



Quality of life among Indonesian family caregivers caring for dependent older persons with type 2 diabetes mellitus in the community: A cross-sectional, correlational study

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Abstract

Background: The global prevalence of older adults with diabetes has increased, and family caregivers in Indonesia play a critical role in managing diabetes and providing personal care. However, caregiving can be complex and challenging, often negatively affecting caregivers' quality of life (QoL).

Objective: This study aimed to develop and test a hypothesized causal model of QoL among Indonesian family caregivers who care for dependent older persons with type 2 diabetes mellitus (T2DM) in 2024.

Methods: A cross-sectional, correlational study was conducted with 270 family caregivers recruited from five Community Health Centers. Data were collected using various scales: the Center for Epidemiologic Studies Depression Scale, the Zarit Burden Interview, the Duke University Religion Index, the Perceived Knowledge on T2DM Care Scale, the Family-Carer Diabetes Management Self-Efficacy Scale, the Multidimensional Scale of Perceived Social Support, and the Quality-of-Life Index. Descriptive statistics and Partial Least Squares Structural Equation Modeling (PLS-SEM) were used for analysis.

Results: The final model explained 89.1% of the variance in the quality of life (QoL) of family caregivers ($R^2 = 0.893$, $Adjusted R^2 = 0.891$), with 66% predictive relevance. Depression symptoms had the strongest negative direct effect on QoL, followed by caregiver burden. Self-efficacy and perceived knowledge had positive direct effects, while social support showed no significant direct effect. Indirect effects revealed that social support and self-efficacy positively influenced QoL through depression symptoms. The total effect (TE) analysis confirmed that depression symptoms had the strongest negative effect on QoL (TE = -0.744, $p < 0.001$), while social support (TE = 0.443, $p < 0.001$) and self-efficacy (TE = 0.413, $p < 0.001$) had positive effects.

Conclusion: Reducing depression symptoms and caregiver burden, strengthening social support, and promoting self-efficacy could significantly improve the QoL of family caregivers who care for older persons with T2DM. Nursing practice should address caregivers' physical and emotional needs, provide education, foster social support, and support caregiver mental health.

Keywords

Indonesia; family caregivers; quality of life; type 2 diabetes mellitus; older persons

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Background

Type 2 Diabetes Mellitus (T2DM) is one of the most common chronic diseases in the world, primarily affecting older adults (Bigelow & Freeland, 2017). The prevalence of this disease continues to rise (Abdul Basith Khan et al., 2020). In 2021, there were 537 million cases globally. The number of diabetic cases is predicted to increase to 643 million by 2030 and 783 million by 2045 if no action is taken (IDF Diabetes Atlas, 2021).

Indonesia ranks fifth globally in diabetes prevalence; in 2021, the number of cases reportedly reached 19.5 million and is predicted to rise to 28.6 million by 2045 (IDF Diabetes Atlas, 2021). According to Statistics Indonesia (2021), the prevalence of T2DM among individuals aged 60 years and older is estimated to be between 15% and 20%. Older adults with T2DM have a two- to three-fold higher risk of physical disability (Hill, 2019) and a 50-90% increased risk of other disabilities (Gregg & Menke, 2018). In Indonesia, the risk of

disability for those with diabetes is 4.89 times higher than for healthy individuals (Isfandari & Mihardja, 2017). The level of dependence due to diabetes has increased by 44.1%, ranging from mild to complete dependency (Statistics Indonesia, 2021). These individuals need support in managing blood sugar, preparing meals, taking medication, preventing complications, and carrying out daily activities such as eating, dressing, or bathing (Sinclair & Dunning, 2014).

Family caregivers are crucial in supporting diabetes management and personal care for this population (American Diabetes Association Professional Practice Committee, 2020). However, caring for dependent older adults is complex and challenging (Bigelow & Freeland, 2017). Caregivers may feel vulnerable, experiencing psychological distress and a high risk of death (Ottaviani et al., 2019; Sambasivam et al., 2019; Schulz & Beach, 1999). Constantly worried about health complications associated with T2DM, such as hypoglycemia and other potential emergencies, they face a complex mix of emotions, physical demands, and lifestyle adjustments while providing care for dependent older adults with T2DM (Kolaric et al., 2023; Kovacs Burns et al., 2016; Ripoll et al., 2018).

