

Review

Integrated Traditional Chinese and Western Medicine Prevention and Treatment of Diabetic Male Sexual Dysfunction Based on the "Kidney Stores Essence" Theory in Huangdi Neijing

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Abstract: Diabetic male sexual dysfunction is a common chronic complication of type 2 diabetes mellitus, mainly manifested as decreased libido, erectile dysfunction and ejaculatory disorders. Simple symptomatic intervention with Western medicine can hardly reverse the damage to gonads, blood vessels and nerves fundamentally, accompanied by limitations such as poor long-term efficacy and prominent adverse reactions. Huangdi Neijing establishes the core theory of "kidney stores essence", proposing that the kidney governs reproduction and kidney essence serves as the foundation of reproductive function. Meanwhile, it fully elaborates the pathological chain of metabolic disorders consuming kidney essence through the discussions on "wasting-thirst disease" and "spleen-dampness disease". Taking the theory of "kidney stores essence" as the main line, this paper combines modern endocrinological and andrological clinical studies, integrates the theories of seasonal health preservation, preventive treatment of disease and staged syndrome differentiation recorded in Huangdi Neijing, sorts out the integrated Chinese and Western pathological mechanisms of diabetic sexual dysfunction, and constructs an integrated prevention and treatment scheme of "stabilizing blood glucose to consolidate the root, tonifying the kidney and replenishing essence, and staged conditioning". Studies have demonstrated that synergistic intervention of integrated Chinese and Western medicine can stabilize blood glucose, repair vascular and nerve injuries, improve sex hormone secretion, invigorate the spleen and kidney, soothe the liver and activate blood to consolidate kidney essence. It can block reproductive injuries in the prediabetic stage in advance, delay sexual function decline in the middle and late stages, and provide theoretical basis of traditional Chinese medicine and feasible clinical approaches for standardized full-cycle prevention and treatment of this disease.

Keywords: Huangdi Neijing; kidney stores essence; wasting-thirst disease; diabetes mellitus; male sexual dysfunction; integrated traditional Chinese and Western medicine; preventive treatment of disease

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1. Introduction

The incidence of metabolic disorders has shown a sustained upward trend in recent years. In individuals with type 2 diabetes, prolonged exposure to hyperglycemic and hyperlipidemic conditions exerts multifaceted detrimental effects on the male reproductive system. Clinical manifestations commonly include erectile impairment, diminished sexual desire, and reduced ejaculatory function—collectively referred to as diabetic-related reproductive dysfunction. This condition is characterized by a high prevalence, low rates of formal healthcare engagement, and substantial functional impact, significantly compromising physical well-being, psychological resilience, and interpersonal relationship quality. Contemporary biomedical investigations indicate that

chronic glycemic dysregulation contributes to progressive microvascular endothelial injury and peripheral autonomic neuropathy. These pathological changes impair neurovascular signaling essential for penile hemodynamics and sexual response coordination. Furthermore, persistent metabolic stress disrupts hypothalamic-pituitary-gonadal axis homeostasis, leading to attenuated synthesis and secretion of key reproductive hormones and reduced expression of corresponding hormone receptors in target tissues. As a result, structural and functional integrity of reproductive organs—including the testes, prostate, and corpus cavernosum—is progressively compromised. Current standard clinical approaches primarily focus on glucose-lowering regimens, nerve-supportive agents, and pharmacological support for erectile physiology [1]. While these modalities offer transient symptomatic relief, they do not address underlying pathophysiological drivers such as systemic metabolic imbalance or progressive gonadal insufficiency. Prolonged use may be associated with adverse physiological responses, including cardiovascular strain and adaptive tolerance. A growing body of clinical consensus emphasizes the necessity of concurrent metabolic stabilization and targeted restoration of reproductive tissue function. Integrated approaches combining evidence-informed traditional Chinese medicine principles with contemporary biomedical strategies have demonstrated superior outcomes in comprehensive disease management, particularly in sustaining long-term physiological equilibrium and functional recovery.

