



# Implications on self-care behaviors among older Korean immigrants diagnosed with diabetes residing in the United States: a path analytical approach

Jung Eun Kim<sup>1</sup> · Ying Hong Jiang<sup>2</sup> · Vivien Dee<sup>3</sup>

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## Abstract

**Background** Diabetes is a prevalent chronic disease. Although self-care is the crucial element in managing diabetes, older Korean immigrants with diabetes face challenges in performing effective self-care related to vulnerability as minority immigrants.

**Purpose** This study measures sociodemographics, self-efficacy, social support, diabetes knowledge, and diabetes self-care activities among older Korean immigrants in the United States. This study also aims to demonstrate the direct and indirect effects of the related factors on diabetes self-care activities using a path analysis.

**Methods** This study uses a cross-sectional design. Convenience sampling targeted Korean immigrants aged 55 or older using paper and online surveys. Four instruments were used to measure variables: self-efficacy was measured by the General Self-Efficacy scale, diabetes knowledge by the Simplified Diabetes Knowledge Test, social support by the Lubben Social Network Scale-6, and diabetes self-care by the Summary of Diabetes Self-Care Activities questionnaire. Using path analysis, the effects of related factors on self-care activities were analyzed.

**Results** 190 older Korean immigrants participated, 53.2% female, and 46.8% male. The mean age was 67.2 (SD=9.9; range, 58–93). A path model shows that sociodemographics (sex, age, education, and years in the United States), diabetes knowledge, self-efficacy, and family support predict diabetes self-care.

**Conclusions** The path model demonstrates the effects of sociodemographics, self-efficacy, diabetes knowledge, and social support on diabetes self-care among older Korean immigrants. The findings can help to understand diabetes self-care among the minority ethnic older group and can be used to develop culturally tailored education, counseling, and healthcare services.

**Keywords** Self-care · Diabetes mellitus · Emigrants or immigrants · Social support

## Background

In the past two decades, the number of adults diagnosed with diabetes has more than doubled, and 48.8% of adults aged 65 and older have prediabetes [1]. Due to the maturing of the population as a whole and the increase in life expectancy, diabetes is increasingly becoming a disease of older adults [2]. Diabetes is the most cost consuming chronic illness in the United States [3]. Among Medicare beneficiaries 65 and older with type 2 diabetes, complications are costly and vary by condition [3]. In 2017, the total cost of complications related to diabetes in this population exceeded \$37 billion. The most prevalent complications were kidney disease, cardiac failure, and stroke [3]. These three conditions accounted for approximately 50% of total costs [3].

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✉ Jung Eun Kim  
jkim133@ilstu.edu

Ying Hong Jiang  
yjiang@apu.edu

Vivien Dee  
vdee@apu.edu

<sup>1</sup> Mennonite College of Nursing, Illinois State University, Normal, IL, United States

<sup>2</sup> School of Education, Azusa Pacific University, Azusa, CA, United States

<sup>3</sup> School of Nursing, Azusa Pacific University, Azusa, CA, United States

Individuals with type 2 diabetes who are older tend to have more complications, and they face unique challenges throughout the self-management process [4]. They are more likely to suffer from numerous chronic conditions, including diabetes, physical and functional impairments, cognitive decline, and memory loss [4]. The management of diabetes in older adults presents a multifaceted challenge due to their functional disabilities (e.g., mobility, eating, personal hygiene) and comorbidities (e.g., cardiovascular disease, visual impairment, arthritis; [5]. Older adults with diabetes are a vulnerable population due to their diminished physical function, which negatively affects their ability to perform daily tasks and engage in physical activities [6]. Effective self-care for older individuals with diabetes is the most important factor in preserving optimal health and preventing future complications, and it is required throughout life. However, self-care activities can be complex, involving multiple tasks such as medication management, diet control, blood sugar monitoring, and ongoing medical visits [7]. These numerous tasks can be difficult, particularly for older patients [7]. Inadequate self-care can result in acute and long-term consequences, including skin and eye complications, neuropathy, functional disability, and even death [8]. In other words, older patients have a higher risk of complications than younger patients [8].

