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Research paper

Health Literacy, Disease Perception, Coping Style, and Self-Management in Kidney Transplant Recipients: A Cross-Sectional Study

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Abstract

Kidney transplantation (KT) is a life-saving procedure that requires recipients to maintain long-term self-management and adapt psychologically to optimize health outcomes. However, gaps remain in understanding how health literacy, disease perception, and coping styles influence self-management behaviors in this population. This study examined the interrelationships among health literacy, disease perception, coping style, and self-management behavior in KT patients in China. A descriptive cross-sectional design was employed with 320 KT recipients who completed a structured questionnaire assessing the four study variables. Data were analyzed using descriptive statistics, independent-sample *t*-tests, ANOVA, and correlation analyses. Findings show that participants demonstrated moderate health literacy, with relatively strong communication and information-seeking skills, but lower motivation to improve health and limited financial capacity for healthcare. Disease perception was moderate, indicating a serious appraisal of the condition. Confrontation was the most commonly adopted coping style, followed by acceptance–resignation, and avoidance. Overall, self-management behavior was low, particularly in physical activity and psychosocial domains. Gender was significantly associated with health literacy; age, comorbidity, and employment status were related to coping styles; and gender and marital status influenced self-management. Disease perception correlated negatively with health literacy and self-management, while health literacy correlated positively with self-management. Positive coping styles were linked to lower disease perception and improved self-management. Overall, enhancing health literacy and promoting adaptive coping styles may strengthen self-management among KT recipients. Tailored nursing interventions, improved follow-up systems, and greater social and policy support are recommended to facilitate successful long-term adaptation. Future work should test the proposed relationships longitudinally and with mediational modeling to clarify causal pathways and potential moderators in diverse Chinese settings.

***Keywords**: kidney transplantation; health literacy; disease perception; coping style; self-management; cross-sectional study; patient education*

1. Introduction

Chronic kidney disease (CKD) affects approximately 850 million people worldwide, with China bearing the largest burden and a prevalence exceeding 10.8% (Cockwell & Fisher, 2020; Kalantar-Zadeh & Li, 2020). In China, more than 120 million individuals are affected, and over 0.03% progress to end-stage renal disease (ESRD) (Zhang et al., 2012). ESRD patients depend on renal replacement therapies, dialysis, or kidney transplantation for survival. Among these options, kidney transplantation (KT) offers the most effective improvement in quality of life and longevity. The global demand for renal replacement is projected to reach nearly 5 million by 2030 (Kugler et al., 2010; Liyanage et al., 2015). In 2017, 77,319 kidney transplants were performed globally, including 10,793 in China, making it the second-highest transplant volume worldwide. (Yoshihara & Yoneoka, 2018). These figures underscore the urgency of enhancing post-transplant care strategies in high-burden countries.

Despite advances in surgical techniques and immunosuppressive therapy, many KT recipients face persistent challenges in maintaining optimal self-management, particularly in physical activity, psychosocial adjustment, and medication adherence (Maasdam et al., 2022; Weng et al., 2010). Effective self-management requires not only clinical follow-up but also adequate health literacy, adaptive coping styles, and accurate disease perception. In China, however, research on the interplay among these factors in KT populations remains limited. International studies have shown that low health literacy in KT recipients is associated with medication non-adherence, increased creatinine levels, and higher complication rates (Demian et al., 2016), while negative illness perceptions have been linked to poorer quality of life and maladaptive coping (Kalfoss et al., 2019). Yet, localized evidence to guide culturally appropriate interventions is lacking.

In essence, health literacy enables patients to obtain, understand, and apply health-related information for informed decision-making. Disease perception shapes how patients interpret their condition and influences coping strategies. Meanwhile, coping style, in turn, determines how individuals manage stress and health-related challenges. Together, these factors play a pivotal role in determining self-management behaviors in KT recipients. Understanding their interrelationships within the Chinese context is essential for developing targeted, sustainable interventions that address both clinical and psychosocial needs.

This study is grounded in Jean Watson's (2008) *Theory of Human Caring* and Dorothea Orem's (2001) *Self-Care Deficit Nursing Theory*. Watson's theory emphasizes holistic, humanistic care, highlighting the importance of trust, empathy, and supportive nurse–patient relationships in fostering emotional well-being and adaptive coping. (Watson, 2008). These elements influence patients' perceptions of illness and their willingness to engage in self-care. Orem's theory provides a structured approach to identifying and addressing self-care deficits, focusing on patients' capacities to meet universal, developmental, and health deviation needs. (Orem, 1995, 2001; Tanaka, 2022). In the context of KT, this involves assessing health literacy, clarifying misconceptions, and providing tailored education to enhance self-management capacity. Integrating these theories offers a comprehensive lens for understanding how cognitive, emotional, and behavioral factors interact to influence KT recipients' health outcomes.

KT is a complex, lifelong journey that extends far beyond the surgical procedure. Meanwhile, biomedical factors are critical, and behavioral and psychosocial determinants play a substantial role in long-term graft survival and patient quality of life. By examining health literacy, disease perception, coping style, and self-management in the same analytical framework, this study addresses a notable research gap in China. The findings will inform the development of targeted, culturally relevant interventions for KT recipients, helping healthcare providers design patient-centered follow-up systems, community-based support programs, and educational strategies that improve adherence, psychological adaptation, and overall well-being. Furthermore, insights from this study can guide policymakers in strengthening reimbursement policies, enhancing employment opportunities for KT recipients, and reducing socioeconomic barriers to effective self-care.

As the current study's cross-sectional design cannot establish causality, the observed patterns motivate a confirmatory, theory-driven program of longitudinal research using mediation/moderation models to identify pathways linking literacy, illness perceptions, coping, and self-management over time. In addition, China's cultural and health-system context with strong family caregiving roles, heterogeneous reimbursement schemes, and variable access to follow-up, likely shapes both health literacy and coping, and therefore merits explicit consideration when interpreting our results. With this in mind, the primary aim of this study is to investigate the relationships and underlying mechanisms among health literacy, disease perception, coping style, and self-management behaviors in kidney transplant recipients in China. Specifically, the study seeks to (1) profile KT patients by demographic and clinical characteristics, including gender, age, employment status, family income, marital status, education, type of pre-transplant dialysis, organ donor source, post-transplant duration, and comorbidities; (2) assess the levels of health literacy, disease perception, coping styles, and self-management behaviors; (3) determine differences in these variables based on patient profile characteristics; and (4) explore the correlations among health literacy, disease perception, coping style, and self-management. Through these objectives, the study aims to provide an empirical foundation for designing evidence-based nursing interventions and policy recommendations to enhance the long-term health and quality of life of KT recipients.

2. Literature Review

2.1 Patient-Related and Clinical Predictors of Self-Management in Kidney Transplant Recipients

Type of dialysis pre-transplant - Pre-transplant dialysis modality has been identified as an important predictor of post-transplant self-management ability. Khezerloo et al. (2019) Found that KT recipients who had undergone peritoneal dialysis exhibited poorer self-management compared to those with prior hemodialysis. Peritoneal dialysis patients were reported to have higher complication rates and worse prognoses, complicating disease management. (Tekkarismaz & Torun, 2020). However, this association is not universally observed, suggesting that other factors may moderate the relationship between dialysis type and self-management.