Several studies have reported that family caregivers caring for dependent older adults with T2DM have lower self-reported quality of life (QoL) in Indonesia than other regions globally (Aurny & Diniari, 2016; Cendrasilvinia & Manus, 2020; Kristina & Perdamaian, 2021). Improving the QoL of these caregivers is crucial because their dedication, support, and advocacy are vital in ensuring the well-being and QoL of their loved ones living with T2DM (American Diabetes Association Professional Practice Committee, 2020; Kolaric et al., 2023). If healthcare providers do not address the QoL issues of family caregivers, these caregivers are at risk of developing health problems themselves, which could hinder their ability to support the patient's treatment program effectively (Ottaviani et al., 2019).

According to the regulation of the Ministry of Health Republic of Indonesia No. 75 of 2014, healthcare teams, including doctors, nurses, and social workers at Community Health Centers (CHCs), are responsible for conducting the Home Visits Home Care (HVHC) program (Suratri et al., 2019). Since 2018, several CHCs have implemented the HVHC program, particularly for families with older individuals suffering from chronic illnesses (Kadar et al., 2022). However, these services primarily focus on the patients, often neglecting the caregiver's needs despite their crucial role in the care process (Kadar et al., 2022). To improve the QoL of family caregivers, it is essential to understand the factors that influence QoL among those caring for dependent older adults with T2DM. Therefore, the study's findings are expected to provide valuable insights to guide the development of targeted interventions to support and improve caregivers' QoL, ultimately enhancing the effectiveness of home healthcare services in Indonesia.

The revised Wilson and Cleary Model of Health-Related Quality of Life (WCM HRQOL) was chosen as the framework for this study (Ferrans et al., 2005). This model identifies causal relationships among elements contributing to overall QoL, including biological and physiological variables, symptom status, functional status, and general health perceptions, where each domain directly influences the others. The revised WCM HRQOL explains how individual and environmental characteristics affect the HRQOL (Ferrans et

al., 2005). The relationships among the factors influencing HRQOL in the model are complex (Bakas et al., 2012) and can be classified as direct and indirect effects (Khamchan et al., 2020). According to this model, QoL is affected by health-related factors and influenced by other individual and environmental factors.

Existing literature has revealed that individual and environmental factors, such as self-efficacy, religiosity, and perceived knowledge, significantly influence the QoL of family caregivers of individuals with chronic diseases. For example, self-efficacy is crucial in determining the QoL (Pothiban et al., 2020; Warapornmongkhokul et al., 2018). Religiosity also impacts QoL, as caregivers who engage in religious activities tend to have higher HRQOL (Nagpal et al., 2015; Tedrus et al., 2020). Moreover, greater knowledge about caring for chronic diseases among family caregivers is associated with better QoL (Seangpraw & Ong-Artborirak, 2020).

Environmental factors, such as social support, significantly predict the QoL of family caregivers. Previous studies have shown that higher levels of perceived social support are associated with better QoL among caregivers of older adults with chronic diseases (Pothiban et al., 2020; Yang et al., 2012; Yoon et al., 2018). In contrast, inadequate social support results in poorer QoL (Choi et al., 2016; Wang et al., 2020). Additionally, previous studies have shown that caring for older patients with T2DM often leads to severe burden, stress, frustration, and depression (Adianta & Wardianti, 2018; Badriah et al., 2014; Kovacs Burns et al., 2016; Ripoll et al., 2018), which are psychological symptoms that directly impact QoL (Geng et al., 2018; Peepratoom et al., 2020).

Although the factors influencing the QoL of family caregivers of older adults with chronic diseases have been well-documented, such as education levels (Putri et al., 2023), financial strain, physical health issues, disruption in daily routines, and increased caregiver burden (Kristina & Perdamaian, 2021), self-esteem, and family support (Cendrasilvinia & Manus, 2020), there is limited research specifically focusing on family caregivers caring for older adults with T2DM in the community in Indonesia. The existing knowledge of how these factors influence the QoL of family caregivers caring for dependent older adults with T2DM remains unclear. To understand the causal relationships, further studies are needed to explore how these factors interact. An understanding of these multiple factors and their pathways is crucial for developing effective interventions to enhance the QoL of family caregivers in this context.

Therefore, based on the revised WCM HRQOL, we selected factors from the individual (self-efficacy, perceived knowledge, and religiosity) and environmental characteristics (social support) as having direct and indirect effects on QoL. We also selected depression symptoms and perceived caregiver burden as psychological symptoms with a direct impact on family caregivers' QoL. These factors can be modified in response to intervention. Our study aimed to test the model of QoL among Indonesian family caregivers caring for dependent older adults with T2DM in the community and examine the direct and indirect effects of depression symptoms, caregiver burden, religiosity, perceived knowledge, self-efficacy, and social support on QoL, using the revised WCM HRQOL model (Ferrans et al., 2005). The hypothesized model is illustrated in **Figure 1**.