Previous literature reported various related factors to self-care among older adults with diabetes. Income has a significant relationship with special diet for older adults with diabetes with low income, and marital status is a significant factor on blood sugar testing [9]. Those who were married or living with a partner monitored blood glucose more frequently than those who were divorced or separated [9]. However, living alone can serve as a protective factor in diabetes self-care and a motivating factor in the pursuit of diabetes-related information to enhance autonomy, independence, and functionality maintenance [10]. Age, sex, and longest occupation worked were significantly associated with various types of diabetes self-care [11]. Older and longer-working older adults were more likely to perform self-care activities, and male patients consumed a healthier diet each week compared to female patients [11]. A higher level of education was frequently associated with a reduced risk of developing diabetes and may be directly correlated with the ability to obtain and utilize health services and information [10]. Self-efficacy was also one of the significant factors showing that integrating the concept of self-efficacy into the diabetes intervention program enhanced adherence to foot care activities for adults with diabetes [12].

There are numerous ethnic immigrant groups in the United States, with Korean immigrants representing a minority group. According to the Migration Information Source [13], 16% of all Korean immigrants are over 65 years old,

which is greater than the percentage of U.S. population that is composed of immigrants (14%). Additionally, the Korean immigrant population in the United States is aging faster than any other ethnic group [13]. The majority of senior Korean immigrants are monolingual, and more than 70% of them report having difficulty understanding medical terminology and utilizing translated informational materials [14]. Compared to younger Korean immigrants, senior Korean immigrants face greater difficulties in diabetes management due to their advanced age, limited language proficiency, and restricted access to health care services [15]. With limited access to insurance, lack of self-care, lack of routine check-ups, inadequate treatment [16], and a lack of social support, it is more difficult for older Korean immigrants to perform self-care activities for the management of type 2 diabetes.

Self-care is crucial for maintaining optimal health and preventing further complications in diabetes [8]. The objective of self-care activities in the management of diabetes is to prevent the deterioration of the disease and its complications and to maintain patients' optimal health status [17, 18]. To reach this objective, it is essential that older patients with diabetes not only receive adequate health care services from medical institutions but also engage in effective self-care activities, such as diet control, exercise, stress management, and medication use to prevent or manage type 2 diabetes [19].

Despite the increasing prevalence of diabetes among older Korean immigrants and the importance of self-care in maintaining optimal health, few studies have been conducted on self-care practices among older Korean immigrants with diabetes. Notably, to our knowledge, this study is the first study to measure diabetes self-care activities using the Summary Diabetes Self-Care Activities (SDSCA) questionnaire for older Korean immigrants and analyze the related factors using path analysis. It is essential to investigate related factors and to examine the relationships and effects among these factors that may impact self-care; findings can be used to develop culturally tailored strategies to improve self-care among older Korean immigrants with diabetes.

This study aims to identify sociodemographic characteristics, the level of self-efficacy, social support, diabetes knowledge, and self-care activities among older Korean immigrants with diabetes in the United States and investigate the direct and indirect effects among related variables on self-care activities among them.

## Theoretical framework

Orem's self-care deficit nursing theory (SCDNT) guided this study to explain the key concepts of self-care. Orem's theory has been one of the most widely employed theories

that provide clinical guidelines for planning and implementing self-care. Orem believed that humans have the capacity to care for themselves and that nurses can assist patients in regaining this capacity by providing direct care and compensatory educational assistance [20]. The self-care framework of Orem comprises six fundamental concepts: self-care, self-care agency, therapeutic self-care demand, self-care deficit, nursing agency, and nursing system. Self-care, self-care agency, self-care demand, and self-care deficit pertain to patients or individuals who require nursing care. Alternatively, nursing agencies and nursing systems are associated with nurses and their practice. Within the set of patient concepts, basic conditioning factors impact self-care agency and self-care demand. Age, gender, developmental state, health state, sociocultural orientation, health care system factors, family system factors, living pattern, environmental factors, and resource availability and adequacy are the basic conditioning factors.