Recent meta-analytic evidence further nuances the dialysis discussion - Pretransplant peritoneal dialysis (PD) is associated with lower delayed graft function and a slightly lower overall graft failure risk compared with hemodialysis, while all-cause mortality and death-censored graft failure do not differ meaningfully between modalities. These findings suggest PD may optimize peri-operative/early graft outcomes without conferring clear survival advantages, helping explain mixed reports across studies. (Ngamvichchukorn et al., 2022). Beyond modality, timing also matters: a comprehensive meta-analysis indicates that pre-emptive kidney transplantation (PEKT), including transplantation before dialysis, confers lower all-cause mortality and lower death-censored graft failure versus non-PEKT, underscoring the value of earlier referral and listing. (Azegami et al., 2023). Ultimately, such evidence on pre-existing oncohematologic disease shows that, with documented remission and multidisciplinary monitoring, patient and graft survival, rejection, and complication rates are comparable to recipients without such histories; limited relapses were successfully treated without allograft loss. This supports individualized candidacy decisions rather than categorical exclusion. (Mella et al., 2025).

Organ donor source - The source of the transplanted kidney can influence post-transplant outcomes and management (Dharia et al., 2022). Kidneys from living-related donors offer controlled surgical timing, lower postoperative complication rates (e.g., infection, rejection, renal insufficiency), and reduced treatment costs and hospital stays. (Auñón et al., 2024). These advantages may facilitate better self-management after surgery compared to recipients of kidneys from deceased donors.

Duration since transplantation - Several studies indicate a decline in treatment adherence over time post-transplant. Some reported that longer post-transplant duration was associated with poorer compliance, often due to reduced follow-up visits, as recipients perceived their health as stable. (Lee et al., 2015; Weng et al., 2017). Taj et al. (2021) Noted that 86.3% of KT recipients reported reducing or stopping medication when feeling well, underscoring the need for sustained patient education and engagement.

Comorbidity - Multiple chronic comorbidities, such as diabetes, hypertension, chronic nephritis, and complications from immunosuppressive therapy, can hinder self-management and reduce quality of life (Lorenz et al., 2019; Yang, Chen, Huang, et al., 2020). These conditions often contribute to anxiety, depression, and reduced adherence, making effective management of comorbidities a key prerequisite for successful post-transplant care.

2.2 Health Literacy in Kidney Transplant Recipients

Concept and definition - Health literacy, first introduced by Simonds (1974) 1974, has evolved to encompass a range of definitions. The American Medical Association defines it as the ability to read, understand, and apply health-related materials, while emphasizing the cognitive and social skills developed through health education (World Health Organization, 2006).

Prevalence and need for screening - Across KT candidates/recipients, limited or borderline health literacy is common. In a Swedish single-center study, about one-fifth of patients screened low or possibly inadequate on the Newest Vital Sign (NVS), with similar rates across candidates versus recipients and across sociodemographic groups, such as supporting routine screening and tailored education. (Lennerling et al., 2021). Pediatric data echo this: in the *HELP-KIDNEY* cohort, many families showed below-adequate literacy, which was linked to more clinic visits early post-transplant, underscoring the need to identify and support low-health literacy caregivers. (Haubrich et al., 2025).

Effects of health literacy - Higher health literacy is associated with better self-management, healthier lifestyles, improved communication with healthcare providers, and reduced depression and anxiety. (Ishikawa & Yano, 2011; Kugbey et al., 2019). Conversely, low health literacy is linked to increased mortality, readmission rates, and reduced quality of life. (Kanejima et al., 2022). In KT recipients, poor health literacy has been associated with non-adherence to immunosuppressive medication and higher complication rates. (Demian et al., 2016). Health literacy also relates to transplant listing access. In a report from the United States within an evaluation cohort (N=423), it is found that higher functional health literacy was positively associated with approval for listing, even after accounting for psychosocial and medical variables; importantly, some patients with low health literacy were still listed, suggesting that programmatic supports can mitigate literacy barriers. (Chen et al., 2022). Furthermore, prospective data suggest a varied situation with time-sensitive links. In a 6-year cohort, higher literacy did not directly predict rejection or graft loss; however, specific self-management skills, especially "*after-care & knowledge*" and "*recognition/management of symptoms*" at 6 months, were associated with lower graft failure. While a lower baseline "coping" was related to more bacterial infections. (Maasdam et al., 2022). Together with pediatric findings on early utilization, this implies that health literacy may act indirectly through self-management competencies and coping, and that early post-KT periods are particularly sensitive windows for intervention. (Haubrich et al., 2025).

Influencing factors - Predictors of health literacy include age, ethnicity, educational attainment, and cognitive function (Cajita et al., 2016). Depression and comorbidities may indirectly lower health literacy through reduced motivation and engagement. (Zhang et al., 2020). Beyond a single score, kidney recipients show distinct strengths and gaps across health literacy domains. Using the Health Literacy Questionnaire (HLQ), the lowest areas were "*appraisal of health information*" and "*navigating the health-care system*," while the highest were "*feeling understood/supported by providers*" and "*active engagement with providers*." Self-efficacy, transplant knowledge, and general health were key correlates across domains; useful targets for education and coaching (Dahl et al., 2020).

Taken together, screening for health literacy, building self-efficacy and transplant-specific knowledge, and addressing navigation/appraisal gaps, especially early after KT and among pediatric caregivers, may strengthen the literacy → coping/perception → self-management pathway as observed in the current study.

2.3 Disease Perception and Its Impact

Effects of disease perception - Disease perception reflects an individual's beliefs, emotions, and understanding of their illness. Positive perceptions are linked to greater self-efficacy, better coping, and improved health behaviors, whereas negative perceptions are associated with higher distress and poorer outcomes. (Atabaki et al., 2020; de Raaij et al., 2018; Qi et al., 2016). In KT recipients, negative disease perception correlates with poorer quality of life and maladaptive coping strategies. (Kalfoss et al., 2019). Furthermore, recent work shows that symptom experience can be depressive with illness perceptions in the early post-transplant period, wherein each additional symptom was associated with lower physical and mental health, and this effect was partly mediated by more unhelpful illness perceptions. (Wang et al., 2023). In adolescents, more negative illness perceptions and medication beliefs are linked to lower transplant-specific quality of life, highlighting a cognitive pathway from beliefs towards well-being in younger recipients as well. (Zelikovsky & Nelson, 2021). Relatedly, attribution training, which targets how patients explain setbacks, improved depressive symptoms, sleep quality, and fatigue shortly after KT, suggesting that adjusting illness attributions (a core component of perception) has tangible emotional and behavioral benefits. (Han et al., 2022).

Influencing factors - Disease perception can be shaped by gender, age, education, and income. (Miceli et al., 2019), as well as personality traits, cultural background (Landrine & Klonoff, 1992), and self-efficacy (Schuz et al., 2012). Excessive negative emotions reduce confidence in disease control, increasing maladaptive perceptions. (Ekmen et al., 2021). While social context shapes perceptions and adaptation. Among young and middle-aged KT recipients in China, social support partly mediated the link between more negative illness perceptions and worse psychosocial adaptation, indicating that supportive networks can buffer the impact of maladaptive perceptions. (Hu et al., 2023). Parallel evidence from liver transplantation shows hope partially mediates the association between social support and self-management (more or less around 40% mediation), pointing to hope as a modifiable psychological resource that translates social support into action. (Zhang et al., 2022).

Stigma, resilience, and life circumstances also matter - Qualitative and network-analytic studies in CKD and dialysis populations in China indicate that perceived stigma (e.g., feeling avoided or blamed, job insecurity) is tightly linked to depressive symptoms, with employment-related stigma acting as a bridge to depression. (Li et al., 2025; Xiong & An, 2025). These dynamics can color illness perceptions and reduce help-seeking. Furthermore, poorer sleep, longer post-transplant time, and lower psychological resilience are associated with greater frailty in KT recipients. (Zhang et al., 2023), which may reinforce more threatening illness models and lower engagement (Schomerus et al., 2022).