Traditional Chinese medicine does not employ a discrete diagnostic label equivalent to the modern biomedical term 'diabetic-related reproductive dysfunction'. Instead, its conceptual framework classifies such presentations under broader syndromic categories including *xiao ke* (wasting-thirst disorder), *yang wei* (erectile impairment), and *leng jing* (cold sperm syndrome). The foundational theoretical basis originates from the *Huangdi Neijing*, particularly the principle that the kidney organ system stores and governs *jing* (essence)—a vital substance fundamental to human growth, maturation, and reproductive capacity. Congenital *jing* determines constitutional endowment for reproductive potential, while postnatal *jing* is continuously replenished through transformation of nutrients by the spleen and stomach. Adequate *jing* ensures robust sexual vitality and proper nourishment of genital structures; conversely, *jing* deficiency manifests as diminished libido, impaired erectile capacity, and suboptimal spermatogenesis. The *Lingshu* chapter 'Wu Bian' observes that individuals with inherently weak *zang-fu* organ systems exhibit heightened susceptibility to wasting-thirst disorders. Those with congenital insufficiency of kidney *qi* and pre-existing *jing* depletion are especially vulnerable to accelerated reproductive decline following onset of metabolic disturbance. From a pattern-differentiation perspective, variations in individual physiological disposition influence the rate and trajectory of *jing* depletion. For instance, individuals exhibiting yin-deficient patterns experience accelerated *jing* consumption due to internal dry-heat accumulation, resulting in earlier onset and more pronounced reproductive symptoms [2]. This progression correlates closely with measurable reductions in reproductive hormone levels and functional markers. Additionally, classical concepts such as seasonal health maintenance and preemptive therapeutic strategies outlined in the *Huangdi Neijing* provide a structured, stage-specific framework applicable across prediabetic, established diabetic, and complication-associated phases. Drawing upon accumulated clinical experience in integrative practice, this analysis centers on the 'kidney stores *jing*' doctrine to systematically examine the pathogenic mechanisms, contemporary biomedical correlates, and synergistic prevention and management methodologies grounded in both traditional and modern medical paradigms. Emphasis is placed on physiological coherence, functional restoration, and sustainable homeostatic regulation across multiple organ systems.

2. Pathogenic Correlation between the "Kidney Stores Essence" Theory in Huangdi Neijing and Wasting-Thirst Disease Complicated with Sexual Dysfunction

"Kidney stores essence and governs reproduction" constitutes a foundational theoretical framework in *Huangdi Neijing* for understanding human reproductive

physiology and pathophysiology, forming the conceptual cornerstone for analyzing male sexual dysfunction arising in the context of wasting-thirst disease [2]. This classical TCM syndrome is clinically aligned with type 2 diabetes mellitus, characterized by chronic hyperglycemia and progressive metabolic dysregulation. Over time, the persistent pathological milieu—marked by dryness-heat accumulation, phlegm-dampness obstruction, liver qi constraint, and stasis of blood—exerts cumulative deleterious effects on both congenital kidney essence inherited from parents and acquired kidney essence derived from postnatal nourishment and functional integrity of the spleen-stomach system. Such sustained depletion directly compromises the physiological functions governed by the kidney, particularly those related to sexual vitality, gonadal activity, and structural maintenance of erectile tissues. Modern clinical investigations in andrology and endocrinology corroborate that metabolic disturbances—including insulin resistance, oxidative stress, endothelial dysfunction, and autonomic neuropathy—interact synergistically with traditional TCM patterns of kidney essence deficiency. These convergent mechanisms impair microcirculation and neurotrophic support to the penile corpus cavernosum, resulting in diminished nitric oxide bioavailability, reduced smooth muscle relaxation, and compromised vascular filling. Consequently, manifestations such as decreased libido, delayed erection onset, insufficient rigidity, and premature detumescence emerge. A systematic analysis of these interlocking pathways enables precise staging of disease progression and informs rational, integrative therapeutic approaches centered on tonifying kidney function and replenishing essence, while simultaneously addressing underlying metabolic derangements through coordinated lifestyle, pharmacological, and constitutional regulation strategies.

2.1. "The Kidney Stores Essence and Governs Reproduction" Is the Foundation of Reproductive Function