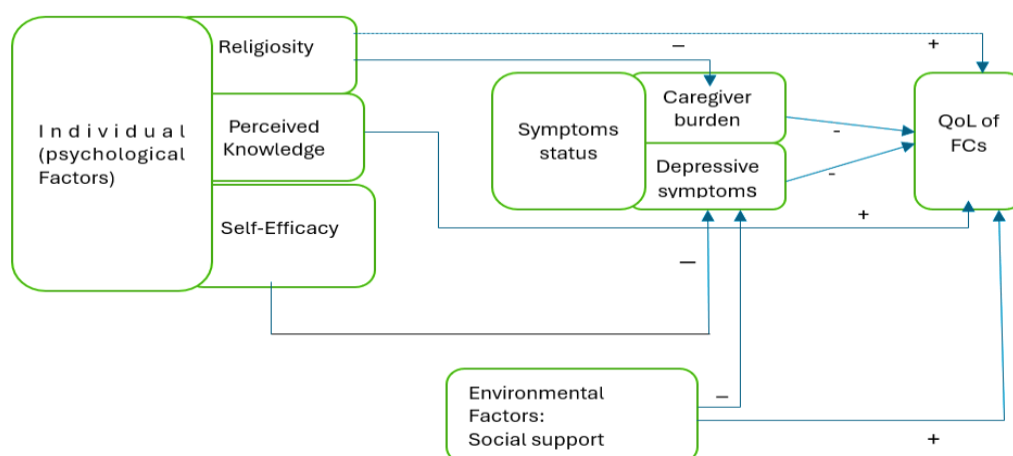


Figure 1 Hypothesized model of QoL of Indonesian family caregivers of dependent older persons with T2DM

Methods

Study Design

A cross-sectional, correlational study design.

Samples/Participants

This study used purposive sampling to maximize our recruitment prospects. The participants were recruited following the inclusion criteria: 1) being 18 years or older, 2) being the primary caregiver for at least three months, 3) living with dependent older persons with T2DM, 4) being able to speak Bahasa Indonesia, and 5) willingness to participate in the study. The inclusion criteria for the dependent older persons with T2DM were: 1) age 60 years and older, 2) being diagnosed with T2DM by a doctor, and 3) having an activity of daily living score between 5-11 as measured by the Barthel Index Modification (BIM). Family caregivers who could not complete the questionnaires during the study were excluded.

The sample size in this study was based on the rule-of-thumb approach for SEM, which suggests "200 cases minimum." Kline (2023) recommends 200 cases for a typical medium sample size in studies using SEM. A total of 274 family caregivers who met the study's criteria were initially recruited. However, four were excluded from the study: three declined to participate due to grief following the passing of their relatives during the data collection period, and one could not be reached because their relative was hospitalized. Thus, the final sample consisted of 270 family caregivers.

Instruments

Eight instruments were used for data collection as follows:

Data Demography Questionnaire (DDQ): This questionnaire was used to collect demographic data from both family caregivers and dependent older persons with T2DM. The DDQ for family caregivers included age, sex, marital status, educational level, monthly household income, duration of caregiving, use of a care assistant, and total duration of caregiving. It also collected demographic data on older persons with T2DM, including age, sex, duration of diabetes, comorbidities, chronic complications, and functional status.

The 10-item Center for Epidemiological Studies Depression-Revision (CES-D R 10) developed by Radloff (1977), originally comprising 20 items, was used to measure depression symptoms in family caregivers. The scale was

previously translated into Indonesian (Tran et al., 2019), and permission was obtained to use it in this study. The scale consists of 10 items with a 4-point Likert scale ranging from "rarely or none of the time" (0) to "all of the time" (3). The total score ranges from 0 to 30, with any score equal to or above 10 considered depressed. In the actual study, Cronbach's alpha was 0.962.

The Zarit Burden Interview (ZBI) developed by Zarit et al. (1986) was used to measure caregiver burden. The ZBI consists of 22 items measuring five aspects: physical burden or caregiver's health, emotional or psychological burden, economic burden, social burden, and the relationship between family caregivers and their patients. Each item has a five-point Likert scale (never = 0, rarely = 1, sometimes = 2, quite frequently = 3, nearly always = 4) (Zarit et al., 2017). The score ranges from 0 to 88, with higher scores indicating greater burden (Zarit et al., 1986). The ZBI Indonesian version has a Cronbach's alpha of 0.878 (Tristiana et al., 2019). In the present study, Cronbach's alpha was 0.970.