2.4 Coping Style and Self-Management

Effects of coping style - Coping styles commonly categorized as confrontation, avoidance, and acceptance–resignation (Feifel et al., 1987), play a central role in post-transplant adaptation. Positive coping (e.g., confrontation) has been shown to alleviate anxiety and depression, improve quality of life, and reduce caregiver burden. (Barata et al., 2018; Lloyd et al., 2019). Negative coping strategies can undermine adherence and overall health. Longitudinal data suggest specific coping/self-management skills, which track clinical events, such as: lower baseline coping predicted more bacterial infections, whereas stronger after-care or knowledge and symptom recognition or management at 6 months predicted lower graft failure over follow-up. (Maasdam et al., 2022). In the immediate postoperative phase, attribution-focused coping training reduced depression, poor sleep, and fatigue, implying that cognitive-behavioral coping interventions can quickly improve modifiable outcomes. (Han et al., 2022). At the family level, in hemodialysis dyads, family resilience mediated the link between patient

coping and caregiver burden, underscoring that coping operates within relational systems. (Zhang et al., 2024).
Role of coping style - Coping style mediates the relationship between disease perception and health behaviors (Liu et al., 2021). Patients using positive coping are more likely to seek social support, utilize resources, and regulate psychological stress (Alanazi et al., 2023). In KT care, encouraging adaptive coping is essential for sustaining long-term self-management. Integrating these findings, coping appears in a chain of influences: illness perceptions towards coping resources/strategies towards self-management and downstream outcomes (Liu et al., 2021). This chain is amplified or buffered by social support, hope, resilience, and family resilience (Zhang et al., 2024). Practically, KT programs can pair perception-shaping (education, attribution retraining, stigma-aware counseling) with coping/skill-building (symptom monitoring, problem-solving, hope-enhancement) to strengthen sustained self-management.

2.5 Self-Management Behavior in Kidney Transplant Recipients

Concept and components - Self-management involves patients' active participation in managing symptoms, treatment, lifestyle modifications, and psychological consequences of chronic illness (Creer et al., 1976; Lorig & Holman, 2003). In KT, this includes diet, treatment adherence, physical activity, and psychosocial well-being. (Zhuang et al., 2009).
Current status - Studies show suboptimal self-management in KT recipients globally and in China, with poor adherence to medication, diet, and exercise, and insufficient skin protection behaviors (Hedayati et al., 2017; Kenawy et al., 2019; Yang et al., 2022). Social and psychological aspects remain particularly weak, with a high prevalence of anxiety and depression. (van Sandwijk et al., 2019).
Effects of self-management - Effective management reduces rejection risk, hospital readmissions, and improves quality of life. (Khezerloo et al., 2019; Maasdam et al., 2022). While noncompliance is a major cause of graft loss (Didlake et al., 1988).
Influencing factors – The issue is quite influenced by demographic (gender, age, employment, education, marital status, income) and clinical factors (type of dialysis, donor source, post-transplant duration, comorbidities) (Sim et al., 2022; Xie et al., 2019). Psychosocial factors such as health literacy and coping style are also critical determinants. (Jamieson et al., 2016; Yang, Chen, Pong, et al., 2020).
In essence, as self-management unfolds within social and economic realities. A large meta-analysis on employment shows persistently low return-to-work rates (≈26% on dialysis, ≈38% post-transplant) and identifies younger age, higher education, absence of diabetes/depression, PD during dialysis, and living-donor KT as positive predictors.. (Kirkeskov et al., 2021). These correlates mirror key elements of self-management capacity, such as health literacy, coping resources, and supportive environments, which highlight the need to integrate vocational and psychosocial supports with clinical follow-up.

2.6 Synthesis and Research Gap

Existing research consistently demonstrates that health literacy, disease perception, and coping style are pivotal in shaping self-management behaviors among KT recipients. Higher health literacy facilitates effective communication with healthcare providers and informed decision-making, while positive disease perceptions and adaptive coping strategies enhance adherence to treatment regimens and promote physical and psychological well-being. Conversely, low health literacy, negative illness perceptions, and maladaptive coping are associated with poor compliance, increased complications, and diminished quality of life. However, despite these well-documented associations in international studies, few investigations have comprehensively examined the interplay and mechanisms among these variables within the Chinese KT population. The existing literature often addresses these factors in isolation, overlooking how they jointly influence self-management behaviors in a culturally specific context. Moreover, potential demographic and clinical moderators, such as donor source, pre-transplant dialysis type, post-transplant duration, and comorbidities, remain underexplored in relation to these psychosocial variables. In addition, modality and timing optimize different outcome domains: PD before KT is linked to better early graft outcomes (e.g., less delayed graft function), whereas PEKT confers survival advantages, clarifying why earlier literature appeared inconsistent when endpoints were pooled. At the same time, post-KT social functioning, particularly employment, remains limited and is shaped by educational, metabolic, and mental-health factors, reinforcing the centrality of health literacy and adaptive coping in sustaining self-management. Importantly, complex comorbidities such as prior oncohematologic disease need not preclude KT when remission and structured surveillance are in place, arguing for personalized pathways and standardized monitoring. Future work in China should test mediating and moderating mechanisms (e.g., literacy to perception/coping to self-management; moderators: donor type, PEKT status) using longitudinal/Structured Equation modeling designs across multiple centers.
This gap is particularly significant when viewed through the lens of Orem's Self-Care Deficit Nursing Theory and Watson's Theory of Human Caring. Orem's framework emphasizes the need to assess patients' self-care capacities and address deficits through targeted interventions, highlighting the role of health literacy in enabling informed self-care. Watson's theory underscores the importance of holistic, trust-based nurse–patient relationships in fostering positive illness perceptions and promoting adaptive coping. Integrating these theoretical perspectives suggests that effective post-transplant care requires not only clinical management but also psychosocial interventions that enhance knowledge, reshape illness perceptions, and support adaptive coping within a caring relationship. Addressing this research gap will provide evidence to guide culturally relevant, theory-driven interventions that strengthen KT recipients' self-management, improve graft survival, and enhance long-term quality of life. Importantly, to reflect global trends, the paper also noted several post-2023 advances emphasizing living-donor pathways and streamlined peri-operative education with potential downstream benefits for self-management. Hence, future studies within the Chinese context should examine how these programmatic features intersect with cultural norms of family support and stigma to shape literacy, coping, and adherence.

3. Method

3.1 Study Design

This study adopted a quantitative descriptive–correlational research design. Descriptive research systematically collects numerical data to present an accurate profile of the characteristics or phenomena under investigation (Cohen et al., 2007; Polit & Beck, 2018). It provides a clear snapshot of variables as they exist in their natural context, without manipulation of the study environment (Flores et al., 2025). As Sandelowski (2000) notes, such designs are particularly valuable for offering straightforward accounts of phenomena and generating foundational evidence that may inform the development of interventions and measurement tools. The correlational component of the design was employed to examine the relationships among key variables, such as health literacy, disease perception, coping styles, and self-management behaviors in KT recipients. Correlational studies do not establish causality; rather, they allow researchers to identify significant patterns of association that may guide future hypothesis-driven or experimental research (Cohen et al., 2007). This approach was appropriate given the study's aim to uncover the interrelationships among psychosocial and behavioral factors that influence post-transplant outcomes. By combining descriptive and correlational strategies, the research design offered both a comprehensive characterization of KT patients and an exploration of how critical variables interact within this population. Such a design not only advances understanding of current self-management practices but also establishes a solid empirical foundation for subsequent studies that may test causal mechanisms and evaluate targeted interventions.

