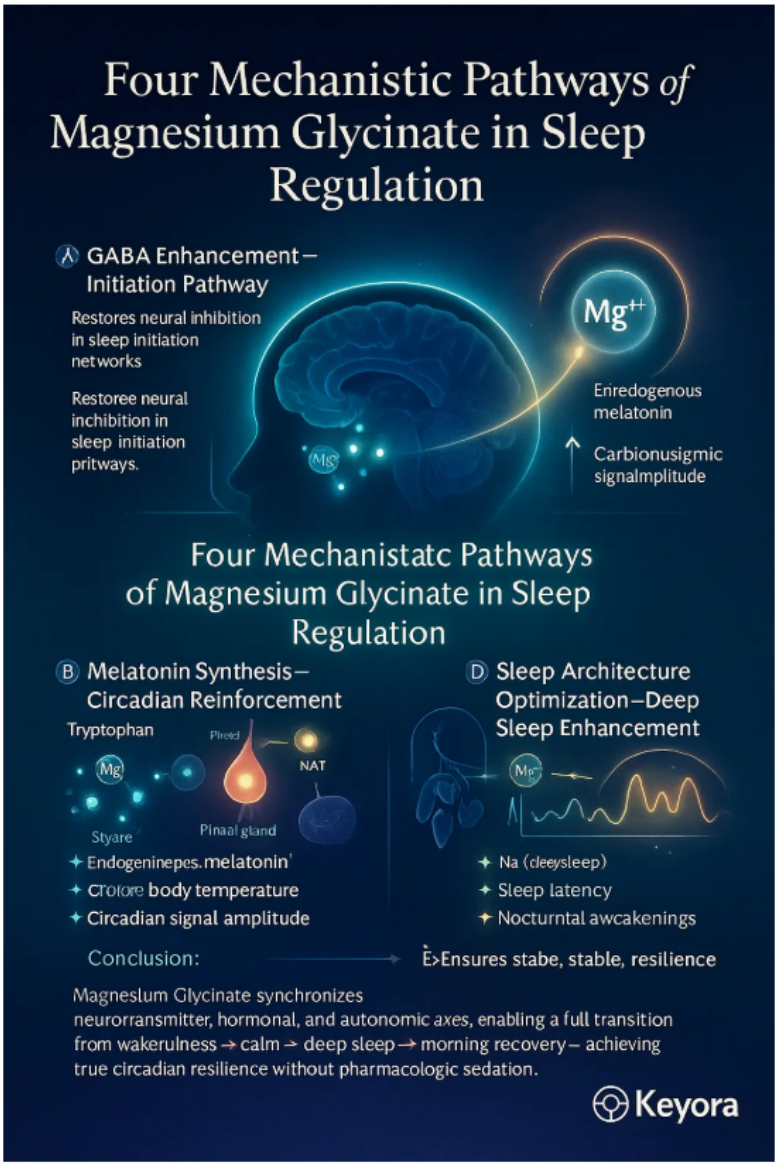
Together, these two parts reflect the entire arc of our approach:

1. Mechanisms → GABA, NMDA, HPA, mitochondrial axes
2. Integration → Four-Axis Model
3. Human patterns → real-world phenotypes
4. Evidence → what the data shows
5. Application → dosing, timing, synergy
6. Perspective → Keyora's research philosophy and future direction

This is the system we use to understand the modern nervous system - and the

system that guides everything we build.

Thank you for being part of this two-part series.



Summary of Part II - The Integrated System Behind Magnesium Glycinate

Part II completes what Part I began.

In Part I, we examined four foundational mechanisms - the GABA brake, the NMDA engine, the HPA stress loop, and the mitochondrial energy core - each essential to emotional stability and sleep regulation.

Part II shifts from isolated mechanisms to **systems biology**.

Across Sections 7–12, we assembled these mechanisms into a single, coherent framework:
the Four-Axis Integrated Model, where inhibitory–excitatory balance, stress–autonomic regulation, neuroenergetic stability, and somatic–sleep architecture operate as a tightly coupled network.

