

# Research Progress on the Interaction between PCOS and Gut Microbiota Based on the Theory of “Spleen Deficiency and Phlegm-Dampness”

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**Abstract:** *Polycystic ovary syndrome (PCOS) is a common gynecological disorder characterized by endocrine and metabolic disturbances, highly prevalent among women of reproductive age. In Traditional Chinese Medicine (TCM), “deficiency of the spleen with phlegm-dampness” is considered one of its core pathological mechanisms. In recent years, the role of gut microbiota as a “bridge” connecting human metabolism and endocrinology has become increasingly prominent in the pathogenesis of PCOS. Based on this, this paper explores the research mechanisms of the interaction between polycystic ovary syndrome and gut microbiota from the theoretical perspective of “spleen deficiency and phlegm-dampness” in TCM, aiming to provide references for the clinical treatment of PCOS.*

**Keywords:** Polycystic ovary syndrome, Gut microbiota, Spleen deficiency and phlegm-dampness, Research progress.

## 1. Introduction

Polycystic ovary syndrome (PCOS) is a common endocrine disorder frequently observed in women of reproductive age, with a highly complex etiology and pathogenesis [1]. The prevalence of PCOS among women of reproductive age ranges from 5% to 10% [2]. Its clinical manifestations include hyperandrogenism, polycystic ovarian morphology, and persistent anovulation, and it may be associated with abdominal obesity, insulin resistance, and impaired glucose metabolism. Currently, most scholars believe that PCOS is a polygenic and multifactorial disease [3]. Its etiology and pathogenesis typically involve genetic factors, inflammatory factors, gut microbiota, endocrine hormones, and insulin resistance (IR) [4]. In recent years, research on the gut microbiota of PCOS patients has garnered widespread attention, with studies indicating that gut microbiota plays a critical role in the development of PCOS [5].

## 2. The Understanding of the “Spleen Deficiency and Phlegm-Dampness” Pattern in PCOS from the Perspective of Traditional Chinese Medicine

Although Traditional Chinese Medicine (TCM) does not include the modern disease entity “Polycystic Ovary Syndrome (PCOS),” based on its clinical manifestations—such as oligomenorrhea, amenorrhea, obesity, hirsutism, acne, and infertility—it can be categorized within traditional TCM disease patterns like “delayed menstruation,” “amenorrhea,” “abdominal masses,” and “infertility.” Through long-term clinical observation, many TCM practitioners have reached a consensus that the core pathogenesis of PCOS lies in the synergistic dysfunction of the Kidneys, Spleen, and Liver. Among these, “Spleen Deficiency and Phlegm-Dampness” constitutes the core pathological foundation that permeates the entire process of the disease’s onset, development, and outcome. It serves as the critical link connecting congenital and acquired factors and regulating the movement and transformation of Qi, Blood, and Body Fluids.

This condition often originates from deficiency of both the Spleen and Kidneys. The Kidneys, considered the “root of pre-heaven,” govern reproduction, store Essence, and control consolidation and storage. The Spleen, regarded as the “root of post-heaven,” governs transportation and transformation and is the source of Qi and Blood production. The Spleen’s healthy transportation function relies on the warming and propulsion of Kidney Yang, while the fullness of Kidney Essence depends on the continuous nourishment from the food essence transformed by the Spleen. If both Spleen and Kidneys are deficient, transportation and transformation become impaired. Consequently, food and fluids are not properly transformed but instead accumulate as Dampness, which condenses to form the core pathological product: “Phlegm-Dampness.” Once Phlegm-Dampness forms, it circulates with the movement of Qi, obstructing the channels and collaterals and impeding the flow of Blood. Over time, this leads to the endogenous production of “Blood Stasis.” This combination of Phlegm and Stasis obstructs the reproductive axis—comprising the “Kidneys-Tian Gui-Chong Ren-Uterus”—leading to severe dysfunction of this axis. This manifests as cessation of menstruation, difficulty for the uterus in capturing essence for conception, and the development of polycystic morphological changes in the ovaries. Therefore, the nature of this disease is characterized as a deficiency in origin and excess in manifestation. The root lies in the dysfunction of the Spleen and Kidneys, while the branch or manifestations are the obstructions caused by Phlegm-Turbidity and Blood Stasis. These two aspects—root and branch—act as both cause and effect, intertwining to perpetuate the disease [6].