3.2 Participants of the Study

Participants were recruited using simple random sampling. (Noor et al., 2022) From KT recipients attending routine re-examinations at the outpatient department of the Second Affiliated Hospital of Shandong University, Jinan, Shandong Province, China. The hospital performs more than 300 kidney transplantations annually, and according to hospital records, an average of 275 outpatient follow-up visits is conducted per month. This clinical volume provided a robust sampling pool for the study. Sample size was estimated using G*Power Version 3.1 (Faul et al., 2009), applying a linear model with an effect size of $d = 0.50$, $\alpha = 0.05$, and power = 0.80, which indicated a minimum requirement of 169 participants. To account for potential loss to follow-up due to noncompliance or unforeseen circumstances, such as sudden illness or inability to complete the questionnaire, an additional 20% adjustment was made in line with previous studies. (Sim et al., 2022). Accordingly, a minimum target of 203 participants was set.

Eligible participants were KT recipients who (a) were aged 18 years or older, (b) had been discharged for at least three months, (c) had sufficient Chinese language and reading proficiency, and (d) provided written informed consent to participate voluntarily. Exclusion criteria included: Cognitive impairment or psychotic illness; severe comorbid organ disease (e.g., advanced heart or liver disease); secondary KT, other organ transplantation, or artificial organ support (e.g., artificial liver support); and physical weakness preventing completion of the questionnaire. Participants were permitted to withdraw at any stage without penalty. Eligibility was verified through review of patients' inpatient medical records, which are retained by the hospital for at least 15 years. These records contain comprehensive clinical information, including past medical history, current diagnoses, and relevant treatment details. Access to records was obtained only after securing ethical approval from the hospital's review board and informed consent from participants. In cases where medical records did not provide sufficient clarity, the research team sought assistance from experienced nursing staff and transplant physicians, each with more than 10 years of clinical experience and concurrently enrolled as graduate students. Their expertise ensured accurate application of the exclusion criteria and reliable screening of eligible participants.

3.3 Study Instrument

Patient profile questionnaire - A self-designed demographic and clinical profile questionnaire was developed to collect background information on KT recipients. Demographic variables included gender, age, employment status, family monthly income (Chinese Yuan; CNY), marital status, and educational attainment. Clinical variables included the type of dialysis before transplantation, organ donor source, duration since transplantation, and the presence of comorbidities. These factors were included because they have been identified in prior research as relevant predictors of post-transplant self-management (Khezerloo et al., 2019; Sim et al., 2022).

Health literacy - This was assessed using the Chinese version of the *Health Literacy Scale for Chronic Patients* (HLSCP), originally developed by Sun et al. (2012). The HLSCP has been validated in Chinese populations with chronic diseases and is culturally appropriate for KT recipients. (Zou et al., 2017). The scale consists of 24 items across four dimensions: *Information Acquisition Ability* (7 items), *Communicative Interaction Ability* (10 items), *Health Improvement Willingness* (4 items), and *Economic Support Willingness* (2 items). Items are scored on a 5-point Likert. (1932) Scale, with a total score ranging from 24 to 120. Scores of 24–72 indicate low health literacy, 72–96 moderate, and ≥96 high health literacy. Reliability testing has demonstrated strong internal consistency (Cronbach's (1951) $\alpha = .88$); denoting good internal consistencies (Cohen et al., 2007).

Disease perception - Illness perception was measured using the Chinese version of the *Brief Illness Perception Questionnaire* (BIPQ) (Broadbent et al., 2006). The BIPQ is a concise tool widely used in KT populations due to its brevity and strong psychometric properties. The scale includes eight scored items, each rated on a 0–10 scale, covering: *perceived consequences, timeline, personal control, treatment control, identity, concern, understanding*, and *emotional response*. Total scores range from 0 to 80, with higher scores reflecting more negative illness perceptions (i.e., greater perceived burden and distress). A ninth open-ended item, which explores patient beliefs about illness causes, was not included in scoring. The Chinese BIPQ has demonstrated good validity and reliability in KT and other chronic illness populations. (Hu et al., 2023; Wang et al., 2021; Wu et al., 2014).

Coping style - Coping strategies were measured using the *Medical Coping Modes Questionnaire* (MCMQ), developed by Feifel et al. (1987) and translated into Chinese by Shen (2000). The instrument consists of 20 items assessing three coping dimensions: *Confrontation* (active problem-solving; 8 items), *Avoidance* (denial or distraction; 7 items), and *Acceptance–Resignation* (helplessness or surrender; 5 items). Responses are rated on a 4-point Likert scale (1 = never to 4 = always), with selected items reverse-scored. Subscale scores are interpreted to indicate low, moderate, or high levels of each coping tendency. The MCMQ has been extensively validated in Chinese clinical populations, with Cronbach's alpha coefficients ranging from .60 to .76 and acceptable test–retest reliability. (Chen et al., 2023; Liu et al., 2018; Shen, 2000). To facilitate interpretation, this study applied a tertile-based classification, categorizing scores into low, moderate, and high levels for each subscale and for overall coping. This approach aligns with coping theory. (Folkman et al., 1986) And prior psychometric practice.

Self-management behavior - Self-management was measured using the *Renal Transplant Recipients Self-Management Scale*, developed by Zhuang et al. (2009) For Chinese KT patients. The scale consists of 28 items rated on a 4-point Likert scale (1 = a lot to 4 = not at all), and encompasses four domains: *Dietary Management* (9 items), *Treatment Adherence* (10 items), *Physical Activity* (5 items), and *Social–Psychological Adjustment* (4 items). Total scores range from 28 to 112, with scores below 68 reflecting low self-management, 68–90 moderate, and >90 high self-management. Higher scores indicate better engagement in health-promoting behaviors. The instrument has demonstrated high internal consistency (Cronbach's $\alpha = .899$) and strong subscale reliability (.78–.94), and has been widely applied in KT research in China. (Xie et al., 2019).

3.4 Data Gathering Procedure

Ethical approval and permissions - Before data collection, written approval was obtained from the Graduate Schools in the Philippines and China, as well as from the respective institutional ethics review boards. At the study site, access to the hospital's inpatient and outpatient medical records database was granted only after approval by the hospital ethics committee and with the informed consent of each participant. Ethical approval included a two-year data storage period. All data were newly collected for this study, which was the first conducted by the research team.

Recruitment and sampling - Following ethics approval, the researchers obtained a list of outpatient KT review patients, including contact information, from the hospital. Patients were contacted by phone or email to explain the study purpose, significance, and procedures. Those who agreed to participate provided permission for the research team to review their medical records and were screened against the inclusion and exclusion criteria. Eligible participants were assigned numbers and selected using a simple random, non-replacement method until the required sample size was achieved.

Informed consent and participation options - Informed consent was obtained from all participants and, when applicable, their guardians. Patients were given the option to complete the survey either in person at the hospital or via email. For email-based participation, guardians were asked to accompany patients during questionnaire completion to monitor for signs of distress, though they did not intervene in answering. Participants were informed that they could withdraw from the study at any time, without penalty.

Questionnaire administration - The survey was administered by the principal investigator and three trained research assistants, all of whom held graduate degrees and had prior research training. They received additional orientation on the instruments and protocols, including procedures for addressing patient questions. Doctors, nurses, and other staff provided logistical support. Questionnaires required approximately 15–20 minutes to complete and were filled out directly by patients. Daily reviews were conducted by the research team to ensure validity; questionnaires were excluded if they contained more than three missing responses, identical answers across all items, or inconsistent demographic information.

