Construction of a structural model of self-care behaviors based on diet-related life skills in patients with diabetes undergoing hemodialysis

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Abstract

Purpose: Protein-energy wasting frequently causes nutritional disorders in patients with diabetes undergoing hemodialysis, adversely affecting quality of life and outcomes. This study aimed to ide ntify factors influencing diet-related life skills and self-care behaviors in this population, guided by the PRECEDE-PROCEED model, and to develop and validate a structural model of self-care beha viors.

Participants and Methods: A cross-sectional survey was conducted among 174 patients with di abetes receiving hemodialysis (aged 50-89 years). Reliable scales assessed diet-related life skills, self-care behaviors, social support, dietary self-efficacy, and living environment. Structural equat ion modeling (SEM) evaluated model fit.

Results: The model demonstrated good fit (χ^2/df = 1.32, CFI = 0.993, RMSEA = 0.043). Diet-related life skills had the strongest direct effect on self-care behaviors (β = 0.377), surpassing so cial support (β = 0.234). An indirect effect through dietary self-efficacy (β = 0.120) was also obse rved.

Conclusions: Diet-related life skills were the primary determinant of self-care behaviors, emphasi zing the need for skill-based education to promote effective dietary self-management and improve quality of life in this vulnerable population.

Key Words

hemodialysis, diabetes mellitus, diet-related life skills, structural equation modeling, self-care

Introduction

The global prevalence of end-stage renal failure (ESRF) has been steadily increasing, exceeding 3.5 million cases by 2021 [1)]. Hemodialysis, a critical renal replacement therapy, plays a pivotal role in managing ESRF. However, patients undergoing dialysis are prone to nutritional disorders such as protein-energy-wasting (PEW), mineral bone disorders, and electrolyte imbalances [2-4)]. PEW is attributed to nutrient loss during dialysis and abnormal hypermetabolism [5)]. This condition often leads to insulin resistance and a persistent inflammatory response, which are common reactions in patients

undergoing dialysis [5].

This condition contributes to the depletion of muscle and adipose tissue [6], which significantly impacts patients' health, including reduced quality of life (QOL), increased osteoporosis, and heightened susceptibility to infection [4, 7, 8]. Patients undergoing hemodialysis who have diabetes experience a notable decline in muscle mass within the first year of dialysis initiation compared with those without diabetes [9, 10], and they are at greater risk of PEW than non-diabetic individuals undergoing hemodialysis [11] In this context, alongside blood glucose control, strengthening patients' ability to perform self-care and maintaining good nutritional status through diet are essential for sustaining their QOL [12, 13]. Thus, nutritional management is a crucial component of the hemodialysis treatment plan [14].

Lifestyle modification is central to chronic disease management [15], and self-management education has been shown to improve diabetes outcomes by enhancing patients' knowledge, skills, and behaviors [16–19]. Previous studies have demonstrated the correlation between protein intake and improved physical and mental QOL [20], highlighted the benefits of nutrition education programs on skills and health outcomes [21], and revealed improved electrolyte balance with better nutrition and self-care practices in patients undergoing dialysis [22]. Nevertheless, conventional education efforts have had limited impact on nutritional status in hemodialysis patients with diabetes [23], underscoring the need for more effective educational strategies.

To inform intervention development and better address the complex behavioral determinants of diet-related self-care, we used the PRECEDE–PROCEED model as a conceptual lens to classify candidate determinants into predisposing, enabling, and reinforcing factors [24, 25] and to guide the specification of hypothesized directional paths in the SEM.

Rather than serving as a comprehensive operational framework, the model informed the development of hypotheses about how these factors may interact. Building on these perspectives, particular attention was given to diet-related life skills—such as food selection, meal planning, and adherence to dietary recommendations—because these skills are hypothesized to be the foundational cognitive and practical abilities necessary to perform effective self-care behaviors. Furthermore, the model considers broader determinants of health behavior. Socioeconomic factors such as employment status are known to affect patients' access to resources and social support, which are critical for managing chronic illness [26, 27]. Likewise, psychosocial factors such as dietary self-efficacy are established as powerful proximal predictors of health behaviors [28]. Based on these findings, we constructed the conceptual framework shown in Figure 1. Although diet-related life skills are suggested to be correlated with improved self-care behaviors in dialysis patients with diabetes [29], the key factors that strengthen these behaviors and their interrelationships have not been sufficiently clarified.