The Duke University Religion Index (DUREL-I) developed by Koenig and Büssing (2010) was used to measure the religiosity of family caregivers. Permission was obtained to use this instrument, previously translated into Indonesian (Nurmansyah et al., 2020). This instrument consists of five items assessing three dimensions of religiosity: organizational religious activity (ORA), non-organizational religious activity (NORA), and intrinsic religiosity (IR). The items have various answer options, with a higher score indicating higher levels of religiosity. In this study, Cronbach's alpha was 0.814.

The Perceived Knowledge on T2DM Scale (PKS) developed by Nguyen et al. (2021) was used to measure the perceived knowledge of family caregivers about T2DM care. This instrument was translated into Indonesian using Brislin's guidelines (Brislin, 1970), and permission was obtained for translation and use. The PKS has seven items to measure common caregiving activities for persons with T2DM, including behavior change (diet, smoking, and physical activity), medication adherence, and complication care (e.g., foot ulceration, anxiety, and hypoglycemia control). The responses are based on a 5-point Likert scale ranging from 0 (definitely not) to 4 (definitely yes) (Nguyen et al., 2021). Total scores range from 0 to 28, with higher scores indicating greater perceived knowledge. The instrument has a

Cronbach's alpha of 0.888 in a pilot study. In the actual study, Cronbach's alpha was 0.965.

The Family-Carer Diabetes Management Self-Efficacy Scale (F-DMSES), modified by [Wichit et al. \(2018\)](#) from the Diabetes Self-Efficacy Scale (DMSES) ([Bijl et al., 1999](#)), was used to measure family caregivers' self-efficacy in diabetes management. It consists of 14 items assessing caregivers' confidence in performing various caregiving activities, including diet management, glucose monitoring, medication adherence, weight control, and physical activity. The scale uses a 5-point Likert scale (1 = definitely not to 5 = definitely yes). Total scores range from 5 to 70, with higher scores indicating greater self-efficacy. The instrument has a Cronbach's alpha of 0.897 in a pilot study of family caregivers of T2DM. In the actual study, Cronbach's alpha was 0.965.

The Multidimensional Scale of Perceived Social Support (MSPSS) developed by [Zimet et al. \(1988\)](#) was used to measure social support from family, friends, and significant others. This instrument was translated into Indonesian ([Winahyu et al., 2015](#)), and permission was obtained to use it in the study. The MSPSS has 12 items with a 1 to 6-point Likert scale, where 1 represents "very strongly disagree," and 6 represents "very strongly agree." The possible score ranges from 12 to 84, with higher scores indicating greater social support. The Indonesian version has shown good validity and reliability with a Cronbach's alpha of 0.85 ([Winahyu et al., 2015](#)). In the actual study, Cronbach's alpha was 0.939.

The Quality-of-Life Index (QLI) generic version III developed by [Ferrans and Powers \(1985\)](#) was used to measure quality of life. The instrument was translated into Indonesian using Brislin's guidelines ([Brislin, 1970](#)), and permission was obtained to translate and adopt it. The QLI consists of 33 items measuring satisfaction and importance across four domains: health/functioning (13 items), social/economic (8 items), psychological/spiritual (7 items), and family (5 items). Each item includes a 6-point rating scale, with satisfaction items rated from 1 (very dissatisfied) to 6 (very satisfied) and importance items rated from 1 (very unimportant) to 6 (very important). Satisfaction scores are weighted by corresponding importance scores. Total scores range from 0 to 30, with higher scores indicating better quality of life. The instrument has a Scale-Content Validity Index (S-CVI) of 1 and a Cronbach's alpha of 0.97. In the actual study, Cronbach's alpha was 0.965.

A pilot study was conducted at Pulo Brayon CHC, where the researcher administered the questionnaire to 30 family caregivers caring for dependent older persons with T2DM. The Cronbach's alpha coefficients for the QLI, DUREL-I, PKS, F-DMSES, MSPSS, ZBI, and CESD-R were 0.977, 0.814, 0.888, 0.897, 0.845, 0.926, and 0.854, respectively.

Data Collection

Data were collected from February 2023 to July 2023 at five Community Health Centers (CHCs) (Darussalam, Sering, Rantang, Lalang, and Bestari CHC) in Medan City, North Sumatra, Indonesia. Family caregivers who met the inclusion criteria were approached to participate in the study. Informed consent was obtained from all participants. Researchers administered the questionnaires and remained with the participants until they completed the answers. A Research Assistant (RA) was trained a day before data collection to help

the participants care for their older persons with T2DM while completing the CHC questionnaires. If participants were unavailable to complete the questionnaire at the CHC, they were allowed to complete it at home, and an appointment was made for a convenient time.