On-site data collection and safety measures - For patients opting to participate in person, a designated hospital room was provided. The space was separate from treatment areas and designed with input from psychologists to minimize stress. Features included: Individual soundproof booths (up to 10 patients at a time) to ensure privacy, a resting/waiting area to prevent participant interaction, a dedicated "*green lane*" for hospital entry, with volunteers escorting patients, and alarm systems and on-site support staff (nurses, residents, and psychologists) to respond to emergencies or signs of emotional or physical distress. All hospital-based procedures adhered strictly to infection control and safety protocols.

Data management - Completed questionnaires were collected, sorted, and securely stored. Data were entered into SPSS version 23.0 by one researcher and verified by another for accuracy. Physical copies were coded and stored securely to prevent data breaches or unauthorized disclosure of personal information.

3.5 Statistical Treatment and Data Analysis

Data analysis was conducted using IBM SPSS Statistics version 23.0 (IBM Corp., Armonk, NY). Both descriptive and inferential statistics were applied, with statistical significance set at $p < .05$ (two-sided). To summarize the demographic and clinical characteristics of KT recipients, including gender, age, employment status, family income, marital status, educational attainment, pre-transplant dialysis type, organ donor source, post-transplant duration, and comorbidities, frequency and percentage distributions were calculated. The levels of health literacy, disease perception, coping styles, and self-management behaviors were assessed using means and standard deviations, providing an overview of central tendency and variability in the sample. Normality of continuous variables was tested using the Shapiro–Wilk test, which informed the choice of parametric or non-parametric tests. To examine differences in health literacy, disease perception, coping styles, and self-management across demographic and clinical groups, non-parametric tests were employed when normality assumptions were not met. The Mann–Whitney U test was used for two-group comparisons, while the Kruskal–Wallis H test was applied for comparisons across three or more groups. Finally, the relationships among health literacy, disease perception, coping style, and self-management behaviors were analyzed using the Spearman rank-order correlation coefficient, which is appropriate for non-parametric data and identifies monotonic associations between variables. Given the study's aims and theoretical framing, Structural Equation Modeling-based mediation/moderation will be a priority in subsequent longitudinal work to probe mechanisms beyond the correlations reported here.

4. Results and Discussions

4.1 Sociodemographic Profile of Participants

A total of 320 KT recipients participated in the study (Table 1). The majority were male (74.4%), while females accounted for 25.6% of the sample. Participants were almost evenly distributed between the younger (49.7%) and older (50.3%) age groups. Regarding employment status, 38.4% were employed, 42.5% were unemployed, and 19.1% were retired or receiving disability pensions. In terms of family monthly income, 24.4% reported earning below CNY 2000, 33.1% between CNY 2000 and 4000, and 42.5% more than CNY 4000. Most respondents were married (86.6%), while 8.1% were single and 5.3% were widowed, divorced, or separated. Educational attainment showed a relatively even spread, with 33.4% completing high school, 30.9% junior college, and 28.7% bachelor's degree or higher, while 6.9% had only middle school or below.

With respect to clinical factors, a large majority had received hemodialysis before transplantation (80.3%), compared with 15% who had undergone peritoneal dialysis, and 4.7% who experienced both modalities. Most kidneys were sourced from cadaveric donors (80.6%), while 19.4% came from living donors. The vast majority of participants had undergone transplantation more than one year prior (85.9%), with only 3.1% transplanted less than six months earlier and 10.9% between six months and one year. Finally, 44.7% of participants reported at least one comorbidity, whereas 55.3% did not.

The demographic findings provide an important backdrop for interpreting psychosocial and behavioral outcomes in KT recipients. The predominance of male participants (74.4%) reflects trends in China, where men are more likely to undergo transplantation, consistent with prior research suggesting gender disparities in access to advanced medical interventions. (Yang et al., 2022). Such imbalances highlight the importance of gender-sensitive education strategies, particularly since the literature shows women often report lower health literacy and self-management capacity compared to men. (Jamieson et al., 2016).

The sample was evenly split between younger and older recipients, suggesting that self-management strategies must be tailored to different life stages. Younger patients may face challenges related to employment and family responsibilities, whereas older recipients often contend with comorbidities and age-related limitations. Employment and income patterns further underscore this concern: more than 40% of participants were unemployed, and nearly a quarter earned less than CNY 2000 monthly. Previous studies emphasize that lower socioeconomic status is strongly linked with reduced health literacy and poorer self-management (Kugbey et al., 2019; Sim et al., 2022). Limited financial resources may hinder patients' ability to access medications, maintain regular follow-up visits, or engage in recommended lifestyle behaviors.

Clinically, most participants had received hemodialysis before transplantation (80.3%). While international studies have suggested that prior peritoneal dialysis may complicate post-transplant management (Khezerloo et al., 2019), the relatively low proportion of peritoneal dialysis patients here reduces the comparative risk burden. Likewise, the dominance of cadaveric donations (80.6%) may reflect systemic organ allocation processes in China, but it also raises questions regarding long-term self-management. Evidence indicates that living-donor transplants are associated with fewer complications and stronger patient motivation for adherence (Auñón et al., 2024).

The finding that 85.9% of patients had lived with their transplant for more than one year is critical. As prior research shows, adherence and follow-up tend to decline over time as patients perceive their health to be stable. (Taj et al., 2021). This suggests that in this cohort, motivational and behavioral support is particularly important for sustaining long-term self-management. Finally, the presence of comorbidities in nearly half the sample (44.7%) is consistent with global KT populations, where hypertension, diabetes, and cardiovascular disease are common. (Lorenz et al., 2019). These conditions not only complicate clinical outcomes but also undermine coping and self-management capacity.

Recent evidence clarifies that pre-emptive KT confers survival advantages, whereas pretransplant PD primarily lowers delayed graft function without a consistent mortality benefit, suggesting that modality and timing influence different outcome domains rather than yielding uniform effects across endpoints. (Azegami et al., 2023; Ngamvichchukorn et al., 2022). Moreover, employment after KT remains low and is shaped by education, mental health, diabetes, dialysis modality, and donor type, underscoring the social-behavioral levers that align with our findings on literacy, coping, and self-management (Kirkeskov et al., 2021). Finally, emerging cohort data indicate that carefully selected patients with prior oncohematologic disease achieve KT outcomes comparable to controls, supporting individualized, multidisciplinary decision-making. (Mella et al., 2025).

From the lens of Orem's Self-Care Deficit Nursing Theory, these demographic and clinical findings point to clear areas of self-care deficits. For example, low-income and unemployed patients may lack the resources or autonomy to consistently adhere to treatment regimens. Those with comorbidities may face compounded deficits that reduce their capacity for physical and psychosocial self-management. Nurses, therefore, play a crucial role in assessing individual self-care limitations and providing compensatory or supportive interventions tailored to these demographic realities. In line with Watson's Theory of Human Caring, the predominance of patients living with transplants for over a year highlights the need for sustained, empathetic engagement to maintain motivation and trust. Holistic care, attending not only to the clinical but also to the emotional and social realities of KT recipients, can reshape illness perceptions and promote adaptive coping. For instance, trust-based nurse–patient relationships may be especially valuable for those with low socioeconomic resources, empowering them to overcome barriers and engage more fully in long-term self-management.

Table 1: Demographic profile of the participants.