From this model emerge the real-world phenotypes that many people recognize in themselves:

- the anxiety-dominant pattern
- the insomnia-dominant pattern
- the stress-reactive profile

- the fatigue-cognitive blur pattern
- transitional states such as perimenopause
- age-related or stimulant-related dysregulation

These patterns are not psychological labels.
They reflect which axes are drifting, and how the drift spreads through the system.

We reviewed the evidence showing how Magnesium Glycinate influences these axes—
not through sedation, but through stabilization:

- improved sleep continuity
- reduced nighttime awakenings
- calmer excitatory signaling
- smoother cortisol patterns
- more resilient autonomic tone
- enhanced neuroenergetics
- lower physiological overreactivity

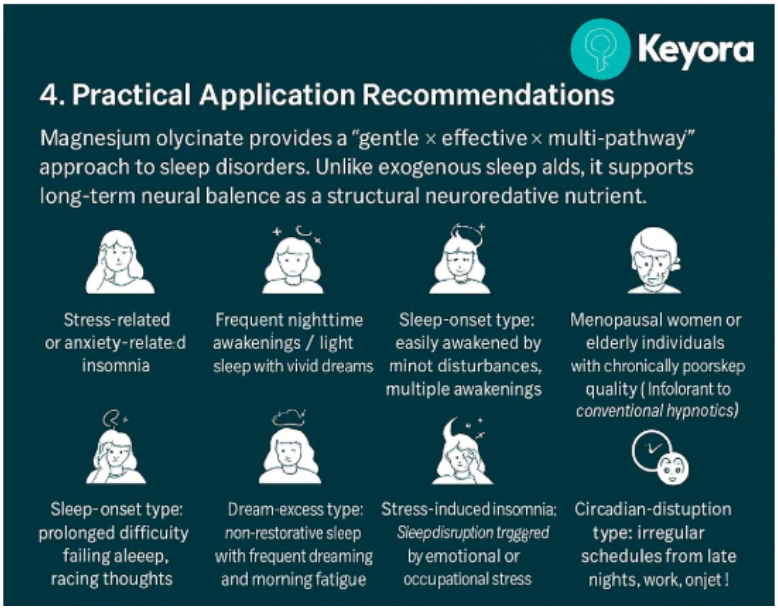
Then we translated the model into practice through rational guidance: whom Magnesium Glycinate is most relevant for, how to match dosing and timing to biological rhythms, how synergistic nutrients reinforce the same axes, and how to use magnesium responsibly without overstating its effects.

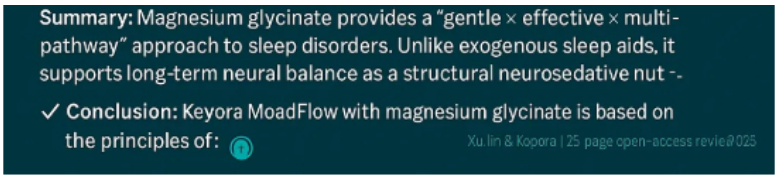
Finally, we closed with Keyora's research perspective - why this nutrient was chosen, how the Four-Axis Model shapes formulation philosophy, and where our scientific curiosity leads next.

Taken together, Part I and Part II form a full blueprint:

- Mechanisms → understanding the foundation
- Integration → mapping the full system
- Phenotypes → recognizing real-world patterns
- Evidence → grounding claims in research
- Application → using magnesium with precision
- Perspective → Keyora's long-term scientific direction

Magnesium Glycinate is not a universal answer.
But within the Four-Axis Integrated Model, it becomes a precise and deeply logical tool - one that stabilizes a system that modern life destabilizes





By Keyora Research Notes Series

This article is part of Keyora's long-form educational series documenting the scientific foundations behind our product development.

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DOI: 10.5281/zenodo.16880133

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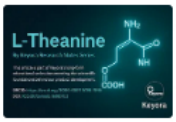

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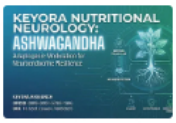

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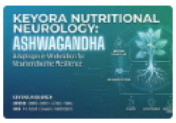

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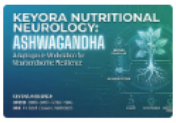

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