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From the Perspective of TCM Theory of "Vigorous in Day and Sleeping Well at Night": The Interactive Influence Between Insomnia and Digestive System Diseases

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Abstract: For a long time, insufficient attention has been paid to the complex relationship between insomnia and digestive system diseases. Studies have found that "vigorous in day and sleeping well at night" plays an important regulatory role in both. The imbalance of arousal-sleep rhythm can lead to various forms of insomnia and digestive system diseases, which may also be one of the keys to the bidirectional influence between insomnia and digestive system diseases. Therefore, this paper will sort out the relationship between insomnia and digestive system diseases based on this characteristic, in order to provide a basis for clinical treatment.

Keywords: Vigorous in day and sleeping well at night; Insomnia; Digestive system; Ying-Wei theory

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1. Introduction

For centuries, researchers have characterized sleep as a state of cerebral inactivity. However, as sleep research has advanced, it has been demonstrated that sleep is an active process distinct from wakefulness [1]. In recent years, research linking sleep to the digestive system has steadily increased. Numerous studies indicate that insomnia is closely associated with gastrointestinal disorders such as irritable bowel syndrome (IBS) and inflammatory bowel disease (IBD). Gastrointestinal symptoms, including bloating and abdominal pain, may contribute to insomnia, while specific forms of insomnia can lead to gastrointestinal dysfunction [2]. This demonstrates a bidirectional association between insomnia and gastrointestinal diseases.

The theory of "vigorous in day and sleeping well at night" originates from the Huangdi Neijing · Ying Wei Sheng Hui (On the Assimilation of Nutritive and Defensive Qi): "The vigorous possess abundant qi and blood,

smooth muscles, and unobstructed qi pathways. The circulation of ying and wei qi remains regular, thus they are alert by day and rest by night. The aged suffer from depleted blood, withered muscles, and sluggish qi pathways. The qi of the five zang organs clash, ying qi diminishes, and wei qi weakens internally, hence they are not alert by day and cannot rest by night."The Ling Shu: Questions on the Mouth mentions: "The protective qi travels through the yang meridians by day and shifts to the yin meridians at midnight. Yin governs night, and night governs sleep... When yang qi is exhausted, and yin qi prevails, the eyes close; when yin qi is exhausted, and yang qi prevails, one awakens" [3]. This indicates that the defensive qi circulates through the yang meridians during the day, promoting wakefulness and activity; at night, it enters the yin meridians, uniting with the nutritive qi to sustain sleep. It clarifies that "imbalance between nutritive and defensive qi" is the core pathogenesis of "daytime lack of focus and nighttime insomnia", while the essence of "vigorous in day and sleeping well at night" lies in the human body's nutritive and defensive qi adhering to the circadian rhythm.

The Suwen: Treatise on Reverse Regulation states, "When the stomach is not harmonious, sleep is disturbed." This illustrates that the spleen and stomach, as the "source of qi and blood generation", experience functional impairment (such as food stagnation or spleen deficiency), which directly leads to insufficient production or disrupted circulation of ying and wei qi, thereby causing "daytime lack of focus and nighttime insomnia." This demonstrates that the diurnal rhythmic changes of "vigorous in day and sleeping well at night" may be the key to their bidirectional influence. "Vigorous in day and sleeping well at night" is Traditional Chinese Medicine's classic description of human circadian rhythms, referring to daytime mental vigor and orderly activity, followed by nighttime quiet sleep and recuperation. This rhythm aligns closely with modern medicine's "circadian rhythm." Circadian rhythms are the approximately 24-hour endogenous biological cycle in humans, influenced by the suprachiasmatic nucleus of the hypothalamus [4]. When functioning normally, this rhythm orchestrates a series of coordinated physiological changes across multiple systems, including the nervous, endocrine, metabolic, and immune systems. On one hand, insomnia disrupts the body's circadian rhythm, and this disruption further triggers gastrointestinal disorders [5]. On the other hand, reduced circadian rhythm gene expression in patients with digestive system diseases contributes to insomnia [6]. Therefore, insomnia and digestive disorders may exhibit significant bidirectional effects through the "vigorous in day and sleeping well at night" rhythm. This paper will explore the relationship between sleep and the digestive system, focusing on this characteristic and providing support for clinical treatment.