Data Analysis

Descriptive statistics were used to analyze the data using IBM SPSS version 26. Partial Least Squares Structural Equation Modeling (PLS-SEM), which can estimate complex models, was used to evaluate the structure ([Sarstedt et al., 2021](#)). [Hair et al. \(2019\)](#) suggest that PLS-SEM offers solutions with small sample sizes when models include many constructs and items. The PLS-SEM analysis was conducted using SmartPLS 3.0, which offers numerous options for constructing outer and inner models, crucial for calculating latent variable scores in the research model.

In the outer model, an indicator is considered valid if its Average Variance Extracted (AVE) value is above 0.5 or if all the variables in its dimension have values greater than 0.5 ([Hair et al., 2019](#)). A Composite Reliability (CR) value of 0.6 – 0.7 is considered good reliability ([Hair et al., 2019](#); [Sarstedt et al., 2021](#)). In addition, Cronbach's alpha measures the scale's reliability, with values closer to 1 indicating stronger internal consistency ([Hair et al., 2019](#)). The Fornell-Larcker Criterion measures discriminant validity. If the square root value of AVE for each construct is greater than the correlation value between the construct and other constructs in the model, the model has good discriminant validity ([Hair et al., 2019](#)). There was no multicollinearity problem (Variance Inflation Factor/VIF <10). It is suggested that values between 5 and 10 are considered the VIF threshold, while values above 10 indicate multicollinearity ([Vittinghoff et al., 2005](#)).

The second step assessed the inner model. This study used path analysis to test the hypothesized model. The hypotheses were analyzed using *t*-statistics or bootstrapping to determine their significance. The *t*-test was intended to test whether the independent variables partially have a significant effect on the dependent variable (the *t*-table for alpha = 0.05 is 1.96)—the path coefficients in a model range from -1 to +1. When the path coefficient is closer to +1, the two constructs (variables) ([Hair et al., 2019](#); [Sarstedt et al., 2021](#)) have a strong positive relationship. In other words, as one variable increases, the other variable tends to increase as well. When the path coefficient is closer to -1, it indicates a strong negative relationship. This means that as one variable increases, the other variable tends to decrease ([Hair et al., 2019](#); [Sarstedt et al., 2021](#)). R-square (R^2) was used to assess the variance explained in endogenous latent constructs by the exogenous latent constructs included in the model. Q-squared (Q^2) was used to evaluate the predictive relevance of our structural equation model ([Hair et al., 2019](#)). By assessing Q^2 , we can determine how our model successfully predicts the outcome of interest. Model fit was evaluated by Root Mean Square Residual (SMSR). An SMSR <0.05 means the model is considered a good fit to the data ([Hair et al., 2019](#); [Sarstedt et al., 2021](#)). By rigorously ensuring the reliability and validity of our measurement instrument, we can be confident that the data used in our SEM analysis accurately reflects the underlying construct, thereby bolstering the credibility and robustness of our study's findings.

Ethical Consideration

This study was approved by the Social and Behavioral Science Institutional Review Board, Prince of Songkla University, Thailand (Approval number: 2022-st-nurs-045), and by the Health Research Ethics Committee, Universitas Sari Mutiara Indonesia (Approval number: 1823/F/KRP/USM/XII/2022). The study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki. Informed consent was obtained from all participants prior to their participation in the study. Participant confidentiality was strictly maintained, and data were anonymized to ensure privacy.

Results

Participants Characteristics

The mean age of family caregivers was 53.67 years (SD = 11.68), with the majority being female (79.3%) and married

(85.9%). A significant portion had attained only an elementary level of education (39.3%), and more than half (67.0%) did not have assistance in caregiving. Most respondents (56.7%) reported a monthly household income of less than 3,000,000 Indonesian Rupiah (approximately 195.27 USD). On average, family caregivers spent 10.36 hours per day caregiving, with 48.5% providing care for 1–2 years. Regarding the characteristics of the older persons with T2DM, their mean age was 74.61 years (SD = 5.35), with an average diabetes history of 9.54 years (SD = 1.74). Over half (52.2%) were female, and 51.9% had three or more comorbidities, including hypertension, osteoarthritis, and stroke. Additionally, 67.8% had two chronic complications. Nearly half (45.9%) had experienced a stroke, and more than half (54.07%) had diabetic foot neuropathy. The mean score for the older persons' functional status, as measured by the Modified Barthel Index (MBI), was 9.20 (SD = 1.00) (see [Table 1](#)).