## Methods

### Study design and participants

This study used a cross-sectional design and a convenience sampling method. Inclusion criteria for participants were being aged 55 or older Korean immigrants who stayed in the U.S. and were born in Korea, diagnosed with diabetes, able to read and write in Korean or English, and willing to sign a consent form to participate in the study.

### Data collection

After receiving IRB approval from Azusa Pacific University (IRB approval ID number: 20–342), data collection commenced. The data were collected from October 3, 2020, to June 30, 2021.

The study included both a paper survey and an online survey. For the paper survey, the principal investigator contacted responsible parties of Korean immigrant community churches and a shopping mall in Southern California and obtained permission from the agencies. To collect data, recruitment flyers were posted in agency buildings. The recruitment flyers for the paper survey were written in both Korean and English and contained the primary investigator's contact information. On the flyer, the purpose, benefits, and risks of participation were detailed. The primary investigator screened potential participants for study eligibility, and those eligible completed the paper survey after signing a consent form.

SurveyMonkey was used as the online platform for the online survey. The SurveyMonkey link was posted on social

networking sites such as Instagram, Facebook, Twitter, and internet communities for Korean immigrants. A consent form was displayed on the first page of the online survey. The consent form detailed the purpose of the study, the benefits and risks of participation, the importance of confidentiality, and the primary investigator's contact information. Participants provided their consent by clicking the informed consent form.

### Data analysis

The Statistical Package for the Social Sciences (SPSS) 26 version was used for data analysis. First, sociodemographic characteristics were analyzed using percentages, frequencies, and descriptive statistics. The levels of self-efficacy, diabetic knowledge, social support, and self-care activities were presented by descriptive statistics. Secondly, the Cronbach's alpha was used for measuring the reliabilities and exploratory factor analysis was used to identify observable constructs in the instruments. Finally, a path analysis was conducted to examine the direct and indirect effects among 10 exogenous and five endogenous variables. Path analysis is based on simple regression techniques, examining the causal or influential relationships between variables [21]. The standardized ( $\beta$ : beta) regression coefficient represents the magnitude of the influence of one variable on another in the path model. The standardized coefficients indicate which independent variables have the greatest direct effect on the dependent variables. Additionally, the model used maximum likelihood estimation with LISREL® (version 11 [22]) based on the covariance.

### Measures

The authors created the demographic checklist and included questions about sex, age, marital status, living arrangement, education level, employment, annual income, health insurance status, religion, years of U.S. residence, and diabetes status.

The level of self-efficacy was measured using the English and Korean versions of the General Self-Efficacy Scale [23]. The GSE scale was developed to measure general self-efficacy and self-beliefs regarding managing stressful life events. Each of the 10 items on the GSE scale has four possible responses. A typical question is, "If I try hard enough, I can always solve difficult problems." There are four possible answers: "not at all" (1 point), "barely true" (2 points), "moderately true" (3 points), and "exactly true" (4 points). The total sum score ranges from 10 to 40, with higher scores indicating greater self-efficacy. In this study, the Cronbach's alpha coefficient of the GSE scale was 0.82.

Diabetes knowledge was measured by the Simplified Diabetes Knowledge Test (S-DKT). The S-DKT was developed by Fitzgerald and colleagues [24] and consists of 20 “true or false” questions. For participants who could only read Korean, this study translated the S-DKT from English to Korean based on World Health Organization guidelines. The Korean version of the S-DKT was validated for reliability and validity. The Cronbach’s alpha of the S-DKT in this study was 0.70.

The Lubben Social Network Scale-6 quantified social support [25]. According to Lubben [26], social networks change with age. Based on the Berkman-Syme Social Network Index [27], Lubben [26] created the first version of the LSNS to evaluate social networks among senior citizens. It contained 10 items. Nonetheless, Lubben and Gironda [25] later developed a standardized, abbreviated version of the LSNS, named the LSNS-6, comprising six items. There are two subscales on the LSNS-6: family and friends. The family subscale consists of three questions regarding families, including relatives. The friend subscale is also derived from the three friend-related questions. According to Lubben and colleagues [28], socially isolated individuals score less than 12. Each item is weighted equally, and the total score ranges from 0 to 30. The LSNS-6 Korean version validated by Hong et al. [29] was utilized for participants who could only read Korean. In this study, the Cronbach’s alpha for the LSNS-6 was 0.83.