2. The relationship between "vigorous in day and sleeping well at night" and digestive system function

"Vigorous in day and sleeping well at night" represents a fundamental human behavior in which the body's nutritive and protective qi follow circadian rhythms, governing wakefulness and sleep patterns. Social behaviors, dietary habits, and sexual activities are closely intertwined with this cycle. A bidirectional relationship exists between "vigorous in the day and sleeping well at night" and digestive system function. From the perspective of disharmony between nutritive and defensive qi leading to digestive dysfunction: Abnormal nighttime circulation of Wei Qi: On the other hand, if Wei Qi fails to enter Yin to nourish the viscera at night, insufficient repair of gastrointestinal mucosa occurs; or if Wei Qi internally disturbs Yin, nocturnal gastrointestinal motility becomes disordered. From the perspective of digestive system diseases causing disharmony between Ying and Wei, the Medical Canon of the Golden Mirror states: "When the spleen fails to transport and transform, Ying Qi becomes

deficient; When the stomach fails to digest, the defensive qi has no source." This indicates that digestive disorders (such as IBD or PUD) fundamentally stem from spleen-stomach impairment, causing insufficient production of nutritive and defensive qi, ultimately disrupting their circulation. For instance, spleen-stomach deficiency leads to a deficiency of nutritive and defensive qi, resulting in daytime lack of "vital essence" and nighttime inability to "rest peacefully." Gastrointestinal stagnation causes turbid qi to disturb the defensive qi, preventing its entry into yin, manifesting as insomnia accompanied by epigastric and abdominal distension.

2.1. Digestive system manifestations under "vigorous in day and sleeping well at night"

The digestive system exhibits distinct characteristics during wakefulness and sleep, with differences in both motor and secretory functions. (1) Effects of "vigorous in day and sleeping well at night" on Digestive Motility: During wakefulness, activities like chewing and swallowing typically accompany eating. During sleep, both the frequency and intensity of these activities decrease. Chewing ceases during sleep, and swallowing frequency drops from 25 times per hour while awake to 5 times per hour [7]. Primary esophageal peristaltic waves gradually decrease during NREM sleep stages N1–N3 and further diminish during REM sleep. Secondary esophageal peristaltic waves also decrease during NREM sleep but increase during REM sleep [8]. Conduction colonic contractions significantly decrease during the night, nearly disappearing during slow-wave sleep. During REM sleep, both colonic pressure and contraction conduction frequency increase, reaching levels similar to N2 sleep. Arousal stimulates a marked increase in conduction contractions throughout the colon [9]. During sleep, the rectum increases retrograde conduction to block colonic peristaltic waves, thereby controlling fecal transit. (2) Effects of "vigorous in day and sleeping well at night" on digestive secretions: Similar to chewing and swallowing, salivary secretion occurs during eating while awake. During sleep, salivary flow decreases from 0.5 ml/min in the awake state to near cessation [10]. Gastric acid secretion exhibits significant nocturnal variation, with peak secretion occurring between 10 PM and 2 AM. Gastric pH during wakefulness is significantly lower than during NREM and REM sleep, while REM sleep pH is higher than during N1 and N2 sleep [11]. REM sleep is also associated with suppressed gastric acid secretion. Therefore, understanding the physiological impact of "vigorous in day and sleeping well at night" on the digestive system can enhance the understanding of digestive disorders and aid clinical diagnosis and treatment.

The phenomenon of "vigorous in the day and sleeping well at night" is driven by endogenous circadian rhythms. Multiple physiological activities in the gastrointestinal tract and its associated digestive organs exhibit circadian rhythmicity, including nutrient digestion and absorption, gastrointestinal motility, intestinal epithelial barrier function, gut microbiota dynamics, and intestinal hormone secretion. The generation, maintenance, and regulation of "vigorous in day and sleeping well at night" at the cellular level rely on the precise control of endogenous circadian gene networks. Research indicates that circadian genes crucial for sleep are widely expressed in gastrointestinal epithelial cells and neurons of the enteric nervous system [12]. Under circadian gene regulation, the digestive system exhibits periodic biological rhythms at different times. Common circadian genes include PER1, PER2, PER3, CRY, CLOCK, and BMAL [13]. In salivary glands, the BMAL1, CLOCK, PER1, and PER2 genes regulate salivary secretion at different times [14]. Animal studies show that α-amylase expression in the submandibular glands of mice varies with circadian rhythms, peaking at night. Inhibiting CRY1/2 genes reduces α-amylase expression [15]. In the colon, circadian genes are expressed in epithelial cells and neurons of the myenteric plexus. The myenteric plexus serves as a critical site for neurotransmitter synthesis and coordination of colonic motility [16]. Colonic motility and intestinal permeability are linked to specific circadian gene functions,

with peak colonic activity during the day, minimal activity at night, and a marked increase upon waking [17].