Table 1 Descriptive statistics of family caregivers' demographic and their older persons (N = 270)

Characteristics	n (%)	Possible Score	Actual Score		Mean ± SD
			Minimum	Maximum	
Age	Years (Mean ± SD)	≥18	27	71	53.67 ± 11.60
Gender	Male	56 (20.7)			
	Female	214 (79.3)			
Marital status	Married	232 (85.9)			
	Widowed	38 (4.1)			
Educational level	Elementary School	106 (39.3)			
	Junior High School	53 (19.6)			
	Senior High School	58 (21.5)			
	University	53 (19.6)			
Care Assistant	Yes	89 (33.0)			
	No	181 (67.0)			
Household Income (IRD) /month	IDR <3.000.000	153 (56.7)			
	IDR 3-5.000.000	99 (36.7)			
	IDR >5.000.000	18 (6.7)			
Duration of caregiving	Hour/day (Mean ± SD)		6	18	10.36 ± 2.68
Overall caregiving duration (Year)	<1	67 (24.8)			
	1-2	131 (48.5)			
	3-5	69 (25.6)			
	6-9	2 (7.0)			
	>10	1 (4.0)			
Age of Older Person	Year (Mean ± SD)	>60	62	90	74.61 ± 5.35
Gender	Male	129 (47.8)			
	Female	141 (52.2)			
Diabetes duration	Year (Mean ± SD)		6	15	9.54 ± 1.74
Comorbidities	1-Comorbid	57 (21.1)			
	2-Comorbids	73 (27.0)			
	3-Comorbids & more	140 (51.9)			
Type of Comorbidities	Hypertension	188 (69.6)			
	Osteoarthritis	147 (54.4)			
	Stroke	124 (45.9)			
	TBC Lung	28 (10.3)			
	Dyslipidemia	38 (14.0)			
	Coronary heart disease	29 (10.7)			
	Kidney disease	88 (32.5)			
No. of chronic complication	1	83 (30.7)			
	2	183 (67.8)			
	3	4 (1.5)			
Chronic complication type:	Diabetic foot	146 (54.0)			
	Visual impairment	140 (51.8)			
	Hearing impairment	91 (33.7)			
Functional status/MBI		5 - 11	6	11	9.20 ± 1.00

Note: SD = Standard Deviation

Correlation between Study Variables

Table 2 presents the correlation between the study variables. The mean score for QoL of family caregivers was 12.43 (SD = 5.01). The mean scores for depression symptoms and caregiver burden were 20.78 (SD = 3.91) and 62.17 (SD = 13.07), respectively. The scores for religiosity, perceived knowledge, self-efficacy, and social support ranged from low to moderate. Furthermore, depression symptoms and

caregiver burden were significantly negatively correlated with the QoL of family caregivers. In contrast, religiosity, perceived knowledge, self-efficacy, and social support were significantly positively correlated with the QoL of family caregivers. Self-efficacy and social support were negatively correlated with depression symptoms. Additionally, religiosity was significantly negatively correlated with caregiver burden.

Table 2 Descriptive statistics of the study variables and correlation between study variables (N = 270)

Variables	Possible Score	Actual Score		Mean (SD)	Caregiver Burden	Depression Symptoms	QoL
		Minimum	Maximum				
Depression symptoms	0 - 33	12	26	20.78(3.90)			-0.951**
Caregiver Burden	0 - 88	43	87	62.17(13.07)			-0.909**
Religiosity	5 - 27	10	24	16.39(2.76)	-0.822**		0.735**
Perceived Knowledge	0 - 28	9	26	18.79(4.21)			0.769**
Self-Efficacy	5 - 70	19	61	44.24(10.48)		-0.785**	0.743**
Social Support	12 - 84	18	79	49.56(15.77)		-0.839**	0.814**
QoL	0 - 30	6.3	22.1	12.43(5.01)			

Note: Data were analyzed using Person Correlation Product Moment | SD = Standard Deviation | ** Correlations are significant at the level of 0.01

Outer Model Assessment Results

This study found that the indicator loading values of all items were >0.733, indicating they were valid. Cronbach's alpha and CR for all constructs were >0.80, demonstrating robust internal consistency. The AVE value for each construct was >0.50, suggesting that all constructs met the requirements for convergent validity. The VIF values were <10. According to [Vittinghoff et al. \(2005\)](#), values between 5 and 10 are considered the threshold for VIF, while values above 10 indicate multicollinearity. The Fornell-Larcker criterion for each construct was greater than its correlation with other variables,

fulfilling the discriminant validity requirement. Thus, all items satisfied the criteria requirements for PLS-SEM analysis.