The Summary of Diabetes Self-Care Activities questionnaire was utilized to assess self-care activities. The Summary of Diabetes Self-Care Activities (SDSCA) is the most popular and widely used for diverse populations [30]. The SDSCA evaluates five types of self-care activities with 11 items: general diet, specific diet, physical activity, medication taking, and blood-glucose monitoring [31]. Each of the five activities receives a calculated score. For items 1 to 10, use a scale from 0 to 7 for the number of days per week. General diet comprises items 1 and 2; special diet, items 3 and 4; exercise, items 5 and 6; blood glucose testing, items 7 and 8; foot care, items 9 and 10; and smoking status, item 11. To evaluate the overall diet, the average number of days for items 1 and 2 is utilized. Similarly, special diet, exercise, and blood glucose testing were calculated using the average number of days. Only for item 4 is reversing needed. The number of cigarettes smoked per day determines a person’s smoking status, item 11. Participants who spoke only Korean were administered the SDSCA Korean version [32]. The Cronbach’s alpha for the SDSCA in this study was 0.77.

## Results

### Sociodemographic characteristics

The sociodemographic characteristics are presented in Table 1.

The total number of participants who met all inclusion criteria following the exclusion of participants with incomplete data was 190; 53.2% of participants were female, and 46.8% of participants who were male. In addition, 49.4% of the 190 participants were between the ages of 55 and 64, while 50.6% were at least 65. The participants’ median age was 67.2 (SD=9.9; range, 58–93). 70% of participants were married. Twenty-six (13.7%) and 26 (13.7%) participants were bereaved and divorced, respectively. Among the 190 participants, 144 (75.8%) lived with family or relatives, 42 (22.1%) lived alone, and three (1.6%) lived with non-family or friends.

The majority of participants (46.8%) held at least a bachelor’s degree. Only 16 participants (8.4%) did not possess a high school diploma. In addition, 53.2% of respondents (101) were unemployed, while 46.8% were employed. The annual income of 81 participants (42.7%) was less than \$30,000, while the annual income of 32 participants (16.9%) fell between \$30,000 and \$50,000. Seventy-seven participants (40.6%) reported a yearly income greater than \$50,000. Among the 190 participants, 103 (54.2%) were covered by Medicare or Medi-Cal, while 17 (8.9%) were uninsured. The majority of participants were Christian (83.2%). Only six participants (3.2%) had resided in the country for fewer than 10 years.

### Mean score of Self-Efficacy, Diabetes Knowledge, Social Support, and self-care activities

The mean scores of self-efficacy, diabetes knowledge, social support, and self-care activities are presented in Table 2. The mean total self-efficacy score, diabetes knowledge, and social support were 29.7 out of 40 (SD=3.7, range 19–40), 59 out of 100 (SD=16.3, range 10–95), and 13.8 out of 30 (SD=5.6, range 0–29). The mean days of general diet, special diet, exercise, blood glucose test, and foot care were 3.9 days, 3.2 days, 3.2 days, 3.1 days, and 1.8 days out of 7 days.