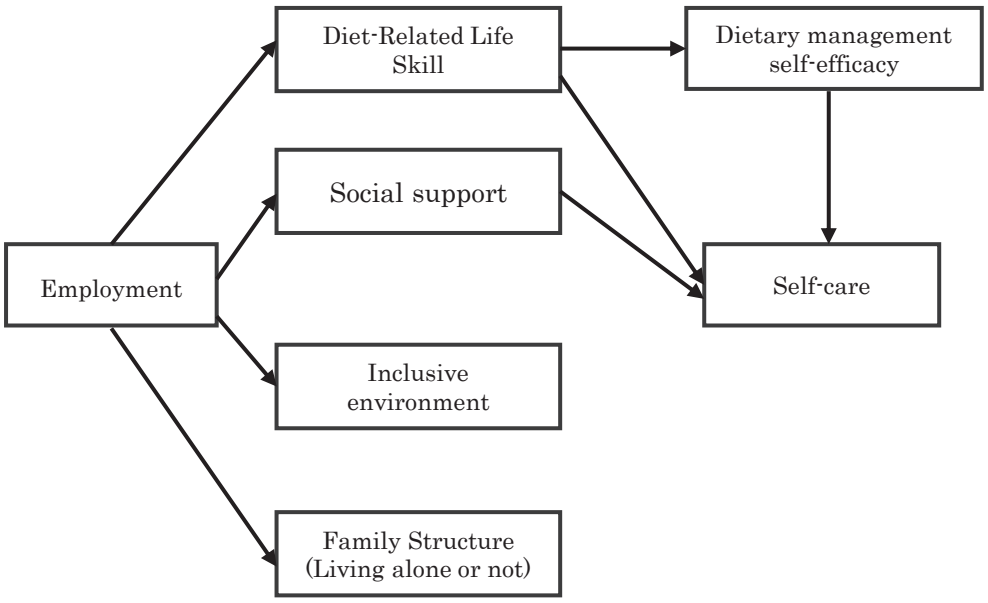
Consequently, healthcare providers face challenges in tailoring nutrition education to individual patients, and there is a lack of specific indicators to evaluate the effects of these interventions. This study, therefore, aimed to identify factors associated with diet-related life skills and self-care behaviors and to establish a self-care behavior structure model using structural equation modeling (SEM).

Materials and methods

Conceptual Framework (Figure 1)

The PRECEDE–PROCEED model, introduced by Green et al., provides a structured approach for organizing factors related to health behaviors into predisposing, enabling, and reinforcing components [30]. Using this perspective, Figure 1 presents our conceptual categorization of the study variables. Diet-related life skills and self-efficacy were categorized as predisposing factors. Inclusive envi-

Figure 1　Conceptual framework (hypothesized model) of this study



Using the PRECEDE–PROCEED model as a theoretical framework, this figure illustrates the hypothesized relationships among variables assumed to influence self-care behaviors. The arrows indicate the hypothesized directional paths based on prior research, which were subsequently operationalized and tested in the SEM.

ronment and employment status were categorized as enabling factors. Social support was categorized as a reinforcing factor. Figure 2 operationalizes this conceptual framework by specifying the corresponding hypothesized directional paths in the SEM and estimating them in the present cross-sectional dataset.

Participants

A cross-sectional survey was conducted between August 2022 and June 2023. Participants were recruited using a convenience sampling method from 24 hospitals (≥ 20 beds) and 11 clinics (<20 beds) across 11 prefectures in Japan. These institutions were those that consented to participate in the study.

The inclusion criteria were: (1) age between 50 and 89 years, (2) receiving hemodialysis for at least one year with a confirmed diagnosis of diabetic nephropathy, and (3) the ability to complete a self-administered questionnaire. The lower age limit of 50 years was adopted because previous studies on patients with hemodialysis have also evaluated frailty among this age group, providing a practical precedent for this cutoff [31].

Exclusion criteria included: the presence of serious medical complications (e.g., blindness, paralysis, cancer) that significantly affected physical or mental functioning, cognitive impairment that would interfere with questionnaire completion, or being deemed unsuitable for participation by the attending physician.

The questionnaires were completed independently by the participants, collected by facility staff, and then forwarded to the researchers for analysis.

Measurement of study variables

Survey Contents

Characteristics of study participants

Participants completed a self-administered questionnaire covering demographic and clinical characteristics (e.g., age, sex, dialysis duration, employment status, and cohabitation with family) and the following scales: (1) dietary management self-efficacy, (2) social support, (3) inclusive environment, (4) diet-related life skills, and (5) self-care behavior.