2.2. Effects of "daytime inactivity and nighttime insomnia" on digestive function

Altered "vigorous in day and sleeping well at night" patterns also disrupt gastrointestinal function, leading to symptoms like abdominal pain, constipation, and diarrhea. Analysis of circadian rhythms in the transcriptome suggests that circadian genes may be implicated in IBD pathogenesis [18]. Polymorphisms in the PER3 gene, associated with circadian rhythms, correlate with earlier onset and more aggressive Crohn's disease, characterized by a higher frequency of immunosuppressive use and the formation of strictures and fistulas [19]. Altered expression of circadian clock genes disrupts the "vigorous in day and sleeping well at night", leading to downregulation of intestinal tight junction gene expression. This alters intestinal permeability and exacerbates immune responses, potentially representing one mechanism underlying IBD pathogenesis.

The "vigorous in day and sleeping well at night" regulates digestive function through the core pathway of "biological clock gene regulation modulating digestive circadian rhythms to maintain intestinal homeostasis."

3. Relationship between insomnia and common digestive disorders

Compared to healthy individuals who experience "vigorous in the day and sleeping well at night", insomnia patients often exhibit "daytime inactivity and nighttime sleeplessness", characterized by daytime dysfunction and nighttime sleep difficulties. In recent years, the interplay between insomnia and digestive system diseases has garnered significant attention. Healthy sleep is associated with a reduced risk of digestive system diseases [20]. Numerous studies indicate a close association between insomnia and functional gastrointestinal disorders. Insomnia can influence gastrointestinal pressure, visceral sensitivity, and the immune system, potentially serving as a key mechanism in the development of digestive system diseases.

"Core shared mechanisms linking insomnia and digestive system diseases": (1) Circadian rhythm gene dysregulation (e.g., PER3 abnormalities, downregulation of CLOCK/Bmal1); (2) Inflammatory factor vicious cycle (insomnia → elevated pro-inflammatory factors → exacerbated intestinal inflammation → further sleep disruption); (3) Gut-brain axis dysfunction (visceral sensitivity, neurotransmitter/hormone imbalance).

3.1. Relationship between insomnia and IBD

Insomnia correlates with IBD severity. Clinical studies reveal sleep disturbances in IBD patients, with disease recurrence linked to reduced sleep duration. Inflammatory factors such as IL-1, IL-6, and TNF-α produced by intestinal inflammation can stimulate brain regions associated with sleep, leading to insomnia. Insomnia also increases IBD recurrence rates to 47% at 3 months and 67% at 6 months [21]. Insomnia may increase the risk of Crohn's disease flare-ups, showing a significant correlation with disease severity. It can diminish quality of life and increase the likelihood of surgery and hospitalization [22]. Insomnia affects innate and adaptive immune function, potentially serving as a key factor in IBD recurrence and exacerbation, with circadian genes playing a crucial role. Insomnia also promotes inflammatory cytokine expression, while these cytokines suppress circadian rhythm gene expression, worsening insomnia and creating a vicious cycle [23]. Tumor necrosis factor-α (TNF-α), as a pro-inflammatory cytokine, plays a crucial role in the immune response of IBD and is central to intestinal mucosal inflammatory reactions. TNF-α can suppress the expression of circadian clock genes (HLF, DBP, TEF, Per1, Per2, and Per3) [24]. Wang et al. found significantly reduced expression of circadian genes Bmal1, Cry1, and Cry2 in active IBD patients.

Intestinal biopsies from IBD patients revealed decreased circadian gene expression, which was negatively correlated with clinical scores and endoscopic assessments. Circadian gene levels in peripheral blood mononuclear cells were closely associated with CRP levels and the erythrocyte sedimentation rate in IBD patients [6]. In animal studies, DSS-induced colitis in sleep-deprived mice exhibited more severe mucosal inflammation than in non-sleep-deprived DSS-induced mice. Chronic sleep deprivation exacerbated inflammation in DSS-induced mice [5, 25]. They also exhibited significant alterations in circadian gene expression profiles. Thus, insomnia-induced changes in IBD may occur through the interaction between circadian genes and the immune system. Current research increasingly suggests that IBD patients with insomnia are associated with poorer clinical outcomes. This relationship is not a simple cause-and-effect dynamic but rather a complex bidirectional interaction [26].