### Reliabilities of the instruments

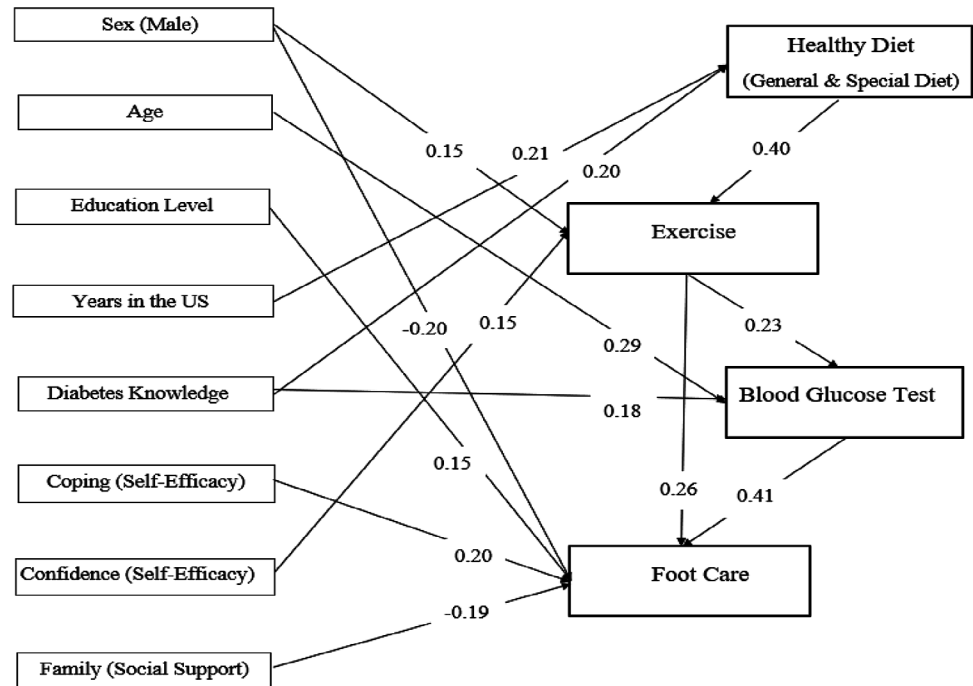
The Cronbach’s alpha of the General Self-Efficacy scale, the Simplified Diabetes Knowledge Test, the Lubben Social Network Scale-6, and the Summary of Diabetes Self-Care Activities questionnaire was 0.82, 0.70, 0.83, and 0.77, respectively, as shown in Table 2. Also, throughout the

**Table 1** Sociodemographic characteristics (n = 190)

Variables	Response	Frequency	Percentage (%)
Gender	Male	89	46.8
	Female	101	53.2
	Total (n)	190	100.0
Age in years	55–59	47	24.7
	60–64	47	24.7
	65–69	33	27.4
	70–74	17	8.9
	75–79	15	7.9
	80–84	17	8.9
	85+	14	7.4
Marital status	Never married	1	0.5
	Married	133	70.0
	Separated	4	2.1
	Divorced	26	13.7
	Widow	26	13.7
Living arrangement	Living in facilities	1	0.5
	Living alone	42	22.1
	Living with family/relatives	144	75.8
	Living with nonfamily/friends	3	1.6
Education level	Less than high school graduate	16	8.4
	High school graduate	35	18.4
	College or associate's degree	50	26.3
	Bachelor degree or higher	89	46.8
Employment status	Employed	89	46.8
	Unemployed	101	53.2
Annual income	Less than 10k	23	12.1
	10k-19,999	44	23.2
	20k-29,999	14	7.4
	30k-39,999	18	9.5
	40k-49,999	14	7.4
	50k-59,999	17	8.9
	60k-69,999	10	5.3
	70k-79,999	10	5.3
	80k-89,999	6	3.2
	90k-99,999	5	2.6
Health insurance status	More than 100k	29	15.3
	Medicare	49	25.8
	Medi-Cal	54	28.4
	Private insurance	70	36.8
Religion	Uninsured	17	8.9
	Christianity	158	83.2
	Buddhist	2	1.1
	Islam	0	0.0
	Hinduism	0	0.0
	Other	2	1.1
	None	28	14.7
Years of residency in the US	Less than 10 years	6	3.2
	10–19	27	14.2
	20–29	53	27.9
	30–39	52	27.4
	40–49	39	20.5
	50–59	12	6.3
	More than 60 years	1	0.5
Diagnosis of Diabetes	Yes	190	100.0
	No	0	0