(1) Dietary management self-efficacy

Dietary management self-efficacy was assessed using the Dietary Management and Self-Efficacy Scale for Hemodialysis Patients [32]. This instrument has established reliability, criterion-related validity, and structural validity [31]. It consists of nine items rated on a 3-point Likert scale (0 = not confident to 2 = very secure). In this study, the Cronbach's alpha coefficient was 0.887.

(2) Social support

Social support was measured using the Social Support Scale for patients with chronic illness [31]. This scale has demonstrated reliability and structural validity and is widely used in research involving chronically ill populations. It includes 20 items—12 addressing daily emotional support and 8 related to illness-specific behavioral support—rated on a 4-point Likert scale (1 = not at all applicable to 4 = strongly applicable). Because dietary support is particularly important for hemodialysis patients, cohabitation status (with or without a roommate) was also included as a related variable. The Cronbach's alpha coefficient in this study was 0.965.

(3) Inclusive environment

The inclusive environment was evaluated using a Comprehensive Environmental Questionnaire for community-dwelling older adults with healthcare needs 32). This instrument has confirmed reliability, structural validity, and criterion-related validity. The questionnaire consists of 14 items addressing three domains: six items on a secure living environment, six on opportunities for social interaction, and two on family environment. Items are rated on a 4-point Likert scale (1 = not at all to 4 = sufficiently). The Cronbach's alpha coefficient in this study was 0.920.

(4) Diet-related life skills

Diet-related life skills were measured using the Diet-Related Life Skills Scale for dialysis patients with diabetes developed by the authors [29]. This scale has been reported to show reliability, content validity, structural validity, criterion-related validity, and known-group validity. It consists of 37 items assessing the extent to which patients utilize dietary life skills, rated on a 5-point Likert scale (1 = not at all applicable to 5 = very applicable). The scale comprises seven subdomains: (1) Dialogue to find the best diet for oneself, (2) Diet planning based on physical condition, (3) Self-analysis and self-adjustment to dietary therapy, (4) Trust and gratitude to those close to oneself, (5) Empathy for those with the same disease, (6) Thoughts on basic dietary therapy for renal protection, and (7) Readiness to continue with the diet therapy. Total scores were used in this study, with higher scores indicating greater diet-related life skills. In the present sample, the Cronbach's alpha coefficient for the total score was 0.946. The 37 items and their domain allocation are provided in Supplementary Table S1 to facilitate assessment of potential content overlap with related constructs.

(5) Self-care behavior

Self-care behavior was assessed using the Self-Care Scale for Hemodialysis Patients [33], which has established reliability, content validity, and structural validity. The scale comprises 13 items: nine items related to daily self-care and four items related to dietary self-care. Items are rated on a 5-point Likert scale (1 = not so to 5 = yes). The Cronbach's alpha coefficient in this study was 0.844.

Data Analysis

The data were analyzed in several steps using SPSS Statistics version 28 and SPSS Amos version 25 (IBM, Armonk, NY, USA). A p-value of less than .05 was considered statistically significant for all analyses.

First, descriptive statistics were calculated for all study variables. The normality of each variable's distribution was assessed using the Shapiro-Wilk test. For normally distributed continuous variables (e.g., age), means and standard deviations (SD) were reported. For ordinal scale variables and continuous variables that were not normally distributed, medians and interquartile ranges (IQRs) were used.

Second, to examine the direction and strength of the basic relationships between the observed variables before the primary analysis, Spearman's rank correlation coefficient was used. Furthermore, to confirm the construct validity of the 'Diet-Related Life Skills' scale as a multifaceted concept, correlations between its seven subscales and the total 'Self-care behavior' score were also examined.

Third, to explore group differences based on participant characteristics, the Mann–Whitney U test was employed for comparisons based on employment status.

Finally, to test the hypothesized relationships among the variables (Figure 1), SEM was performed. Model parameters were estimated using the Maximum Likelihood (ML) method. Although ML assumes multivariate normality, previous research indicates that ML parameter estimates remain robust even under moderate non-normality [34] and with 5-point Likert scales [35]. To further ensure the stability of the estimates and correct for potential bias in standard errors due to non-normality, we performed bootstrapping with 2,000 resamples [36]. We evaluated the significance of the paths using bias-corrected 95% confidence intervals (95% CI). The adequacy of the sample size was confirmed based on established guidelines, which recommend a minimum of 10 participants per observed variable [37, 38]. Model fit was assessed using multiple indices. Following the widely accepted cutoff criteria [39], a good model fit is indicated by a Comparative Fit Index (CFI) of 0.95 or greater and a Root Mean Square Error of Approximation (RMSEA) of 0.06 or less.