The Huangdi Neijing establishes the kidney as the fundamental zang organ governing reproductive physiology, emphasizing its role in storing both congenital essence—innately endowed at birth—and acquired essence derived from the transformation of food and water by the spleen and stomach [1, 3]. This dual-source replenishment mechanism ensures sustained vitality of reproductive tissues and functions. Congenital kidney essence directly influences baseline reproductive capacity, including gonadal development, hormonal priming during puberty, and long-term gametogenic competence. Acquired essence, continuously refined through digestive and metabolic processes, serves as a dynamic reservoir that supports daily physiological demands and compensates for age-related or stress-induced depletion. Clinically, abundant kidney essence correlates with robust libido, optimal erectile hemodynamics, and structural integrity of the penile corpus cavernosum, whereas deficiency manifests as diminished sexual desire, delayed or absent erection, reduced sperm motility, and impaired ovarian follicular maturation. The Lingshu chapter on Five Transformations further observes that constitutional fragility of the zang-fu system predisposes individuals to metabolic disorders such as wasting-thirst disease. In particular, preexisting insufficiency of kidney qi and essence significantly increases susceptibility to sexual dysfunction following the onset of such conditions. Furthermore, individual patterns of essence metabolism vary markedly: patients exhibiting yin deficiency experience accelerated depletion due to internal dryness-heat scorching the essence, resulting in earlier symptom emergence and greater functional severity; those with phlegm-dampness or qi stagnation patterns demonstrate slower but progressive impairment linked to obstructed transformation and transport. These distinctions underscore the centrality of kidney essence as both substrate and regulator of reproductive homeostasis.

2.2. Three-Layer Pathogenesis of Kidney Essence Consumption Throughout the Course of Wasting-Thirst Disease

First, unregulated dietary habits—particularly excessive consumption of greasy, sweet, and highly processed foods—impair spleen function and disrupt the physiological

process of transforming food into usable acquired essence. According to classical theoretical foundations in Traditional Chinese Medicine, such dietary patterns obstruct the middle jiao, impairing the spleen-stomach's capacity for transportation and transformation. This dysfunction leads to pathological accumulation of phlegm-dampness and turbid grease, which further impedes the upward movement of refined nutrients required to replenish kidney essence. Over time, the sustained interruption of acquired essence supply results in progressive depletion of kidney essence, a fundamental constitutional resource governing growth, reproduction, and vitality [4]. Clinical observations consistently indicate that male patients with prolonged exposure to high-carbohydrate and high-fat dietary regimens exhibit markedly higher prevalence rates of sexual functional disturbances compared to those maintaining balanced nutritional intake. These disturbances correlate with measurable declines in physiological markers associated with reproductive health and metabolic homeostasis, underscoring the critical role of dietary regulation in preserving kidney essence integrity throughout the disease course.

Second, persistent internal dryness-heat constitutes a central pathogenic mechanism that directly damages kidney yin and depletes kidney essence. In the framework of Traditional Chinese Medicine, wasting-thirst disease is fundamentally characterized by yin deficiency accompanied by excess heat [5, 6]. Sustained hyperglycemia serves as a biomedical correlate to this concept of internal heat. When dryness-heat accumulates and lingers in the lower jiao over extended periods, it exerts a scorching effect on kidney yin and its essential substance, thereby compromising structural and functional integrity of tissues dependent on kidney essence nourishment. Notably, insufficient essence fails to adequately support microcirculatory perfusion and trophic maintenance of the penile corpus cavernosum, contributing to diminished erectile response and reduced physiological drive. Contemporary laboratory assessments demonstrate concurrent reductions in key endocrine parameters alongside elevated systemic inflammatory mediators and increased oxidative stress burden within pancreatic β -cells. These interrelated pathological processes collectively accelerate the exhaustion of kidney essence, establishing a self-perpetuating cascade wherein metabolic dysregulation and essence depletion mutually reinforce one another.

Third, impaired flow of qi and consequent blood stasis obstruct the channels through which kidney essence is distributed, thereby depriving distal structures—including the external genitalia and penile corpus cavernosum—of vital nourishment. Classical texts emphasize the close relationship between emotional equilibrium and liver function, particularly its role in regulating the smooth flow of qi. Prolonged states of psychological tension and mood imbalance disturb hepatic qi dispersion, leading to stagnation that impedes microcirculatory dynamics and nutrient delivery. Even when kidney essence remains intrinsically sufficient, compromised transport mechanisms prevent its effective utilization at target sites, resulting in functional deficits manifesting as sexual dysfunction. Empirical data show that chronic psychological strain correlates with elevated cortisol secretion, which in turn exacerbates disturbances in glucose metabolism and suppresses gonadal axis activity [7]. This creates a self-sustaining pathological loop wherein emotional dysregulation initiates metabolic perturbation, which further depletes kidney essence and diminishes physiological responsiveness, thereby reinforcing the original imbalance. Therapeutic strategies targeting both emotional regulation and circulatory optimization are therefore essential to restore the dynamic balance required for sustained essence preservation and functional recovery.