Inner Model Assessment Results

Bootstrapping Path Coefficient of Direct Effects (DE) of Study Variables

The results of the bootstrap calculation of the coefficient estimates revealed that depression symptoms had the strongest negative direct effect on the QoL of family caregivers (DE = -0.744, *t* = 15.874, *p* < 0.001), followed by caregiver burden (DE = -0.269, *t* = 4.054, *p* < 0.001) (**Table 3**).

Table 3 Bootstrapping Path Coefficient Direct Effects (DE) of Study Variables

Variables	Original Sample (O)	Sample Mean (M)	SD	t-statistics (O/STDEV)	p-value
Caregiver Burden → QoL of Family Caregivers	-0.269	-0.268	0.066	4.054	<0.001
Depression Symptom → QoL of Family Caregivers	-0.744	-0.747	0.047	15.874	<0.001
Religiosity → QoL of Family Caregivers	-0.055	-0.051	0.059	0.933	0.351
Perceived Knowledge on T2DM → QoL of Family Caregivers	0.138	0.134	0.061	2.264	0.024
Self-Efficacy → QoL of Family Caregivers	0.185	0.185	0.048	3.830	<0.001
Social Support → QoL of Family Caregivers	0.026	0.024	0.053	0.485	0.628
Religiosity → Caregiver Burden	-0.800	-0.801	0.019	42.919	<0.001
Self-Efficacy → Depression Symptom	-0.306	-0.303	0.061	5.036	<0.001
Social Support → Depression Symptom	-0.561	-0.564	0.054	10.375	<0.001

Note: The *t*-value for significance at alpha 0.05 is 1.96, and alpha 0.10 is 1.65.

Bootstrapping Path Coefficient of Indirect Effect (IE) of Study Variables

Table 4 shows that social support (IE = 0.417, *t* = 8.727, *p* < 0.001) was the strongest positive indirect effect on

the QoL of family caregivers, followed by self-efficacy (IE = 0.228, *t* = 4.651, *p* < 0.001).

Table 4 Bootstrapping Path Coefficient Indirect Effect (IE) of the Study Variables

	Original Sample (O)	Mean	SD	t-statistics (O/SD)	p-value
Religiosity → Caregiver Burden → QoL of Family Caregivers	0.215	0.214	0.053	4.056	<0.001
Self-Efficacy → Depression Symptoms → QoL of Family Caregivers	0.228	0.227	0.049	4.651	<0.001
Social Support → Depression Symptoms → QoL of Family Caregivers	0.417	0.421	0.048	8.727	<0.001

Bootstrapping Path Coefficient of Total Effect (TE) in the Final Model

Based on calculations using bootstrapping, as presented in **Table 5**, the coefficient estimation for the direct effect of depression symptoms on QoL was -0.744, with a *t*-value of 14.598 and a *p*-value of <0.001. This indicates that the direct effect of depression symptoms on QoL is statistically significant. Depression symptoms had the strongest negative direct effect on the QoL of family caregivers, followed by caregiver burden (IE = -0.269, *p* = 0.05). In contrast, for the indirect effect, social support (IE = 0.417, *p* = 0.05) was the strongest positive indirect effect on the QoL of family caregivers, followed by self-efficacy (IE = 0.228, *p* = 0.05).

The final model, based on the total impact, shows that depression symptoms had the strongest negative direct effect on the QoL of family caregivers (TE = -0.744, *p* = 0.05), followed by social support and self-efficacy, which indirectly affected QoL through depression symptoms (TE = 0.443, *p* = 0.05 and TE = 0.413, *p* = 0.05, respectively) (**Figure 2**).

The coefficient of determination (*R*²) value was 0.893, and the adjusted *R*² was 0.891. The *Q*² value was 0.660, indicating that approximately 66.0% of the variation in QoL is predicted or explained by the combined effects of the variables included in the model. The standardized root mean square residual (SRMR) value was 0.048, less than 0.05, confirming that the model fits the data well.