3.2. Relationship between insomnia and IBS

IBS is considered a multifactorial disorder, with visceral hypersensitivity, altered interactions between the enteric and central nervous systems, changes in gut microbiota, increased intestinal permeability, and intestinal inflammation all contributing to its pathogenesis [27]. Insomnia is a common symptom among IBS patients, and irregular sleep patterns significantly increase IBS incidence. Thirty-three percent of insomnia patients suffer from IBS; insomniacs are 1.6 times more likely to develop IBS than healthy individuals [28]. IBS symptoms worsen following insomnia onset, as sleep deprivation intensifies visceral pain responses, exacerbating IBS manifestations. According to Pittsburgh Sleep Quality Index assessments, individuals with subjective insomnia exhibit heightened sensitivity to rectal distension [29]. Additionally, pro-inflammatory cytokines induced by poor sleep may perpetuate symptoms in IBS patients [30]. Research indicates that regulating circadian rhythm function can promote sleep and potentially treat IBS by alleviating pain symptoms in constipation-predominant IBS and by enhancing intestinal motility [31].

3.3. Relationship between insomnia and gastroesophageal reflux disease

Gastroesophageal reflux disease (GERD) is a common gastrointestinal disorder characterized by abnormal reflux of gastric contents, accompanied by symptoms such as heartburn [32]. Continuous pH monitoring of the distal esophagus reveals distinct differences between nocturnal and diurnal reflux. Awake reflux events are characterized by high frequency and short duration, with brief gastric acid-esophageal contact time. Nocturnal reflux events occur less frequently but involve significantly prolonged gastric acid-esophageal contact time [33]. Physiological changes during sleep include prolonged esophageal gastric acid clearance time and increased reflux volume, leading to prolonged acid exposure and greater acid migration toward the proximal esophagus. These alterations predispose to gastroesophageal reflux [34]. Given GERD's involvement of the esophagus and other organs like the larynx, oropharynx, and bronchi, it may cause systemic effects contributing to insomnia. Physiological changes in the esophagus during sleep may exacerbate GERD-induced damage to the esophageal mucosa, increasing the risk of severe erosive esophagitis, gastrointestinal strictures, esophageal ulcers, and esophageal complications. Concurrently, the severity of insomnia also increases [35]. Studies indicate a strong association between GERD and insomnia. Animal studies confirm that the severity of reflux symptoms in GERD model rats correlates with increased arousal, accompanied by reduced NREM sleep during light exposure and increased sleep fragmentation [36]. Furthermore, a bidirectional relationship exists between GERD and sleep: poor sleep may exacerbate GERD clinical symptoms by heightening esophageal sensitivity to gastric acid stimulation and altering the ghrelin-to-leptin protein ratio [37]. Insomnia exacerbates GERD, which in turn further

contributes to insomnia. Moreover, circadian rhythms of clock genes are disrupted in GERD, particularly during acute episodes, when GERD alters clock gene expression in the gastrointestinal tract and other liver regions [38]. Disruption of circadian rhythms in clock genes may influence cytokine expression in GERD. This could potentially induce elevated levels of cytokines such as IL-1β, IL-6, and IL-8 in the esophageal mucosa, thereby exacerbating symptoms [39].

3.4. Relationship between insomnia and peptic ulcer disease

Peptic ulcer disease (PUD) primarily manifests as epigastric pain caused by excessive exposure of the digestive tract mucosa to gastric acid and pepsin. It may be accompanied by other gastrointestinal symptoms, such as increased salivation, heartburn, belching, and vomiting [40]. Although the etiology of PUD remains unclear, Helicobacter pylori infection, gastric acid hypersecretion, and impaired gastric mucosal defense mechanisms are considered primary pathogenic factors [41]. PUD patients exhibit poorer sleep quality than healthy individuals, primarily attributed to various insomnia symptoms caused by epigastric pain, such as difficulty falling asleep, increased awakenings, and prolonged wakefulness. Among the elderly, PUD patients exhibit poorer sleep quality than healthy individuals. In elderly patients with *Helicobacter pylori* infection, the recurrence rate of PUD is higher in insomniacs than in those with good sleep [42]. Among women, those sleeping less than 7 hours per night have twice the risk of developing PUD compared to those sleeping more than 9 hours per night [43].