2.3. Disturbed Four-Season Rhythms Accelerate Kidney Essence Consumption

The seasonal health preservation theory articulated in the Huangdi Neijing underscores the physiological importance of aligning human activities with natural cyclical patterns, particularly emphasizing winter as the season governing storage and conservation of vital substances. When winter routines are disrupted—such as through inadequate rest, excessive physical exertion, or exposure to cold without proper

protection—kidney qi fails to consolidate effectively, resulting in diminished capacity for containment and gradual depletion of kidney essence, a fundamental substance associated with growth, reproduction, and longevity [6, 8]. In spring, impaired regulation of liver function disrupts the normal ascending and dispersing movement of qi, leading to pathological excess of wood qi that over-controls the spleen, thereby compromising its transformative and transporting functions. This impairs the conversion of food and drink into refined essences (gu qi and ying qi), reducing the upstream supply necessary for replenishing kidney essence. Concurrently, dysregulation of defensive qi circulation contributes to systemic metabolic dysfunctions, including aberrant glucose utilization and lipid accumulation, while promoting persistent low-grade inflammatory states. Such chronic inflammation exerts cumulative deleterious effects on renal tissue integrity and gonadal endocrine activity, ultimately undermining the integrated physiological processes of generation, storage, and distribution of kidney essence—thereby accelerating functional decline in conditions such as diabetic sexual dysfunction.

2.4. Modern Pathogenic Mechanisms of Diabetic Male Sexual Dysfunction (Microscopic Evidence of Kidney Essence Deficiency)

Modern clinical investigations have confirmed the objective pathological underpinnings associated with the traditional Chinese medicine (TCM) concept of 'kidney essence deficiency' through integrated analyses spanning endocrinological, microvascular, and neurophysiological domains [9, 10]. First, dysfunction of the hypothalamic-pituitary-gonadal regulatory axis has been consistently observed in male individuals with type 2 diabetes, manifesting as diminished circulating levels of key steroid hormones and gonadotropins, alongside reduced expression and sensitivity of corresponding hormone receptors in target tissues—findings that align closely with microscopic correlates of kidney essence depletion described in classical TCM theory. Second, chronic hyperglycemia induces structural and functional alterations in the penile microvasculature, including endothelial damage, capillary rarefaction, and luminal stenosis within the corpora cavernosa; concurrently, autonomic and somatic nerve conduction velocities decline progressively, impairing both vasodilatory signaling and sensory feedback—collectively resulting in insufficient delivery of qi and blood to the external genital organs, a pathophysiological state interpreted in TCM as failure of kidney essence and qi-blood to adequately nourish the reproductive system. Third, persistent metabolic dysregulation fosters a systemic pro-inflammatory milieu characterized by elevated cytokines and oxidative stress markers, which exert cumulative deleterious effects on renal parenchyma and gonadal tissue integrity while accelerating the depletion of refined physiological substances—this cascade mirrors the TCM pathogenic pattern of 'dryness-heat consuming essence' and 'phlegm-dampness impairing kidney function'.

Epidemiological evidence indicates that the prevalence and severity of sexual dysfunction in diabetic males exhibit strong positive associations with multiple modifiable and non-modifiable factors, including duration of diabetes, magnitude of glycemic variability, presence and degree of dyslipidemia, advancing age, and psychosocial stress burden. Specifically, longer disease duration and greater instability in blood glucose control are correlated with more pronounced manifestations consistent with kidney essence deficiency, such as diminished libido, delayed erection initiation, reduced rigidity, and diminished ejaculatory volume. Conventional Western therapeutic strategies—including monotherapy with oral hypoglycemic agents or exogenous androgen administration—tend to address isolated biochemical parameters without restoring systemic balance; they do not support the spleen's role in transforming and transporting nutrients, fail to regulate liver qi flow to ensure smooth circulation of qi and blood, and lack integration with seasonal and environmental rhythms emphasized in TCM constitutional regulation. Consequently, such interventions often yield transient improvements but demonstrate limited durability and high rates of symptom recurrence due to their inability to sustainably replenish kidney essence and restore foundational yin-yang equilibrium.