Ethical Considerations

Consent was obtained after explaining the purpose of the study in writing to the person in charge of the medical institution for this study. Through the person in charge of the medical institution, a document explaining the purpose and methods of the study, as well as the principles of freedom of cooperation, anonymity, and publication of the study results, was distributed to the participants. In addition, we sent a letter requesting collaboration, stating that the return of the questionnaire would be regarded as consent. This study was approved by the ethics review committee of Toyama Prefectural University (Approval No. Nursing R4-5).

Results

Characteristics of Participants（Table 1）

Questionnaires were distributed to 221 hemodialysis patients with diabetes, and 195 responses were collected (collection rate: 88.2%). After excluding incomplete responses, 174 questionnaires were retained for analysis (valid response rate: 89.2%). Table 1 summarizes the characteristics of the participants. The mean age was 65.0 ± 10.0 years, and the mean duration of dialysis was 68.0 ± 54.4 months. Of the participants, 53 (30.5%) were employed, and 139 (79.9%) lived with their families.

Table 1　Participants' attributes

Variable (years)	Mean±SD／n(%)
Age	65.0 ± 10.0
Hemodialysis duration （month）	68.0 ± 54.4
Gender	
Male	130（74.7%）
Female	40 （23.0%）
Unknown	4 （2.3%）
Employment	
Yes	53（30.5%）
No	102（58.6%）
Unknown	19（10.9%）
Family structure	
Living together	139（79.9%）
Living alone	35 (20.1%)

SD = standard deviation

Descriptive Statistics of Study Variables (Table 2)

Table 2 presents the descriptive statistics for each study variable, reported as medians with their corresponding interquartile ranges (IQR).

Among the key variables in our model, the median score was 119.00 (IQR: 106.00–131.00) for diet-related life skills, 8.00 (IQR: 5.00–9.25) for dietary management self-efficacy, and 50.00 (IQR: 46.00–55.00) for self-care behaviors.

Comparison of Scale Scores by Employment Status（Table 3）

As shown in Table 3, no statistically significant differences in scale scores were observed between employed and non-employed participants.

Correlations Among Study Variables (Table 4, 5)

As shown in Table 4, diet-related life skills showed moderate positive correlations with social support (r =.423, p <.01), self-efficacy (r =.491, p <.01), inclusive environment (r=.354, p<.01), and a strong correlation with self-care behaviors (r =.614, p <.01). As detailed in Table 5, all seven subscales of diet-related life skills were significantly and positively correlated with total self-care behavior scores, with correlation coefficients (r) ranging from .351 to .543 (all p < .01).

Validation of the Hypothetical Model (Figure 2)

The final model demonstrated an excellent fit to the data: χ^2 (7) = 9.264, p = .254, CFI = 0.993, and RMSEA = 0.043. As shown in Figure 2, diet-related

Table 2　Distribution of observation variables in study participants（N=174）

Scale	Median [IQR]
Dietary management self-efficacy	8.00 [5.00–9.25]
Social support	60.00 [50.00–71.00]
Diet-related life skills	119.00 [106.00–131.00]
Inclusive environment	40.00 [35.00–44.00]
Self-Care Scale for Hemodialysis Patients	50.00 [46.00–55.00]

Table 3　Comparison of scale scores by employment status（N=155）(N=174)

Scale	Employed（n=53）	Non-Employed（n=102）	p-value
Dietary management self-efficacy	8 [4.50–10.00]	8.00 [4.00–10.00]	0.541
Social support	63.00 [51.50–75.00]	59.00 [52.00–69.75]	0.544
Diet-related life skills	120.00 [104.00–132.50]	118.00 [106.00–129.75]	0.608
Inclusive environment	42.00 [37.00–47.00]	40.00 [33.00–43.75]	0.203
Self-Care Scale for Hemodialysis Patients	50.00 [44.00–55.00]	51.00 [46.00–55.00]	0.550