**Table 2** Mean score of self-efficacy, diabetes knowledge, social support, and self-care activity

Latent variable	Observable variable	Measurement	Cronbach's alpha	Mean/Total	SD	Range
Self-Efficacy	Coping	The GSE scale	0.82	29.7/40	3.7	19–40
	Confidence					
Diabetes Knowledge	Diabetes knowledge	S-DKT	0.70	59/100	16.3	10–95
Social Support	Family support	The LSNS-6	0.83	13.8/30	5.6	0–29
	Friends support					
Self-Care Activity	General diet	SDSCA	0.77	3.9/7	1.9	0–7
	Special diet			3.2/7	1.4	0–7
	Exercise			3.2/7	2.2	0–7
	Blood glucose test			3.1/7	2.8	0–7
	Foot care			1.8/7	2.2	0–7

**Fig. 1** Path model for self-care activities among older Korean immigrants with diabetes. *Note:* All paths are significant at the  $p < .05$  level. The coefficients between the variables are the standardized beta coefficients

exploratory factor analysis, the sub-constructs (observable variables) of the instruments were identified as shown in Table 2. The relationships among the observable variables were depicted in Fig. 1 with the path coefficients, which is the standardized (beta) regression coefficients.

### Path analysis

The path model provided an excellent fit to the data ( $\chi^2(46) = 57.26$ ,  $p = .12$ ),  $\chi^2/df$  ratio = 1.24, AGFI = 0.90, GFI = 0.96, ECVI = 1.09, CFI = 0.98, IFI = 0.98, and RMSEA = 0.04). The path model explains 9% of the variance in healthy diet (general and special diet), 22% of the variance in exercise, 14% of the variance in blood glucose test, and 37% of the variance in foot care. Additionally, in this study, the general and special diets were considered one variable, healthy diet, based on the exploratory factor analysis in this study.

Standardized parameter estimates for the final path model were shown in Fig. 1. According to the path diagram, a healthy diet was predicted by years of U.S. residency ( $\beta = 0.21$ ,  $p < .05$ ) and diabetes knowledge ( $\beta = 0.20$ ,  $p < .05$ ). Exercise was predicted by sex ( $\beta = 0.15$ ,  $p < .05$ ), confidence ( $\beta = 0.15$ ,  $p < .05$ ), and a healthy diet ( $\beta = 0.40$ ,  $p < .05$ ). Age ( $\beta = 0.29$ ,  $p < .05$ ), diabetes knowledge ( $\beta = 0.18$ ,  $p < .05$ ), and exercise ( $\beta = 0.23$ ,  $p < .05$ ) predicted blood glucose levels. Foot care was predicted by sex ( $\beta = -0.20$ ,  $p < .05$ ), education level ( $\beta = 0.15$ ,  $p < .05$ ), coping (self-efficacy) ( $\beta = 0.20$ ,  $p < .05$ ), family support ( $\beta = -0.19$ ,  $p < .05$ ), exercise ( $\beta = 0.26$ ,  $p < .05$ ), and blood glucose test ( $\beta = 0.41$ ,  $p < .05$ ).

Among the sociodemographic characteristics, sex, age, education level, and residence years in the United States predict self-care activities including healthy diet, exercise, blood glucose test, and foot care. Self-efficacy represented by coping and confidence predict foot care and exercise. Diabetes knowledge predicts only blood glucose test among

the four different diabetes self-care activities. Family social support predicts foot care in a negative way, and friend social support did not predict any diabetes self-care in this study.

## Discussion

The path model illustrates exogenous and endogenous variables' overall associations and effects. The path diagram demonstrates the effects of four demographic factors, self-efficacy (coping and confidence), diabetes knowledge, and family support, on four types of self-care activities. The four types of self-care activities include a healthy diet (general and special diet), exercise, blood glucose test, and foot care, among older Korean immigrants with diabetes in the United States. According to previous studies, there are numerous self-care activities for diabetes management. However, it is indisputable that blood glucose testing, exercise, a healthy diet, and foot care are crucial for optimal self-care. The fact that this study generates a path model to explain the direct and indirect effects on the related variables is significant.