Demographics	Frequency (*N* = 320)	%
Gender		
Male	238	74.4
Female	82	25.6
Age		
Younger	159	49.7
Older	161	50.3
Employment		
Employed	123	38.4
Unemployed	136	42.5
Disability pension/retiring	61	19.1
Family Monthly Income		
<CNY 2000	78	24.4
CNY 2000 to 4000	106	33.1
>CNY 4000	136	42.5
Marital Status		
Married	277	86.6
Widowed/divorced/separated	17	5.3
Single	26	8.1
Educational Status		
Middle School or Below	22	6.9
High School	107	33.4
Junior College	99	30.9
Bachelor's degree or Above	92	28.7
Type of Dialysis Pre-transplant		
Peritoneal	48	15.0
Hemodialysis	257	80.3
Peritoneal and Hemodialysis	15	4.7
Organ Donor Source		
Live Donor	62	19.4
Cadaver	258	80.6
Duration of Post-Kidney Transplant		
<6 months	10	3.1
6 to 12 months	35	10.9
1 to 5 years or Above	275	85.9
Comorbidity		
Yes	143	44.7
No	177	55.3

Note. Total number of participants.

Cultural context may help explain several patterns. Spousal and extended-family caregiving is common in China and can bolster adherence, aligning with our higher self-management among married participants. Conversely, women's caregiving and employment constraints may help account for their lower health literacy and self-management scores. Differential reimbursement and travel distance for follow-up may also dampen motivation among low-income recipients, even when information access is adequate.

4.2 Levels of Health Literacy, Disease Perception, Coping Styles, and Self-Management

Table 2 shows that the overall mean health literacy score of KT recipients was 79.73 ± 7.38, indicating a moderate level of health literacy. Among the four dimensions, Communicative Interaction Ability had the highest mean (34.14 ± 4.46), followed by Information Acquisition Ability (25.75 ± 2.62), Economic Support Willingness (13.15 ± 1.95), and Health Improvement Willingness (6.69 ± 2.30). The relatively low scores for willingness to improve health and economic support suggest that while patients demonstrate adequate communication and information-seeking skills, they lack motivation and financial capacity to sustain long-term health behaviors.

Table 2: Level of Health Literacy of Kidney Transplant Patients.

Variables	Mean	Standard Deviation
Information Acquisition Ability	25.75	2.62
Communicative Interaction Ability	34.14	4.46
Health Improvement Willingness	6.69	2.30
Economic Support Willingness	13.15	1.95
Health Literacy Total	79.73	7.38
Interpretation	Lack of Health Literacy (moderate level)	

Note. N=320.

These findings align with prior research showing that Chinese KT recipients often have sufficient technical literacy to access information, but struggle with health motivation and financial barriers. (Kugbey et al., 2019; Zou et al., 2017). International studies also indicate that health literacy is a critical determinant of medication adherence and complication rates. (Demian et al., 2016). The weaker domains in this study, motivation and financial capacity, underscore the structural challenges facing Chinese KT patients, particularly those with lower socioeconomic status. According to Orem's Self-Care Deficit Nursing Theory, patients with limited willingness or financial capacity represent self-care deficits requiring nursing intervention. Nurses should provide supportive-educative systems that not only transmit information but also enhance motivation and address resource constraints. From Watson's Theory of Human Caring, building trust and empathy in nurse–patient relationships may help foster intrinsic motivation for health improvement, even in the face of financial barriers. Within the Chinese context, relatively low "concern" and "timeline" scores may reflect high trust in specialist care and optimism after surgery; however, without periodic re-education, this optimism could slide into complacency, especially once routine follow-up intervals lengthen.
For disease perceptions, Table 3 shows the mean total score of 43.18 ± 8.13, reflecting a moderate level of illness perception. The highest subscale scores were observed in Treatment Control (8.84 ± 1.56) and Understanding (7.60 ± 1.88), suggesting that patients believe treatment is effective and have a reasonable understanding of their condition. In contrast, Concern (0.88 ± 1.52) and Timeline (1.46 ± 1.91) were notably low, indicating limited worry and uncertainty about disease chronicity. These results indicate that while KT patients recognize the seriousness of their condition (high consequences and identity scores), they simultaneously hold optimistic views regarding treatment efficacy. This finding diverges somewhat from Kalfoss et al. (2019), who reported higher illness burden perceptions and negative coping among KT recipients in Western contexts. The moderate perception in this cohort may reflect improved transplantation care and health education in China. However, low concern and timeline perception could contribute to complacency, reducing long-term adherence. (Taj et al., 2021).

Table 3: Level of Disease Perception of Kidney Transplant Patients.

Variables	Mean	Standard Deviation
Consequences	5.25	2.91
Timeline	1.46	1.91
Personal Control	6.76	2.53
Treatment Control	8.84	1.56
Identity	6.64	2.79
Concern	0.88	1.52
Understanding	7.60	1.88
Emotional Response	5.75	2.89
Disease Perception Total	43.18	8.13
Interpretation	Moderate Illness Perception	

Note. N=320.

From Watson's perspective, patients' relatively optimistic views can be nurtured through caring interactions that validate their beliefs in treatment efficacy while gently correcting underestimation of long-term risks. Orem's theory highlights the need to address misconceptions (e.g., low concern about disease timeline) through structured self-care education, ensuring that patients do not prematurely relax adherence.
As for the coping styles, Table 4 shows that the most frequently reported was Confrontation (23.62 ± 2.29), followed by Avoidance (12.93 ± 2.28) and Acceptance–Resignation (12.09 ± 1.78). The total coping score was 48.64 ± 3.74, suggesting a tendency toward active problem-solving strategies, though maladaptive coping styles were also present at moderate levels. The predominance of confrontation reflects a positive coping orientation, consistent with Barata et al. (2018) And Liu et al. (2021), who emphasized that active coping reduces anxiety, enhances quality of life, and improves adherence in KT populations. However, the presence of avoidance and resignation suggests that some patients still resort to maladaptive strategies under stress, particularly those with comorbidities or socioeconomic challenges.

Table 4: Level of Coping Style among Kidney Transplant Patients.

Variables	Mean	Standard Deviation
Confrontation	23.62	2.29
Avoidance	12.93	2.28
Acceptance-Resignation	12.09	1.78
Coping Total	48.64	3.74

Note. N=320.

This finding concurs with Watson's Theory of Human Caring emphasizes fostering hope and resilience, which can strengthen confrontation coping while mitigating avoidance and resignation. Orem's framework situates maladaptive coping as a form of self-care deficit that requires nursing intervention through counseling, peer support, and resilience-building programs.
For self-management, Table 5 shows the overall score as 49.20 ± 12.26, indicating a low level of self-management among KT recipients.

Among the domains, the highest mean scores were for Diet (16.38 ± 4.87) and Treatment Adherence (15.85 ± 4.30), while the lowest were for Activity (9.11 ± 2.70) and Social-Psychological Adjustment (7.87 ± 2.16). This suggests that patients are relatively better at dietary control and medication adherence but fall short in maintaining physical activity and psychosocial well-being. These findings are consistent with prior studies reporting low self-management in Chinese KT recipients, particularly in psychosocial and lifestyle domains (Xie et al., 2019; Yang et al., 2022). Similar global studies highlight that non-adherence to exercise and psychosocial self-care contributes significantly to graft loss and reduced quality of life (van Sandwijk et al., 2019). This underscores the importance of comprehensive interventions that go beyond medication management to include psychosocial support and rehabilitation programs.

Table 5: Level of Self-Management among Kidney Transplant Patients.

Variables	Mean	Standard Deviation
Diet	16.38	4.87
Treatment	15.85	4.30
Activity	9.11	2.70
Social psychology	7.87	2.16
Self-Management Total	49.20	12.26
Interpretation	Low Level of Self-management	

Note. N=320.