During deep sleep, gastric mucosal secretions, blood flow, and melatonin secretion increase while gastrin secretion decreases, helping prevent PUD development and recurrence. Sleep deprivation can cause gastric mucosal ulcers and erosions, potentially through mechanisms such as reduced gastric mucosal blood flow, inhibited cell proliferation, slowed mucosal repair, and weakened mucosal barrier function [44]. Furthermore, the TFF2 protein in the gut has been identified as essential for nocturnal gastric mucosal structural protection and repair of damage. Insomnia reduces TFF2 expression, increasing the risk of gastric ulcers [45]. Reactive oxygen species (ROS) are also implicated in PUD pathogenesis. Insomnia may influence PUD onset and progression by altering the expression of genes related to oxidative stress and mitochondrial function, such as GPX1, DARS2, PRDX6, HAAO, RBM14-RBM4, NDUFS3, OGFOD2, and ATP5G1[46]. Therefore, insomnia—particularly the interplay between insomnia and PUD—reveals a close association. Sleep quality serves as both a causative factor in disease onset and a critical determinant of prognosis and recovery.

4. Mutual interdependence in treating insomnia and digestive system diseases

Currently, whether it is digestive system diseases that cause insomnia or insomnia that causes digestive system diseases, treating one condition alleviates the symptoms and severity of the other. This is due to the bidirectional nature of insomnia and digestive system diseases. For healthy individuals, ensuring adequate sleep is an effective way to prevent digestive system diseases.

Treating insomnia can effectively alleviate digestive system symptoms and yield therapeutic benefits. Melatonin and melatonin agonists promote sleep and have potential therapeutic effects for various gastrointestinal disorders [47]. Clinical studies indicate that melatonin has beneficial effects in IBD. Melatonin inhibits increased intestinal permeability and suppresses TNF-α expression, a pro-inflammatory cytokine [48]. Melatonin optimizes gut microbiota composition, promoting SCFA (especially butyrate) production; SCFAs enhance BMAL1 expression via HDAC inhibition, stabilizing host circadian rhythms [49]. Melatonin also serves

as an adjunctive therapy for reflux disease, helping prevent esophageal mucosal damage. Melatonin prevents PUD recurrence by scavenging free radicals, promoting cell proliferation, and enhancing gastric mucosal microcirculation [50]. Ramiprilat selectively binds melatonin receptors MT1 and MT2 in the suprachiasmatic nucleus for treating insomnia with difficulty initiating sleep. It has been demonstrated to significantly improve gastroesophageal reflux symptoms in patients with non-erosive reflux disease, enhance sleep efficiency, and increase sleep latency [51]. The Chinese herbal medicine lily (Lilium) exhibits sedative, anti-fatigue, antioxidant, and immunomodulatory effects, effectively improving gastrointestinal function in insomnia-induced rats [52]. Jiaotai Pills treatment significantly reduced lipopolysaccharide levels in sleep-deprived rats and alleviated insomnia-induced intestinal damage, including shorter, sparser, and incomplete villi, wider inter-villus spaces, and mucosal swelling and congestion. This mechanism is associated with upregulation of the intestinal circadian rhythm proteins Cry1 and Cry2, as well as the tight junction protein Ocln [53]. Acupuncture improves circadian rhythm disorders through multi-pathway, multi-target mechanisms, including autonomic nervous system regulation, neuroendocrine effects (influence of acupuncture on plasma melatonin and cortisol in chronic insomnia patients), the brain-gut axis, and gut microbiota [54–56].

Acupuncture influences circadian rhythms through multiple pathways. For instance, in the regulation of the autonomic nervous system, acupuncture treatment enhances parasympathetic markers in heart rate variability (HRV), reduces nocturnal awakenings, and prolongs deep sleep duration. Regarding digestive disorders, parasympathetic activation promotes gastrointestinal motility and regulates digestive secretion. Acupuncture can restore normal rhythms by regulating the neuroendocrine system. On one hand, it suppresses excessive activation of the HPA axis, lowering corticotropin and cortisol levels to mitigate adverse effects on sleep and gastrointestinal function. On the other hand, acupuncture upregulates melatonin receptor expression, promoting nocturnal melatonin secretion and improving sleep quality. Simultaneously, acupuncture regulates the secretion of gastrointestinal hormones, such as gastrin and cholecystokinin. These hormones not only participate in digestion but also regulate sleep.