The statements in The Yellow Emperor’s Classic of Internal Medicine—“All disorders involving dampness and fullness are attributed to the Spleen” and “The Spleen is the source of phlegm production”—accurately reveal the initiating role of Spleen dysfunction in the formation of Phlegm-Dampness. Spleen Deficiency leading to impaired transportation is not only the root cause of endogenous Dampness and Phlegm-Turbidity but also the direct reason for signs of internal exuberance of Phlegm-Dampness, such as an obese

body shape, a greasy tongue coating, and a slippery pulse. Therefore, in the clinical TCM treatment of PCOS, the core therapeutic principles often focus on “Fortifying the Spleen, Resolving Dampness, Transforming Phlegm, and Dissipating Nodulation.” The aim is to cut off the source of Phlegm, eliminate the foundation for Stasis, and thereby restore the functional balance of the reproductive axis and the harmonious flow of Qi and Blood.

### 3. The Functional Commonalities Between “Spleen Deficiency and Phlegm-Dampness” and Gut Microbiota

#### 3.1 “Spleen Deficiency” and Gut Microbiota

In Traditional Chinese Medicine (TCM), the “Spleen” is regarded as the root of post-heaven vitality and the source of Qi and Blood production. Its core function, “the Spleen governs transportation and transformation,” encompasses the entire process of digestion, absorption, and energy conversion of food and fluids within the digestive system as understood in modern medicine. The gut microbiota, a vast microbial ecosystem residing in the human intestines, plays crucial roles in decomposing complex polysaccharides, synthesizing essential vitamins, participating in bile acid metabolism, and regulating the transformation of xenobiotics. These functions represent an indispensable biological extension and execution of the macro-level function of “Spleen governing transportation and transformation” at the micro level. Together, they form a highly unified “macro-micro functional entity.”

When the Spleen and Stomach functions are robust, a state known as “flourishing Spleen” in TCM, a stable and diverse gut microbiota collaborates efficiently. It transforms food essence into easily absorbable small-molecule nutrients and beneficial metabolites, such as short-chain fatty acids. This process perfectly corresponds to the ideal TCM state of “transporting and transforming water and grains, generating Qi and Blood.” Conversely, if factors like dietary irregularities, emotional stress, or improper balance of work and rest lead to “Spleen Deficiency,” its transportation and transformation capacity declines. This directly manifests as severe dysbiosis of the gut microbiota structure: a significant decrease in microbial diversity, a reduction in beneficial bacteria abundance, and overgrowth of conditional pathogens. This disrupted microbiota fails to perform its metabolic duties effectively, leading to digestive and absorptive impairments and systemic energy metabolism disorders. Furthermore, the dysbiotic microbiota produces and releases large amounts of harmful substances like endotoxins. These endotoxins entering the systemic circulation trigger a systemic chronic low-grade inflammatory response. From a TCM pathogenesis perspective, this is equivalent to the endogenous pathological products such as “Dampness” and “Phlegm-Turbidity” arising from Spleen Deficiency. These pathological products circulate with Qi and Blood, obstructing the channels and collaterals, thereby becoming the initiating link in triggering a series of core PCOS symptoms like insulin resistance and hyperandrogenism.

Spleen Qi Deficiency impairs the distribution of essence, leading to inadequate nourishment of the intestines. This alters the dominant bacterial species in the gut microbiota,

disrupts the microbial balance, and results in gut microbiota dysbiosis. TCM links Spleen function to intestinal microecological stability, considering gut microbiota dysbiosis as one of the pathological manifestations of Spleen Deficiency [7]. Spleen Deficiency-induced diarrhea can cause changes in gut microbiota diversity in rats and significantly reduce the average relative abundance of Bacteroidetes [8]. Mice with Spleen Qi Deficiency exhibit gut microbiota imbalance, decreased evenness and species richness, and increased pathogenic bacteria [9]. Yu Hanchuan et al. [10] found that Spleen-deficient mice had overgrowth and structural disorder of gut microbiota, while oral administration of Buzhong Yiqi Decoction to fortify the Spleen Qi significantly improved the gut microbiota structure and intestinal immune status, suggesting a close relationship between Spleen Deficiency and gut microbiota.