In Orem's model, the low self-management scores, especially in activity and psychosocial adjustment, represent clear self-care deficits. Nurses and caregivers must provide supportive systems that empower patients to gradually take responsibility for these aspects of care. From Watson's humanistic lens, the relational and emotional dimensions of care are crucial for motivating patients to engage in physical and psychosocial self-management, reinforcing the caring relationship as a vehicle for long-term adaptation.

4.3 Group Differences in Health Literacy, Disease Perception, Coping Styles, and Self-Management

For health literacy, only gender showed a statistically significant difference in health literacy ($U = 8193.000$, $z = –2.168$, $p = .030$) (see table 6). Female participants reported significantly lower health literacy scores than males. No significant differences were observed for age, organ donor source, comorbidity, employment, income, marital status, educational status, dialysis type, or transplant duration.

Table 6: Significant Difference in Health Literacy of Kidney Transplant Patients.

Variables	*U*	*z*	*p*
Gender	8193.000*	-2.168	.030
Age	12410.000	-0.471	.638
Organ donor source	7092.500	-1.386	.166
Comorbidity	12441.000	-0.261	.794
	*χ*2	*df*	*p*
Employment	0.051	2	.975
Family monthly income	1.552	2	.460
Marital status	1.759	2	.415
Educational status	3.176	3	.365
Type of dialysis pre-transplant	0.860	2	.651
Duration of post-kidney transplant	2.043	2	.360

Note. N=320. U = Mann–Whitney U test; χ^2 *= Kruskal–Wallis H test; df = degrees of freedom. *p < .05.*

This finding is consistent with prior studies reporting gender disparities in health literacy, where women tend to have lower scores, often linked to socioeconomic constraints and caregiving roles. (Jamieson et al., 2016; Sim et al., 2022). According to Orem, this represents a self-care deficit in specific subgroups (female recipients) that requires targeted educational and motivational support. From Watson's perspective, nurses should employ caring, empathic communication to empower women with confidence and agency in managing their condition.

For disease perception, Table 7 shows that there are NO statistically significant differences in disease perception observed across demographic or clinical variables (all $p > .05$). The uniformity of illness perception suggests that KT recipients, regardless of gender, age, or socioeconomic status, may share similar understandings of their disease. This aligns with studies indicating that post-transplant education and shared clinical experiences standardize illness beliefs. (Kalfoss et al., 2019). However, moderate perception levels (from Table 3) still signal a need for reinforcing accurate disease timelines and long-term risks. Both Watson's caring framework and Orem's deficit theory highlight that uniform but incomplete perceptions can be addressed through sustained education and relational support.

Table 7: Significant Difference in Disease Perception of Kidney Transplant Patients.

Variables	*U*	*z*	*p*
Gender	8890.500	-1.202	.230
Age	12193.500	-0.733	.464
Organ donor source	7037.500	-1.470	.142
Comorbidity	11303.500	-1.644	.100
	*χ*2	*df*	*p*
Employment	2.441	2	.295
Family monthly income	5.222	2	.073
Marital status	3.711	2	.156
Educational status	5.105	3	.164
Type of dialysis pre-transplant	0.679	2	.712
Duration of post-kidney transplant	1.081	2	.583

Note. N=320. U = Mann–Whitney U test; χ^2 *= Kruskal–Wallis H test; df = degrees of freedom.*

Table 8 shows that coping styles differed significantly by age ($U = 10986.500$, $z = –2.199$, $p = .028$), comorbidity ($U = 10986.000$, $z = –2.037$, $p = .042$), and employment ($\chi^2 = 6.060$, $df = 2$, $p = .048$). Post hoc (Table 9) revealed that participants receiving disability pension/retirement scored significantly lower in coping than unemployed patients ($p = .015$). No significant differences emerged between employed versus unemployed or employed as compared to the retired groups. The findings show that older patients and those with comorbidities exhibited less adaptive coping, consistent with Barata et al. (2018), who noted that health burdens can undermine resilience. The finding that retired/disability pension patients had weaker coping than unemployed patients highlights the psychological strain of long-term health limitations. Under Orem's theory, these groups represent populations with reduced coping resources, requiring compensatory nursing interventions. From Watson's lens, fostering hope, trust, and emotional support is particularly vital for older and chronically ill patients, helping them maintain confrontation coping and reduce resignation.

Table 8: Significant Difference in Coping Style of Kidney Transplant Patients.

Variables	*U*	*z*	*p*
Gender	9404.500	-0.491	.623
Age	10986.500*	-2.199	.028
Organ donor source	7886.500	-0.171	.864
Comorbidity	10986.000*	-2.037	.042
	$\chi 2$	*df*	*p*
Employment	6.060*	2	.048
Family monthly income	0.063	2	.969
Marital status	0.959	2	.619
Educational status	5.936	3	.115
Type of dialysis pre-transplant	0.084	2	.959
Duration of post-kidney transplant	4.213	2	.122

Note. N=320. U = Mann–Whitney U test; χ^2 *= Kruskal–Wallis H test; df = degrees of freedom.*p < .05.*

Table 9: Post hoc for Employment.

Employment	Test Statistic	Std. Error	Std. Test Statistic	*p*
Employed - Unemployed	-8.404	11.503	-0.731	.465
Employed - Disability pension/retiring	26.414	14.477	1.825	.068
Unemployed - Disability pension/retiring	34.818	14.246*	2.444	.015

For self-management, table 10 shows significant differences in self-management were found for gender ($U = 7971.000$, $z = –0.491$, $p = .013$) and marital status ($\chi^2 = 9.090$, $df = 2$, $p = .011$). Female patients reported significantly lower self-management compared to males. Post hoc analysis (table 11) showed that married participants had significantly higher self-management than widowed/divorced/separated patients ($p = .014$). The difference between married and single patients was marginal ($p = .057$). These findings mirror prior studies. (Xie et al., 2019; Yang et al., 2022) Showing that social support, particularly from a spouse, is strongly associated with better adherence and long-term adaptation. Female patients' lower self-management also corresponds with their lower health literacy (Table 6), suggesting compounded vulnerabilities. From Orem's theory, widowed/divorced/separated patients may experience significant self-care deficits due to diminished support systems, necessitating tailored nursing education and community assistance. Watson's caring framework reinforces the role of empathic, relationship-centered care to rebuild patients' sense of belonging and motivation for self-care.

Table 10: Significant Difference in Self-Management Behavior of Kidney Transplant Patients.

Variables	*U*	*z*	*p*
Gender	7971.000*	-0.491	.013
Age	11357.000	-1.744	.081
Organ donor source	7891.000	-0.164	.870
Comorbidity	11699.000	-1.163	.245
	$\chi 2$	*df*	*p*
Employment	0.531	2	.767
Family monthly income	3.265	2	.195
Marital status	9.090*	2	.011
Educational status	1.641	3	.650
Type of dialysis pre-transplant	1.646	2	.439
Duration of post-kidney transplant	3.567*	2	.168

Note. N=320. U = Mann–Whitney U test; χ^2 *= Kruskal–Wallis H test; df = degrees of freedom. *p < .05.*

Table 11: Post hoc for Marital Status.

Marital status	Test Statistic	Std. Error	Std. Test Statistic	*p*
Married - Widowed/divorced/ Separated	-57.019	23.100	-2.468	.014
Married - Single	-36.076	18.962	-1.902	.057
Widowed/divorced/ Separated - Single	20.943	28.835	0.726	.468

Taken together, these subgroup differences suggest culturally attuned targeting, such as literacy and empowerment supports for women, resilience-building for older/comorbid recipients, and relationship-centered outreach for widowed or divorced patients, to address specific self-care deficits.