For instance, electroacupuncture at Shenmai (HT7) and Zhaohai (KI6) increases melatonin secretion, significantly improving sleep-wake circadian rhythm disorders [57]; electroacupuncture at Ganshu (BL18) modulates core circadian clock genes Clock and Bmal1, restoring normal sleep rhythms [58]. Simultaneously, selecting acupoints with bidirectional regulatory effects—such as Shenmen (HT7), Zusanli (ST36), and Zhongwan (CV12)—to modulate neurotransmitters and autonomic balance achieves clinical efficacy for digestive disorders and insomnia [59–61]. In summary, acupuncture effectively balances the autonomic nervous system by acting on the central nervous system, optimizing melatonin secretion rhythms and levels [62]. Combined with anti-inflammatory and mood-regulating mechanisms, it fundamentally corrects circadian rhythm disorders associated with insomnia, promoting the restoration of natural sleep-wake cycles.

Similarly, medications for digestive disorders can also alleviate insomnia. For PUD, first-line therapy primarily employs proton pump inhibitors (PPIs), which effectively reduce insomnia and enhance sleep quality, thereby improving the quality of life for patients with PUD experiencing nocturnal symptoms. Concurrent use of PPIs with antibiotics further reduces gastric acid secretion and promotes mucosal healing [63]. Currently, improving both insomnia and digestive system diseases remains a challenge in clinical treatment. Given their bidirectional influence, exploring effective combination therapies for medications targeting digestive disorders and insomnia may offer new avenues for future clinical management.

5. Conclusion

Sleep is a vital physiological function linked to cognition, immunity, and endocrine systems, with proven significance in psychiatric, cardiovascular, and metabolic disorders. However, research on sleep-digestive system interactions has lagged. Recent technological advances and increased clinical focus have spurred a rise in studies examining these relationships.

Literature analysis reveals a bidirectional relationship between insomnia and digestive disorders, in which the onset of one condition may trigger the development of the other. The concept of "vigorous in day and sleeping well at night" has been identified as a key factor in this bidirectional influence. In this context, "daytime" represents yang, while "nighttime" represents yin. As mentioned earlier, the protective qi (wei qi) and nutritive qi (ying qi) mentioned in "the circulation of protective and nutritive qi remains uninterrupted, ensuring daytime vitality and nighttime rest" are transformed from the essence of water and grains. The Yellow Emperor's Inner Canon: Meeting of Nutritive and Defensive Qi states: "The nutritive qi resides within the vessels, the defensive qi outside them. The nutritive qi circulates ceaselessly, reuniting every fifty cycles. Yin and yang interconnect, forming an endless loop" [3]. The Wei qi belongs to Yang and circulates externally, while the Ying qi belongs to Yin and resides within the vessels. The human body's Wei-Ying qi alternates between day and night: during the day, the Wei qi circulates in Yang, where Yang predominates, leading to wakefulness; at night, the Ying qi circulates in Yin, where Yin predominates, leading to sleep. This is expressed as "When Yang qi is strong, the eyes open; when Yin qi is strong, the eyes close." Thus, the circulation of Wei-Ying Qi exhibits a circadian rhythmic pattern aligned with day-night cycles, profoundly influencing physiological states. As discussed earlier, "vigorous in day and sleeping well at night" not only governs sleep-wake cycles but also regulates gastrointestinal function, inflammation, metabolic balance, and hormonal signaling. "Daytime alertness disrupted, nighttime rest disturbed" is a major contributing factor to various disorders, including insomnia, digestive system diseases, and cancer. This imbalance may stem from dysfunction of the melatonin system, environmental desynchronization, genetic polymorphisms, or bodily aging. Melatonin-based medications, acting as regulators of the sleep-wake cycle and potent antioxidants, can influence sleep-wake patterns by improving circadian rhythms. They modulate gastrointestinal motility, promote sleep, alleviate mild gastrointestinal inflammation, and enhance gastrointestinal neural sensitivity. These properties yield favorable therapeutic effects for comorbid insomnia and digestive disorders, making them suitable for clinical treatment of insomnia complicated by digestive diseases. Concurrently, the secretion and levels of melatonin and cortisol in the human body exhibit circadian rhythmicity. Acupuncture aids in restoring the dysregulated rhythms of these substances and influences gastrointestinal function through multiple pathways, including the gut microbiota, the autonomic nervous system, and the brain-gut axis [64]. In summary, acupuncture plays a pivotal role in treating the pathological state of "daytime lethargy and nighttime insomnia" [65]. In conclusion, ongoing research on sleep and the digestive system holds promise for opening a new dimension in understanding the pathophysiology of their bidirectional influence. This mutual impact also offers prospects for novel clinical diagnosis and treatment. Currently, high-quality studies on the complex interactions between sleep and digestive disorders remain scarce. Researchers should further explore these areas to uncover deeper relationships between sleep characteristics and digestive diseases, as well as their underlying mechanisms.

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Disclosure statement

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