#### 3.2 “Internal Obstruction of Phlegm-Turbidity” Affects Gut Microbiota Balance

“Internal Obstruction of Phlegm-Turbidity,” a core TCM pathological product in PCOS, originates from the failure of the “Spleen governing transportation and transformation.” When Spleen transformation is impaired, food essence is not properly transformed but instead accumulates as Dampness, which condenses into Phlegm. This is the essence of the TCM concept that “the Spleen is the source of Phlegm production.” From a modern biomedical perspective, the generation of Phlegm-Turbidity is profoundly associated with disorders of body lipid metabolism. Some scholars suggest that excessively accumulated adipose tissue, sticky and stagnant in morphology and texture, can be viewed as “tangible Phlegm.” In contrast, the series of disordered adipokines secreted by imbalanced adipocytes and the chronic inflammatory state they induce, characterized by their systemic circulation and lack of tangible form, resemble the pathogenic characteristics of “intangible Phlegm” [11]. These two forms of “Phlegm” together constitute an important pathological environment affecting gut microbiota balance.

Specifically, the high-fat, high-sugar dietary pattern corresponding to “tangible Phlegm” directly alters the nutritional substrate of the gut microenvironment. This dietary structure is not only the material basis for Phlegm-Turbidity production but also a key external force shaping and driving the gut microbiota structure towards dysbiosis, leading to the reduction of beneficial bacteria and proliferation of conditional pathogens.

More importantly, Phlegm-Turbidity, as a diffuse pathological factor, obstructs the ascending and descending movement of Qi in the Middle Jiao. This not only macroscopically exacerbates the state of impaired Spleen transformation but also microscopically translates into slowed intestinal motility and structural damage to the intestinal barrier function. The destruction of the intestinal barrier, equivalent to the failure of the “defensive exterior function” in TCM, allows harmful substances like bacterial endotoxins to more easily translocate into the bloodstream, triggering systemic chronic low-grade inflammation. This vicious cycle, initiated by “Internal Obstruction of Phlegm-Turbidity” and progressing from the local intestine to the whole body, continuously exacerbates the imbalance of the gut microbiota.

Ultimately, through mechanisms like the “gut-ovary axis,” it deeply participates in core pathological aspects of PCOS such as insulin resistance, hyperandrogenism, and ovulation disorders.

#### 4. The Correlation Between Gut Microbiota and PCOS

Studies have shown that gut microbiota dysbiosis is prevalent among PCOS patients, characterized not only by reduced diversity but also by a decrease in metabolically protective beneficial bacteria (such as short-chain fatty acid-producing bacteria) and a concurrent increase in potential pathogens. This microecological imbalance can exacerbate the core pathophysiology of PCOS through multiple mechanisms. On one hand, dysbiotic microbiota damages intestinal barrier integrity, leading to endotoxin entry into the bloodstream, triggering systemic chronic low-grade inflammation and insulin resistance, which in turn stimulates the ovaries to produce excess androgens. On the other hand, alterations in the spectrum of microbial metabolites further interfere with the host’s energy metabolism and endocrine stability. Furthermore, through communication via the “gut-brain axis,” disordered gut signals may affect the central nervous system’s regulation of the reproductive axis.

Gut microbiota participates in regulating the host’s immune function, material and energy metabolism, maintaining gastrointestinal homeostasis, and inhibiting inflammatory responses. It is thus referred to as an acquired “organ” and the “second genome” of the human body [12]. Once gut microbiota homeostasis is disrupted, it can mediate the development of endocrine dysfunction, IR, sex hormone secretion disorders, inflammation, and obesity, thereby increasing the risk of PCOS and its long-term complications.

Numerous studies have found altered gut microbiota in PCOS patients. Bacteroidetes decrease, while Firmicutes, which promote calorie absorption, increase. JOBIRA et al [13] found that PCOS patients had a higher relative abundance of Actinobacteria and a lower relative abundance of Bacteroidetes. The relative abundances within Bacteroidaceae, Porphyromonadaceae, and Streptomyetaceae were also lower. CHU [14] using metagenomic analysis, found a decrease in Gram-negative bacteria including Bacteroides. Lactobacillus and Bifidobacterium are beneficial bacteria that enhance immunity and nutrient absorption; these bacteria are significantly reduced in PCOS patients. Studies have reported reduced alpha diversity in PCOS patients, and some research indicates a negative correlation between testosterone concentration and alpha diversity [15].