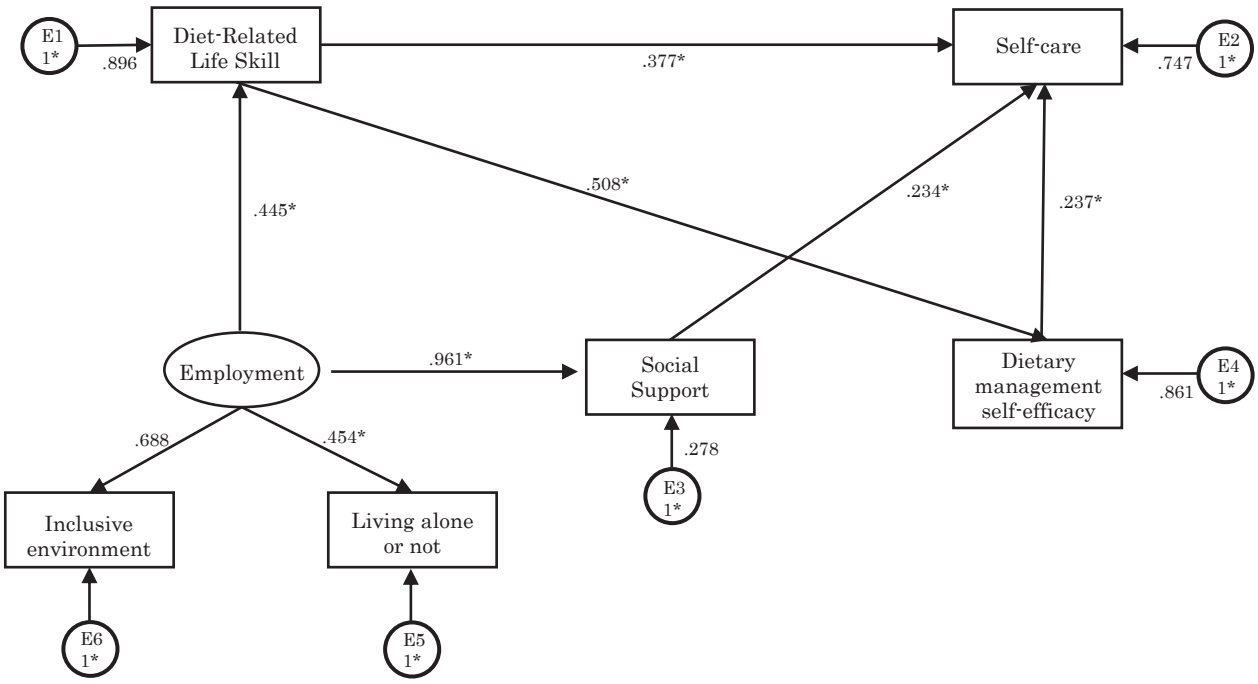
Table 4　Correlations among observable variables（N=174）

Criterion　Scale	Dietary management self-efficacy	Social Support	Diet-related life skills	Inclusive Environment
Dietary management self-efficacy				
Social Support	0.319**			
Diet-related life skills	0.491**	0.423**		
Inclusive Environment	0.305**	0.654**	0.354**	
Self-Care Scale for Hemodialysis Patients	0.506**	0.496**	0.614**	0.403**

Table 5　Correlation of each life skill subscale total score with self-care total score（N=174）

Life Skills Subscale	r
Dialogue to find the best diet for oneself	.416**
Diet planning based on one's own physical condition	.417**
Self-analysis and self-adjustment to diet therapy	.418**
Trust and gratitude to those close to oneself	.419**
Empathy for those with the same disease	.420**
Thoughts on basic dietary therapy for renal protectic	.421**
Readiness to continue with the diet therapy	.422**

Figure 2　Final Structural Equation Model of Self-Care Behaviors



The model demonstrates a good fit to the data. Standardized path coefficients are shown. All paths were statistically significant ($p < .05$), as confirmed by bias-corrected 95% confidence intervals from 2,000 bootstrap resamples excluding zero.
Model fit indices: $\chi^2(7) = 9.264$, $p = .254$; CFI = 0.993; RMSEA = 0.043.
Note: E1–E6 indicate error terms (disturbances) for endogenous variables. "1*" indicates a factor loading fixed to 1.0 (marker indicator) for model identification and to set the scale of the latent variable.