3. Stratified Integrated Chinese and Western Prevention and Treatment System Based on the "Kidney Stores Essence" Theory

Drawing upon classical theoretical foundations in traditional Chinese medicine, particularly the physiological principle that the kidney stores essence—a vital substance governing growth, development, reproduction, and constitutional resilience—this framework operationalizes a staged preventive and therapeutic approach aligned with contemporary clinical staging of diabetes. It integrates evidence-informed Western biomedical monitoring protocols—including glycemic surveillance, metabolic profiling, and early detection of microvascular and neurogenic changes—with time-tested TCM interventions centered on kidney-tonifying and essence-replenishing strategies. The system is structured across three clinically distinct phases: first, the prediabetic stage characterized by insulin resistance and subclinical metabolic dysregulation; second, established diabetes without overt organ damage, where functional imbalances such as yin deficiency and qi stagnation may dominate; and third, diabetes complicated by sexual dysfunction, reflecting deeper depletion of kidney essence and associated impairment of reproductive and neurological functions. Each phase employs coordinated modalities—including herbal formulations, acupuncture, lifestyle regulation, and targeted pharmacotherapy—to modulate pathophysiological pathways while preserving physiological integrity and enhancing long-term health outcomes [11].

3.1. Prediabetes Stage (Spleen-Dampness Stage): Invigorate the Spleen to Replenish Essence and Block the Source of Disease

This stage corresponds to the 'spleen-dampness' pattern described in classical Chinese medical texts, particularly the Huangdi Neijing, and is characterized by the absence of overt kidney essence depletion or sexual dysfunction. The fundamental pathophysiological mechanism involves impaired transportation and transformation functions of the spleen and stomach, resulting in accumulation of internal phlegm-dampness and consequent insufficiency in the generation and distribution of acquired essence—the vital nutrient substance derived from food and drink. As such, this phase represents a pivotal prodromal window during which timely and appropriate therapeutic strategies may effectively halt disease progression before irreversible metabolic and functional deterioration occurs [12]. Clinically, individuals often present with symptoms such as fatigue, heaviness in the limbs, abdominal distension, loose stools, greasy tongue coating, and slippery pulse—signs collectively reflecting dampness obstructing spleen qi. Early recognition and targeted modulation of this pattern are essential for preserving long-term physiological homeostasis and preventing downstream complications related to endocrine and reproductive health.

From a contemporary biomedical perspective, management emphasizes lifestyle optimization grounded in evidence-based principles: adherence to a low-glycemic-index dietary pattern rich in whole grains, legumes, non-starchy vegetables, and lean proteins; consistent engagement in moderate-intensity aerobic physical activity—such as brisk walking, cycling, or swimming—for at least 150 minutes per week; and sustained weight management through caloric balance and behavioral support. These measures collectively enhance cellular glucose uptake, mitigate chronic low-grade inflammation, reduce excessive endogenous heat production associated with metabolic overload, and thereby protect renal and gonadal tissues from premature exhaustion of vital essence reserves. Importantly, such approaches align with national public health initiatives promoting preventive care and healthy aging [8].

Traditional Chinese medicine employs an integrative, multi-modal approach combining herbal formulations, dietary therapy, seasonally attuned physical practice, and emotional cultivation—all coordinated to strengthen spleen function and support kidney essence. Herbal prescriptions typically include ingredients that resolve dampness, fortify spleen qi, nourish kidney yin or yang, and replenish refined essence. Seasonal adaptation is integral: liver-soothing and spleen-invigorating herbs and foods are emphasized in spring to harmonize rising wood energy; warming and consolidating formulas are

prioritized in winter to safeguard stored kidney essence [13]. Mindful movement practices—including Baduanjin and Tai Chi—are recommended to enhance circulation of qi and blood, unblock meridian pathways, and facilitate the conversion of postnatal nutrients into high-grade essence. Complementary auditory modalities, such as five-tone music therapy, are utilized to ease emotional constraint, regulate liver qi flow, and prevent pathological heat accumulation that could otherwise deplete yin and impair reproductive vitality. Clinical observation indicates that this holistic strategy contributes meaningfully to glycemic stabilization and significantly lowers the incidence of subsequent reproductive system disorders.

3.2. Confirmed Diabetes Stage without Reproductive Complications: Tonify the Kidney and Nourish Yin to Consolidate and Protect Essence

Patients present with sustained hyperglycemia, accompanied by early-stage yin deficiency and mild dryness-heat manifestations, along with gradual depletion of kidney essence. However, no clinically apparent disturbances in reproductive physiology are observed at this stage. The therapeutic strategy prioritizes disease stabilization and prevention of further pathological progression, with emphasis on reinforcing the fundamental kidney qi and preserving the intrinsic essence to maintain long-term physiological integrity and metabolic homeostasis.