#### 5. Current Research Status on TCM Regulation of Gut Microbiota for PCOS Prevention and Treatment

##### 5.1 Chinese Herbal Medicine Treatment

Based on the TCM theory of the Spleen governing transportation and transformation and the pathogenesis of PCOS involving Spleen and Kidney deficiency, some

researchers have used Cangfu Daotan Decoction combined with catgut embedding at acupoints to treat obese PCOS patients. Results showed increased colony counts of Lactobacillus and Bifidobacterium, decreased colony counts of Enterobacteriaceae, and improved intestinal microecological imbalance. Concurrently, patients exhibited reduced IR, improved T-cell immune response indicators, and increased periodic ovulation and pregnancy rates [16]. Providing PCOS patients with a high dietary fiber diet primarily consisting of TCM food-grade whole grains and prebiotics can regulate gut microbiota structure, reduce obesity levels, and alleviate IR [17]. Obesity and PCOS are mutually initiating factors; obesity is both a predisposing factor and a major complication of PCOS. Increased Firmicutes abundance, decreased Bacteroidetes abundance, and an increased Firmicutes/Bacteroidetes ratio are commonly observed in the microbiota of obese patients. Clinical reports indicate that Huazhi Pills can reduce the abundance of Firmicutes and the Firmicutes/Bacteroidetes ratio in the intestines of patients with Phlegm-Dampness Internal Abundance type primary obesity, and lower the patients’ TCM syndrome scores [18]. Qiwei Baizhu Powder can reduce Prevotella and increase Bacteroides in obese patients with Spleen Deficiency and Dampness Retention pattern, lower body mass index, improve glucose and lipid metabolism, and alleviate IR [19].

##### 5.2 Acupuncture and Moxibustion Treatment

Modern medicine suggests that acupuncture and moxibustion can adjust the proportion of gut microbiota, decrease the expression levels of intestinal inflammatory factors and their receptors, inhibit intestinal inflammatory responses, and thus restore intestinal barrier function. Furthermore, via the “microbiota-gut-brain axis,” it enhances central sensitivity to leptin, achieving the goal of improving IR and lipid metabolism [20]. Current research on the mechanisms of acupuncture and moxibustion for PCOS primarily focuses on regulating the “hypothalamic-pituitary-ovarian axis” function and improving metabolism.

Chen Lu et al [21] used the “Regulating Spirit and Fortifying the Spleen” acupuncture method to treat diarrhea-predominant irritable bowel syndrome and found reduced short-chain fatty acid content in patient feces, along with improved gut microbial community structure and diversity. Xue Ting et al [22] applied electroacupuncture at bilateral Zusanli and Zhongwan acupoints in rats and found it could upregulate serum IL-4 expression levels, downregulate serum IL-6 expression levels, partially regulate gut microbiota structure, and restore intestinal barrier function. Regarding the regulatory effect of moxibustion on gut microbiota, studies suggest that moxibustion can increase gut microbiota diversity, maintain stable gut microbiota structure, and protect the colonic mucosal barrier [23]. Moxibustion can also increase the proportion of beneficial bacteria by reducing the expression levels of inflammatory factors, thereby regulating the gut microbiota.

##### 5.3 Other Treatments

Modern research indicates that regular practice of Baduanjin can optimize gut microbiota structure, specifically manifested

as a significant increase in the quantity and abundance of beneficial bacteria in the intestines. These beneficial bacteria are key forces in maintaining intestinal barrier integrity and producing short-chain fatty acids. The optimization of microbiota structure directly leads to an overall improvement in gastrointestinal physiological function, including enhanced digestive and absorptive efficiency and reduced endotoxin translocation into the blood, thereby effectively alleviating the chronic low-grade inflammatory state commonly seen in PCOS [24].

## 6. Conclusion

Spleen Deficiency and Phlegm-Turbidity are the fundamental basis of PCOS pathogenesis. Spleen Deficiency leads to impaired transportation and transformation, causing food essence to be improperly distributed and instead accumulate as Phlegm-Turbidity. This pathological product is both the core pathogenesis and a key pathogenic factor of PCOS. Gut microbiota dysbiosis resulting from this pathological mechanism has been proven to deeply participate in various pathological processes of PCOS, including follicular development, hyperandrogenemia, insulin resistance, obesity, and oxidative stress. Clinically, using Chinese herbal medicines to tonify Spleen Qi, resolve Phlegm, and dry Dampness, combined with therapies like acupuncture and Baduanjin, has shown definite efficacy in improving PCOS symptoms. This not only verifies the scientific nature of TCM theory but also elucidates, from a modern scientific perspective, the complete pathogenic chain of “Spleen Deficiency and Phlegm-Turbidity - Gut Microbiota - PCOS,” providing new theoretical basis and intervention strategies for clinical prevention and treatment.

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