Supplementary Table S1
Diet-related Life Skills Assessment Scale for Dialysis Patients with Diabetes

Item number	Item content
Factor1	
Dialogue to find the best diet for oneself	I discuss my diet with my healthcare provider until I am satisfied with it.
	I talk to my heathcare provider about the information I have learned from TV, newspapers, magazines, or the Internet.
	I communicate my diatary needs to my healthcare provider.
	I choose medical personnel who can provide useful information and talk to them myself.
	When the diet is not working, I ask for help from the medical staff myself.
	I discuss blood suger levels and diet with other dialysis patiants with diabetes.
	I tell the people around me that I am on a diet.
Factor2	
Diet planning based on one's own physical condition	I talk the right amount of calories for my body.
	I eat the right amount of protein for my body.
	I make a diet plan to keep my blood sugar level good
	I make my own dicisions about my own diet rather than leaving it to a medical professional.
	I make a plan for a better diet based on my blood test result.
	I make diet plans to manage my physical deconditioning.
	I have a specific plan for meal times and meal contents to avoid hypoglycemia symptoms.
Factor3	
Self-analysis and self-adjustment to diet therapy	I clarify whether the information I have obtained about diet and nutrition applies to me.
	When I find the diet difficult, I clarify what is difficult about it.
	When I eat less, I identify the cause of this behavior.
	I wonder if there is betterway to diet.
	When hypoglycemia occurs, I identify the cause according to my blood suger levels and diet.
	When I gain too much weight, I look back at my diet identify the cause.
	I analyze whether the information I receive about diet and nutrition is reliable.
	If the diet does not work, I plan to adjust with exercise and other foods.
	I keep track of my weight, blood sugar, and other results.
Factor4	
Trust and gratitude to those close to oneself	If I can not do it myself, I ask for help from my family.
	I am on a diet, and I owe it to my healthcare provider and my family.
	I show gratitude and appreciation to my family members for the diet.
Factor5	
Empathy for those with the same disease	I am interested in changes in the physical condition and behavior of other dialysis patients.
	When I hear other dialysis patients talking to their healthcare providers, I feel like I can relate to them.
	Whenever I see a dialysis patiant who is having trouble eating, I think about it with them.
Factor6	
Thoughts on basic dietary therapy for renal protection	I think about the effects of phosphorus and potassium on my body.
	I think about the effects of salt on my body.
	I think about the effects of water on my body.
Factor7	
Readiness to continue with the diet therapy	I believe that being familiar with food preparation and seasoning is necessary for treatment.
	I am positive about changing my diet from diabetic diet to dialysis diet.
	I am detamined to make my diet therapy a lifelong job.
	I try to distract myself with other things to avoid focusing on my diet.
	I take care to maintain good relationships with medical personnal and other dialysis patients.

critical information analysis in self-management for these patients.

Regarding the descriptive statistics (Table 2), participants in this cohort of hemodialysis patients with diabetes showed moderate-to-high levels of diet-related life skills, self-efficacy, and self-care behavior. This may reflect selection factors (e.g., respondents capable of completing questionnaires) and the context of hemodialysis care, where patients have frequent contact with healthcare professionals and repeated opportunities for education and feedback [22, 23]. In non-dialysis populations with type 2 diabetes, dietary and exercise self-care behaviors are often challenging to maintain over time [12];

thus, the regularity of dialysis care and repeated professional contact may help support certain self-care practices. Nevertheless, because different instruments are used across studies, direct numerical comparisons should be interpreted cautiously. Furthermore, direct comparisons with non-dialysis diabetic patients are complicated by distinct clinical and psychosocial challenges. A recent study highlighted that while high intake of fruits and whole grains is recommended to prevent progression of diabetic kidney disease [41], hemodialysis patients must strictly restrict these foods to prevent hyperkalemia and hyperphosphatemia. This creates a "therapeutic conflict" where adherence to one guideline violates another [42]. Additionally, qualitative research reveals that hemodialysis patients experience a unique "disruption to normal life" caused by these severe dietary restrictions, which fundamentally differs from the experience of pre-dialysis patients [43]. Given these qualitative differences and the need for dialysis-specific measurement scales [44], we focused on exploring the internal associations within this population rather than performing direct numerical comparisons with non-dialysis groups.

In our path model, diet-related life skills showed the strongest association with self-care behavior, suggesting the potential clinical importance of strengthening diet-related skills in hemodialysis patients with diabetes. Previous studies have highlighted the importance of social support and self-efficacy for self-management and self-care [14, 45–47]; our findings add that diet-related life skills may represent a particularly proximal correlate of self-care behavior in this population.

