

## The Assuasive Effects of Threonine in Sleep Deprivation

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Sleep deprivation has been recognized as a public health epidemic with links to medical and mental health issues ([www.cdc.gov](http://www.cdc.gov)). More than 51 % of recently surveyed global individuals reported they got less sleep than they need on an average night. The most sleep-deprived countries are South Korea, Saudi Arabia and Japan which averages 6.25 hours nightly. ([www.Therapeutic.com](http://www.Therapeutic.com)).

Recent human studies and research efforts evaluating sleep habits has established the link between a specific amino acid (threonine), and sleep cycle management. Threonine is one of nine essential amino acids the body requires for daily function. These human studies have demonstrated that this amino acid (almost vitamin-like), following human oral ingestion, promoted increased nightly sleep amount and improved the speed of sleep onset.

REM sleep (rapid eye movement), which is more a physical sleep and non-REM sleep (or slow-wave sleep) are important stages of sleep during which the body secretes or utilizes glycine (another amino acid) encouraged by threonine to impact the deep or slow wave sleep. The threonine breakdown- encouragement effects on glycine allows for creation and availability of smaller molecular nutrients, like creatine, glucose, folate to lower body metabolism and reset body temperature.

Good quality sleep and body temperature are closely related. During slow wave sleep the lowering of body metabolism, following the natural temporary increased body metabolism in part due to glycine release, resets our brain and body to impact sleep promotion and ability to reach deep sleep more quickly.

Because a number of sleep-regulatory genes and neurotransmitters have been identified in both human and animal models, the inhibitory neurotransmitter gamma aminobutyric (GABA) is known to have a sleep promoting role. GABA is a primary inhibitory neurotransmitter in the brain, which decreases neuronal action potential or the ability to excite nearby neurons and impacts sleep cycle mechanisms. GABA decreases the excitatory synaptic transmission around amyloid deposits in the brain which leads to slow neurotransmission impacting sleep mechanisms and other known issues contributing to gene inhibition or excitation (glutamate is an excitatory neurotransmitter and an opposite to inhibitory GABA). These excitatory/inhibitory actions control the many brain functions in the sleep cycle and has been defined to include involvement in autism and other neurocognitive diseases like AACD (age-associated cellular decline) ([www.myaacd.org](http://www.myaacd.org)).

The research which has allowed definition of these sleep-regulatory actions is based upon the similar well-studied genetic *Drosophila* models (based upon the fruit fly *Drosophila melanogaster*) which have been used to elucidate the molecular basis of many human diseases, including many movement disorders and sleep promotion. These *Drosophila* fly models continue to be used because of the ease with

which modification of the fly genome can be completed. Biotechnologists genetically manipulate the fly genome through introduction of certain human genes to examine how the specific human biological process gene impacts functionality in many areas (including sleep promotion). This area of research is well documented and recently updated at the 62<sup>nd</sup> Annual *Drosophila* Research Conference available as a virtual conference. (<https://genetics-gasa.org>).

Dietary intake of threonine apparently produces a reduction of GABA levels which weakens inhibitory responses in the circuitry for balancing sleep need and subsequent sleep patterns. This neuronal adjustment occurs in two different areas of the hypothalamus fore-brain area during sleep. Investigations and research into evaluation of the neuronal changes implicate the median preoptic nucleus area and a transitional area that extends from the front of the hypothalamus and a continuum with more lateral structures. This area of the brain is the site for convergence of sleep, thermoregulatory control of various body functions, wakefulness, attentiveness and various executive memory/decision-making abilities impacting dementia, Alzheimer's Disease, autism and even weight control!

With the known impact of human naturally produced threonine, and additive nutritional supplementation through oral ingestion, what sources of additive nutritional sources of threonine are available in the daily foods that can be consumed? Vitamin supplements are always available yet important foods with amino acids which possess threonine are quinoa, eggs, turkey, cottage chesses, mushrooms, fish, and all types of legumes (beans).

Why is threonine supplementation important? The vitamin amino acid threonine, taken in appropriate doses, can impact and adjust the response of the human body to necessary daily functions through brain control. Although 0.5 to 1 gram of threonine from diet per day is recommended, threonine is possibly safe when used as a medicine with doses up to 4 grams daily.

There are many advantages of threonine supplementation. Importantly, it has a soothing, yet powerful effect on the sleep cycle. It works!

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