Contemporary clinical management includes standardized glycemic control and lipid profile optimization through evidence-based pharmacological protocols. Routine assessment of endocrine parameters—including gonadal hormone levels—and evaluation of vascular endothelial integrity are integral components of longitudinal monitoring [13]. Proactive surveillance enables timely identification of subclinical microvascular changes, allowing for early intervention aimed at preserving organ-specific microcirculation and delaying structural deterioration.

Traditional Chinese Medicine intervention centers on strengthening the kidney system, replenishing vital essence, nourishing yin, and alleviating internal dryness. This foundational approach is synergistically augmented with herbs that soothe liver qi stagnation and promote blood circulation to resolve latent stasis. Seasonal health maintenance practices are systematically integrated: during autumn, emphasis is placed on lung-nourishing and fluid-generating strategies to counteract environmental dryness and mitigate excessive yin consumption; in winter, moxibustion applied at the Guanyuan acupoint supports deep consolidation of kidney function and enhances the stability of stored essence. Clinical experience indicates that well-formulated herbal regimens contribute to improved glucose utilization and lipid metabolism, exert anti-inflammatory effects at the systemic level, support endocrine activity of the gonads, and help sustain hormonal balance over time.

3.3. Diabetes Complicated with Sexual Dysfunction Stage: Tonify the Kidney and Dredge Collaterals to Treat Root and Branch Simultaneously

Patients present with profound depletion of kidney essence, which serves as the foundational substance governing reproductive function and overall vitality in traditional Chinese medicine theory; this constitutional deficiency is further complicated by the concurrent emergence of multiple pathological patterns—namely phlegm-dampness accumulation obstructing the flow of qi and blood, static blood impeding microcirculation, and liver qi constraint disrupting the free coursing of qi throughout the body [14, 15]. Such complex, multi-layered pathogenesis necessitates a coordinated therapeutic strategy that integrates evidence-informed Western clinical approaches with time-tested TCM principles to simultaneously address both the underlying constitutional weakness (root) and the manifesting symptoms (branch).

In Western clinical practice, glycemic control remains the cornerstone of management, achieved through appropriately selected hypoglycemic agents tailored to individual metabolic profiles; adjunctive supportive measures include neurotrophic support to promote peripheral nerve integrity and agents that enhance microvascular perfusion to improve tissue oxygenation and nutrient delivery. When clinically indicated

and under strict medical supervision, temporary modulation of endocrine parameters may be considered to support physiological function during the recovery phase.

Traditional Chinese medicine prioritizes replenishing kidney essence and strengthening the root through tonification, while concurrently resolving secondary pathogenic factors via syndrome differentiation: for cases characterized by yin deficiency with internal heat and dryness, treatment focuses on nourishing yin and reinforcing the kidney; for those dominated by phlegm-dampness obstructing the lower jiao, therapy combines spleen-strengthening, kidney-tonifying, and phlegm-resolving actions; and for presentations involving liver qi stagnation and blood stasis, the approach integrates kidney supplementation, blood activation, and liver-qi soothing. Complementary modalities such as acupuncture and herbal fumigation are employed to unblock the lower jiao, regulate qi and blood circulation, and facilitate the physiological transport of vital substances to relevant anatomical regions. Furthermore, seasonally adjusted health-preserving regimens—emphasizing dietary moderation, appropriate physical activity, and lifestyle alignment with natural cycles—serve to consolidate kidney qi over time and mitigate the risk of recurrence. Clinical experience and observational data collectively indicate that integrated approaches yield synergistic benefits, including improved glycemic stability, enhanced endocrine balance, and measurable gains in functional outcomes, consistently outperforming monotherapy in comprehensive efficacy assessments.

4. Research Prospects

First, deepen mechanism research by integrating advanced omics technologies and systems biology approaches. Specifically, metabolomics profiling combined with network pharmacology analysis can be employed to systematically identify and validate the key molecular targets and signaling pathways through which kidney-tonifying herbal formulas modulate the hypothalamic–pituitary–gonadal axis and ameliorate metabolic dysregulation associated with insulin sensitivity impairment. This integrative strategy enables a multi-level interpretation of the classical TCM concept of 'tonifying the kidney and storing essence', linking macroscopic clinical improvements in reproductive function and metabolic homeostasis to underlying cellular and molecular events. Such investigations not only bridge traditional theoretical frameworks with contemporary biomedical understanding but also generate robust experimental data that substantiate foundational concepts described in classical medical texts, thereby reinforcing the scientific validity and clinical relevance of time-honored therapeutic principles.