Among the various sociodemographic characteristics, sex, age, education level, and years living in the United States predict diabetes self-care activities. Males are more likely to exercise compared to females, and the more aged Korean immigrants tend to check their blood glucose level. Older Koreans who reside longer in the United States are more likely to eat a healthy diet, and education level was a predictor of foot care. These unique characteristics are essential information for healthcare professionals and can be used in providing healthcare services. Particularly, the positive association between education level and effective self-care in this study aligns with previous studies [10]. The number of days a week diabetes self-care activities were performed in this study was fewer than previous studies. The participants in this study performed 3.9 days for general diet and 3.2 days for special diet. The number of days is lower than 5.35 days (general diet) and 4.86 days (special diet) among community-dwelling older adults with diabetes in the United States [33] and 5.10 days (general diet) among older adults with type 2 diabetes in Singapore [11]. The days of blood glucose testing in this study was 3.1 days, which is fewer than the 4.52 days for community-dwelling older adults with diabetes in the United States [33] and more than the 1.51 days among older adults in Singapore [11]. Significantly, the days of foot care in this study is the least number, 1.8 days, which is fewer than the 3.7 days of David et al. [33] and 2.48 days of Seah et al. [11].

Self-efficacy has been identified as a critical determinant in diabetes self-care [34, 35]. This could be attributed to the fact that individuals who possess higher levels of

self-efficacy are more likely to readily acquire information and guidance regarding their illness and proactively seek assistance from their healthcare providers and family members, which empowers them to sustain their self-management practices [36]. In this study, self-efficacy represented by coping and confidence was a predictor of foot care and exercise, respectively, and it can be interpreted that more self-confident older Korean adults with diabetes are likely to exercise and perform foot care more. Aligned with this finding, prior research has demonstrated favorable advancements in foot self-care among patients with diabetes through the integration of the self-efficacy concept into their interventions [12, 37].

According to the path model, diabetes knowledge predicts blood glucose test among the four types of diabetes self-care. This result supports the findings of Borba et al. [10], who discovered that the maximum proportion of accurate responses was in the blood glucose test–related items in the Diabetes Knowledge Test questionnaire. Comprehending the disease is essential for the acquisition of competencies in the self-care of diabetes. The path model does not demonstrate the relationship between diabetes knowledge and education level; however, previous literature reported that education level was one of factors associated with increased levels of diabetes knowledge [38]. As diabetes knowledge predicts blood glucose test among older Korean immigrants with diabetes, healthcare providers can create diabetes education programs to provide tailor-made care and counseling for this minority group.

This study examined effects of social support on diabetes self-care; social support includes from family and friends. However, in this study, only family social support was a predictor of diabetes self-care, particularly foot care, negatively. This finding contradicts previous studies showing that family is a main support for older adults in performing self-care [6, 39–41]. The negative effect of family support on foot care in this study should be examined further in future studies.

For individuals with diabetes, a healthy diet may necessitate a switch from their previous diet to a diabetic diet. They must have a strong willingness, patience, and plan to alter their dietary habits. Dietary changes in foreign countries may be more difficult, particularly for ethnic immigrants. Despite their desire to maintain their cultural identity through traditional dishes, they may be forced to abandon or modify their traditional diet to control their glucose levels. Immigrants of a specific racial or ethnic background who have diabetes face more significant obstacles to healthy living. Regarding the relationship between diabetes knowledge and a healthy diet, healthcare providers should develop and offer culturally sensitive diet education programs to ethnic

minority immigrants. Future research must examine the effect of years in the United States on a healthy diet.

The path model demonstrates that exercise is directly influenced by confidence (self-efficacy subscale), gender (male), and a healthy diet. The positive association between self-efficacy and exercise has been the subject of voluminous previous research [42–44]. Bandura's [45] social cognitive theory frequently served as the basis for "self-efficacy" definitions. Self-efficacy is the capacity of an individual to perform the actions necessary to achieve a desired performance, such as an exercise. For specific behaviors such as exercise, confidence, coping skills, and a positive outlook are needed. Consistent with prior research, the path model shows that exercise is influenced by confidence. However, the influence of sex on exercise must be investigated further in future studies. According to Vanden Bosch et al. [44], certain demographic factors, such as age, race, marital status, level of education, income, and employment status, affect the amount of exercise that diabetic adults engage in. Nonetheless, the effect of sex on exercise is poorly understood. Future research must investigate the effect of gender differences on exercise among senior ethnic immigrants.