Additionally, while previous studies [14, 45, 48] emphasized the importance of social support and self-efficacy in relation to self-care, our findings suggest that diet-related life skills were more strongly associated with self-care behaviors than social support or self-efficacy alone. Social support represents external assistance from health professionals, family, and friends [18, 49], whereas diet-related life skills reflect adaptive behaviors that patients acquire and apply to manage their diet in daily life [50]. Indeed, interventions focusing on life skills training based on self-care have been shown to significantly enhance quality of life and mental health in vulnerable populations [51]. For hemodialysis patients with diabetes, acquiring practical knowledge and skills may therefore be closely linked to better self-care than relying solely on external support or self-efficacy. This perspective aligns with Orem's theory, which views self-care as an acquired skill that can be learned even by individuals with chronic diseases or disabilities [52].

Self-efficacy is widely recognized as an important correlate of chronic disease self-management [53–55]. In our model, self-efficacy may represent a pathway linking diet-related life skills to self-care behavior, although the present cross-sectional data do not allow causal interpretation.

Although employment status was included in our initial conceptual framework (Figure 1) as a potential enabling factor, it was excluded from the final SEM (Figure 2) to present a more parsimonious model, given the lack of significant differences in the initial bivariate analysis (Table 3). This lack of significant association contrasts with some findings from the DOPPS program [56]. This discrepancy may partly reflect the low employment rates and reduced physical activity levels, specifically among hemodialysis patients with diabetes [57]. Overall, our findings suggest that psychosocial factors captured by life skills, self-efficacy, and supportive environments may be more proximal and informative targets for supporting self-care than employment status per se in this population.

Several limitations should be acknowledged. First, the cross-sectional design precludes causal inference; the SEM results represent hypothesized associations rather than effects over time. Second, although age, dialysis duration, and comorbid conditions may influence self-care behavior, we did not

include these potential confounders in the SEM to maintain parsimony, given the sample size [58] and to focus on psychosocial factors, future studies should test expanded models that adjust for clinical and socioeconomic covariates. Third, the sample was recruited from a limited number of facilities, and participants who were unable to complete questionnaires independently may have been underrepresented, thereby limiting generalizability. Fourth, all variables were assessed by self-report at a single time point; therefore, common method variance and partial content overlap across scales cannot be ruled out (see Supplementary Table S1), which may have inflated the observed correlations and path estimates.

Future research should investigate educational interventions specifically targeting diet-related life skills, evaluate their impact on self-care behaviors and related health outcomes, and explore how such interventions can be effectively integrated into routine patient care. Additionally, longitudinal studies are needed to clarify causal relationships and assess the long-term effects of life-skills-based interventions.

Conclusion

This study developed and tested a structural model that identifies key psychosocial factors associated with self-care behavior in hemodialysis patients with undergoing diabetes. Our findings suggest that diet-related life skills, together with self-efficacy and the social/contextual environment, are relevant targets to consider when designing educational approaches for dietary self-management in this population.

Conflict of interest

There are no conflicts of interest in this study.

Author Contributions

Study design: H.H., Y.M., and R.K.
Data collection: H.H. and Y.M.
Data analysis: H.H. and R.K.
Manuscript writing: H.H.
Final approval: H.H., Y.M., and R.K.

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糖尿病透析患者における食事関連ライフスキルに基づくセルフケア行動構造モデルの構築

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要　旨

目的：糖尿病透析患者の栄養障害は生活の質に影響する．本研究は，PRECEDE-PROCEED モデルを枠組みに，食事関連ライフスキルとセルフケア行動の関連要因を特定し，構造モデルを構築・検証することを目的とした．

対象者および方法：50 ～ 89 歳の糖尿病透析患者 174 名に，食事関連ライフスキル，セルフケア行動，ソーシャルサポート，自己効力感，生活環境を尺度評価し，仮説モデルを構造方程式モデリングで検証した．

結果：モデル適合度は良好（χ^2/df = 1.32, CFI = 0.993, RMSEA = 0.043）であった．食事関連ライフスキルは，セルフケアへソーシャルサポート（β = 0.234）を上回る最も強い直接効果（β = 0.377）を示し，自己効力感を介した間接効果（β = 0.120）も認めた．

結論：食事関連ライフスキルはセルフケアの最も強い規定要因であり，スキルに基づく教育が重要であることが示唆された．

キーワード

血液透析，糖尿病，食事関連ライフスキル，構造方程式モデリング，セルフケア