4.4 Correlations among Key Variables

As shown in Table 12, significant correlations were observed among most of the study variables. Health literacy was negatively correlated with disease perception ($r = –.311$, $p < .001$) and positively correlated with self-management behavior ($r = .367$, $p < .001$). Disease perception was negatively associated with self-management behavior ($r = –.417$, $p < .001$). For coping style, no significant correlation was found with health literacy ($r = .069$, $p = .219$). However, coping style was negatively associated with disease perception ($r = –.146$, $p = .009$) and positively associated with self-management behavior ($r = .110$, $p = .048$).

The correlation results highlight the interrelated nature of literacy, perception, coping, and self-management in KT recipients. Higher health literacy was associated with lower illness burden perceptions and better self-management. This aligns with Demian et al. (2016) and Kugbey et al. (2019), who found that stronger health literacy improves adherence and patient activation. In this sample, patients who could access and communicate health information were more likely to sustain effective self-care behaviors. From Orem's perspective, low health literacy constitutes a self-care deficit requiring supportive education. Watson's theory reinforces that nurse–patient trust and caring dialogue are essential to motivate patients to apply health knowledge meaningfully.

For disease perception and self-management, the negative correlation indicates that patients who perceive their illness as severe and distressing are less likely to engage in self-management. This echoes Kalfoss et al. (2019), who showed that maladaptive illness beliefs undermine adherence. The finding underscores the importance of reshaping illness perceptions through psychosocial support, reframing illness not as an uncontrollable burden but as manageable with active participation. This resonates strongly with Watson's emphasis on humanistic care, which helps patients reinterpret their suffering, and Orem's approach, where nurses guide patients in redefining their capacity for control and adaptation.

While for coping style, although coping was not significantly correlated with health literacy, it was associated with lower illness perception and higher self-management. This suggests that positive coping functions as an adaptive buffer, enabling patients to reframe illness perceptions and sustain health behaviors. (Barata et al., 2018; Liu et al., 2021). Active coping may therefore mediate the effects of negative disease perception, strengthening resilience over time. Watson's caring theory directly supports the cultivation of hope and resilience as therapeutic strategies, while Orem's theory points to coaching and supportive interventions that build patients' coping capacity.

Table 12: Correlations among Key Variables.

Variables	*r*	*df*	*p*
health literacy and disease perception	-.311	318	< .001
health literacy and self-management behavior	.367	318	< .001
disease perception and self-management behavior	-.417	318	< .001
coping style and health literacy	.069	318	.219
coping style and disease perception	-.146	318	.009
coping style and self-management behavior	.110	318	.048

As a single-center cohort from an urban tertiary hospital in Shandong, the current study sample may differ from recipients in rural areas or other provinces with distinct reimbursement and follow-up infrastructures. Even so, the observed literacy–perception–coping–self-management links are theoretically grounded and consistent with international evidence, suggesting cautious applicability to other Chinese and global KT settings pending multi-site replication.

Emerging role of AI and tech-enabled care. Complementing our psychosocial findings, artificial intelligence (AI) tools are rapidly entering the KT pathway, such as from pre-transplant evaluation and donor acceptance to post-transplant surveillance. Machine-learning models can refine organ/donor to recipient matching and often outperform legacy indices for predicting who benefits from higher-risk organs, potentially lowering waitlist mortality. (Schwantes & Axelrod, 2021). After transplantation, AI has been applied to optimize immunosuppression dosing, detect rejection (radiology/pathology automation), predict early graft function, and monitor adherence via mobile/remote systems, enabling more personalized, proactive care. (Kotsifa & Mavroeidis, 2024; Seyahi & Ozcan, 2021). For the current context, these tools could target the weak links the study has pointed out, such as activity, psychosocial adjustment, and sustained follow-up. By pairing decision support with patient-facing apps and telehealth coaching. Yet real-world impact hinges on embedding AI at the point of decision and designing interfaces that are health-literacy–sensitive to avoid widening disparities (Kotsifa & Mavroeidis, 2024; Schwantes & Axelrod, 2021).

5. Conclusion

This study examined the interrelationships among health literacy, disease perception, coping styles, and self-management in Chinese kidney transplant recipients. The findings revealed that participants demonstrated moderate health literacy, with strengths in information access and communication but weaknesses in motivation and financial support. Disease perception was moderate, reflecting awareness of illness seriousness but some complacency toward long-term risks. Coping styles were dominated by confrontation, yet avoidance and resignation were also present. Importantly, self-management behaviors were generally low, particularly in physical activity and psychosocial adjustment. Gender differences emerged in health literacy and self-management, while age, comorbidity, and employment status influenced coping styles, and marital status was associated with self-management. Correlation analyses confirmed that higher health literacy and adaptive coping were linked to better self-management, whereas more negative disease perceptions were detrimental. These findings underscore the crucial role of psychosocial and behavioral determinants in shaping long-term transplant outcomes, extending the theoretical insights of Orem's Self-Care Deficit Nursing Theory and Watson's Theory of Human Caring.

Based on these findings, nursing practice should prioritize tailored interventions that strengthen health literacy, address illness perceptions, and cultivate adaptive coping. Structured patient education programs should move beyond information delivery to include motivational enhancement, empowerment strategies, and financial navigation support for economically disadvantaged patients. Psychosocial counseling and peer-support initiatives are recommended to reduce maladaptive illness perceptions and promote resilience, particularly among older patients, those with comorbidities, and widowed or divorced individuals who may lack strong social support. Clinical follow-up systems should be redesigned to sustain engagement beyond the first year post-transplant, incorporating regular monitoring of self-management behaviors in physical activity and psychosocial domains. At the policy level, social protection measures, including expanded reimbursement and employment reintegration programs, are essential to reduce socioeconomic barriers. Collectively, these recommendations highlight the need for integrated, patient-centered care models that combine clinical, educational, and social support dimensions. Looking forward, embedding telehealth, mobile adherence tools, and peer-support models into standard follow-up may address motivational and psychosocial gaps identified here. Multi-site longitudinal studies using Structural Equation Modeling which can test whether boosting health literacy and adaptive coping causally improve self-management and downstream clinical outcomes.

5.1 Limitations of the Study

Several limitations should be acknowledged. First, the cross-sectional, single-center study limits causal inference and external validity. Longitudinal or intervention-based studies are needed to clarify causal mechanisms. Second, data were based on self-report questionnaires, which may be subject to recall bias or social desirability bias. Third, the study was conducted at a single medical center in Shandong Province, potentially limiting the generalizability of findings to other regions in China or internationally. Finally, while the instruments used were validated, cultural nuances and individual differences in illness experience may not have been fully captured. Future research should employ multi-site designs, incorporate qualitative approaches, and test interventions guided by the theoretical frameworks of Orem and Watson to provide more comprehensive insights. Furthermore, additional future work should also incorporate repeated measures and linkage to clinical endpoints (e.g., rejection, readmissions) to reduce self-report bias. Designing the next phase around theory-driven mediation (e.g., literacy → perception/coping → self-management) and moderation (e.g., gender, marital status, donor source) will directly address these limitations.

Declaration of Generative AI and AI-assisted Technology Use in the Writing Process

The authors utilized Wordtune solely to improve the language and readability of this manuscript. All content was carefully reviewed and refined by the authors to ensure accuracy, and they accept full responsibility for the final published version.

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