Blood glucose monitoring is one of the most important self-care activities for diabetes. Uncontrolled glucose levels can lead to kidney failure, vascular disease, and cardiovascular disease complications. Regular blood glucose testing prevents complications caused by hypoglycemia and hyperglycemia. According to the path model, diabetes knowledge and exercise influence the blood glucose test, and the glucose test has a direct effect on foot care. It can be assumed that the greater a person's diabetes knowledge is, the more frequently they check their glucose levels. Moreover, they are more likely to care for their feet. The connection between diabetes knowledge, blood glucose testing, and foot care assists healthcare providers in comprehending and developing effective diabetes education and healthcare plans.

Fourth, foot care is directly affected by sex, education level, coping, family support, blood glucose test, and physical activity. One of the most severe complications in diabetes with a high mortality rate, prevalence, and cost is diabetic foot [46]. Despite the importance of foot care, individuals with diabetes have a lower rate of daily foot examination, foot hygiene, protection from trauma, correct footwear selection, and referrals to foot specialists [46]. Specifically, in this path model, education level rather than diabetes knowledge directly influences foot care. Family support and (male) sex have a negative effect on foot care. There is a presumption that participants with more family support are less likely to practice foot care. Additionally, men are less likely to perform foot care. Future research must investigate the negative effects of male sex and family support on foot care.

Overall, the path model provides reciprocal effects between exogenous and endogenous variables and assists healthcare providers in identifying factors related to self-care activities among older Korean immigrants with diabetes. Additionally, the path model can be applied to other ethnic diabetes populations.

## Limitations

Due to the COVID-19 pandemic, the majority of responses were gathered via online survey. It is possible that older Korean immigrants who have difficulty using mobile phones or computers were overlooked. Therefore, it is possible that the results of this study are not representative of all senior Korean immigrants with diabetes in the United States. In addition, even though a larger sample size is more appropriate for a complex model, the actual sample size in this study was 190 due to the COVID-19 pandemic. The small sample size is one of the limitations of this study's interpretation.

To measure the level of self-care activities, this study used the SDSCA questionnaire, but the instrument did not include items related to taking of oral medications or insulin. While there was an average increase in glycemic monitoring among older adults who used insulin or oral antidiabetic medications [47], this study did not examine the factors associated with diabetes self-care that are related to the use of antidiabetic medications.

Lastly, the absolute value of the regression coefficients in the path model ranged from 0.15 to 0.41, which can be considered weak or moderate. The results might be related to a small sample size, existence of outliers, or variability of predictor variables.

## Conclusion

This study examined the effects of sociodemographics, self-efficacy, diabetes knowledge, and social support on diabetes self-care activities among older Korean immigrants in the United States. The path model demonstrates the unique relationships between the related factors and the four types of self-care activities using arrows. The findings of this study help healthcare providers understand sociodemographic characteristics and the significant related factors on diabetes self-care among this minority immigrant group and can be used in development of culturally tailored education programs, counseling, and interventions. This study's findings also can be applied to future nursing research, education, and practice for ethnic minority immigrant groups.



## New contributions to the literature

Individuals receive various types of care from nurses, including clinical practice, education, and advocacy. Particularly in the United States, nurses provide care for diverse ethnic groups from various cultures with distinct values and health practices. Each ethnic group has a unique outlook on health. This study's findings will facilitate a deeper understanding of the Korean ethnic minority, particularly the health issues of older Korean immigrants with diabetes. In addition, the results of this study can be used to develop health strategies that are culturally appropriate for older Korean immigrants in the United States. In addition, preventive diabetes education programs and healthcare services can be developed based on the findings of this study. Overall, the findings can be used to improve the self-care performance of older Korean immigrants with diabetes.

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## Declarations

**Ethical approval** All procedures performed in studies involving human participants complied with ethical requirements. The research was approved by the authors' University's Institutional Review Board (IRB). All participants were informed of the purpose, risks, benefits, and rights to confidentiality and withdrawal from the study. All participants in this study provided their consent after being fully informed.

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