Second, strengthen the foundation of evidence-based practice through rigorously designed clinical studies. Future efforts should prioritize prospective, multi-center, large-sample randomized controlled trials that directly compare long-term outcomes—including sexual function parameters, glycemic control stability, quality-of-life metrics, and incidence of secondary complications—among three distinct therapeutic strategies: conventional pharmacotherapy alone, traditional Chinese medicine regimens centered on kidney tonification and essence replenishment, and coordinated integrative protocols combining both modalities. These trials must employ standardized diagnostic criteria, validated outcome assessment tools, and extended follow-up periods to reliably determine differential efficacy, safety profiles, and cost-effectiveness. The resulting high-quality clinical evidence will support the development of consensus-based, clinically actionable guidelines for managing diabetic sexual dysfunction, ensuring reproducibility, transparency, and widespread applicability across diverse healthcare settings.

Third, advance the development of a standardized, intelligent health support system grounded in personalized wellness paradigms [14, 16]. This entails synthesizing individualized pattern identification—based on comprehensive clinical evaluation—with established principles of seasonal adaptation and physiological rhythm alignment. Quantitative standards will be established for stratified dietary prescriptions, tailored physical activity regimens, and precisely calibrated herbal formulations, all calibrated to individual physiological profiles. Concurrently, an intelligent risk prediction platform

will be constructed, incorporating multimodal data streams including constitutional characteristics, metabolic biomarkers, and reproductive functional indicators. Such a system facilitates early detection, dynamic monitoring, and proactive adjustment of supportive measures, thereby enhancing feasibility, fidelity, and scalability of implementation at community health service levels and primary care institutions.

Fourth, extend the application of holistic chronic disease management into a comprehensive, stage-adapted framework for diabetes care. Drawing upon core preventive doctrines such as 'treating disease before it arises', the physiological principle of 'kidney storing essence', and the cyclical wisdom of seasonal health preservation, this model structures care across the natural progression of diabetes. In the initial phase, emphasis is placed on spleen-invigorating and essence-nourishing strategies to support foundational qi and prevent early metabolic decompensation. During the intermediate stage, kidney-protecting and root-consolidating approaches aim to preserve endocrine resilience and delay organ involvement. In advanced stages, integrated methods combining kidney tonification with collateral-regulating interventions address structural and functional deterioration. This phased, physiologically anchored paradigm seeks to mitigate the cumulative burden of male reproductive complications, reduce long-term disability, and promote sustained functional integrity throughout the lifespan [8].

5. Conclusion

The classical theoretical framework of 'the kidney stores essence'—as articulated in foundational texts of traditional Chinese medicine—provides a coherent pathophysiological interpretation for the progressive deterioration observed in male sexual function among individuals with diabetes. This perspective identifies sustained metabolic dysregulation as the primary driver of systemic depletion, particularly affecting both congenital and acquired kidney essence, thereby underpinning clinical manifestations such as erectile dysfunction and diminished reproductive capacity. Conventional biomedical approaches, while effective in managing acute symptoms and optimizing glycemic parameters, do not address the underlying constitutional depletion or support long-term restoration of physiological integrity. In contrast, an integrative approach harmonizes evidence-informed Western strategies—including targeted glucose stabilization, microvascular protection, and neurophysiological support—with time-tested traditional principles centered on kidney essence replenishment, spleen qi fortification, liver qi harmonization, and alignment with natural seasonal rhythms. Such integration enables stage-specific responsiveness: early-phase support aimed at preserving functional reserve during prediabetic metabolic stress; mid-stage emphasis on structural and energetic consolidation to mitigate further decline; and late-stage focus on functional recovery and reproductive system resilience. Future advancement hinges on deepening interdisciplinary dialogue—bridging systems biology, endocrinology, urology, and traditional medical epistemology—to co-develop clinically validated, patient-centered frameworks for managing diabetic reproductive sequelae. These frameworks must prioritize safety, physiological sustainability, and holistic functional outcomes, grounded in rigorous scientific methodology and culturally informed clinical reasoning.

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