Table 5 Bootstrapping Path Coefficient of Total Effect in the Final Model

Variables	Final Model		
	Direct Effect (DE)	Indirect Effect (IE)	Total Effect (TE)
Depression symptom → Family Caregivers' QoL	-0.744*	-	-0.744*
Caregiver Burden → Family Caregivers' QoL	-0.269*	-	-0.269*
Religiosity → Family Caregivers' QoL	-0.055ns	0.215*	0.160*
Perceived Knowledge on T2DM → Family Caregivers' QoL	0.138*	-	0.138*
Self-Efficacy → Family Caregivers' QoL	0.185*	0.228*	0.413*
Social Support → Family Caregivers' QoL	0.026ns	0.417*	0.443*
Religiosity → Caregiver Burden	-0.800*	-	-0.800*
Self-Efficacy → Depression Symptoms	-0.306*	-	-0.306*
Social Support → Depression Symptoms	-0.561*	-	-0.561*

Note: **p* < 0.05 | ns = not significant | *R*² = 0.893 | *Q*² = 66.0% | Adjusted *R*²: 89.1% | Root Mean Square Residual (SMSR) = 0.048

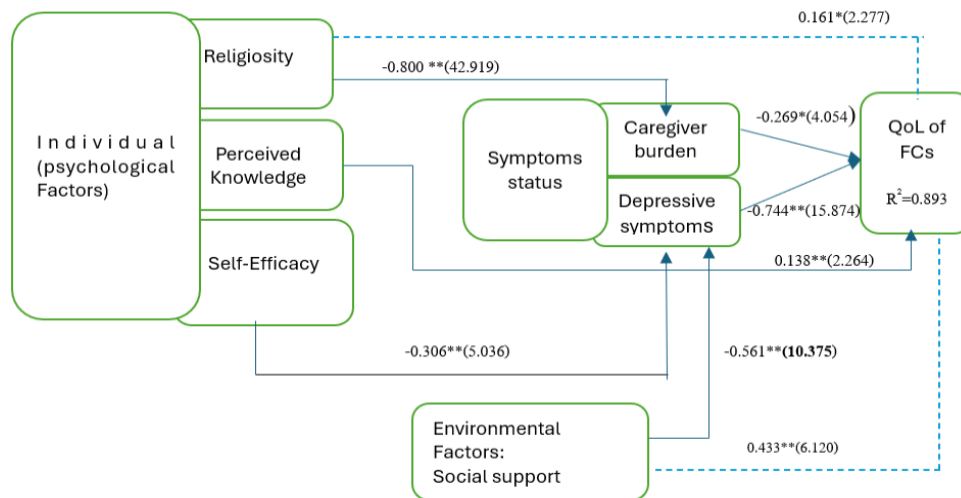


Figure 2 The final model of QoL of family caregivers (FCs) of dependent older persons with T2DM
 Note: (**p* < 0.05, ** *p* < 0.001)

Discussion

The SRMR value was 0.048, less than 0.05, confirming that the model fits the data well. The new model demonstrated that the QoL of family caregivers was simultaneously influenced by depression symptoms, caregiver burden, perceived knowledge, religiosity, self-efficacy, and social support. Depression symptoms had the strongest negative direct effect on the QoL of family caregivers, followed by caregiver burden. In contrast, social support and self-efficacy had the strongest positive indirect impact on the QoL of family caregivers through depression symptoms. Additionally, religiosity indirectly affected the QoL of family caregivers through caregiver burden, while perceived knowledge had a positive direct effect on their QoL.

Depression symptoms had a strongly negative direct effect on the QoL of family caregivers. Consistent with a prior study, depression was significantly more frequent among family caregivers of diabetic patients, who also had poorer QoL compared to the control group (Anaforoglu et al., 2012). Family caregivers in this study spent approximately 10.36 hours daily caring for dependent older persons with T2DM. Zhong et al. (2020) revealed that family caregivers who provided care for several hours throughout the day were more likely to be depressed. Additionally, the older persons, aged between 75 and 90, had moderate to severe dependency with comorbidities, the most common being hypertension, osteoarthritis, and stroke. They also suffered from complications such as diabetic foot, vision, and hearing problems. As a result, caregiving became increasingly

complex and consumed significant energy, thought, and financial resources. Bigelow and Freeland (2017) reported that older persons with T2DM, along with complications and other chronic conditions, can increase the burden for both patients and caregivers. Due to these caregiving responsibilities, caregivers often lacked time to care for themselves, could not participate in social activities, felt lonely and bored, and had little free time. They experienced stress and depression, which ultimately affected their own QoL.

This finding aligns with the theoretical model of WCM HRQL, which posits that symptom status, including depression, influences QoL (Ferrans et al., 2005). Individuals with higher depression had poorer QoL (Peepratoom et al., 2020). Kovacs Burns et al. (2016) also found that family concerns about diabetes management, frustration from not knowing how to help, and increased responsibility for diabetes management were associated with a negative psychological impact (distress) and a perceived lower QoL.

The caregiver burden has a negative direct effect on the QoL of family caregivers. Our findings align with MirHosseini et al. (2020) reported that higher burden scores were associated with a decrease in the QoL of Iranian family caregivers of diabetic patients. Studies consistently agree that informal caregivers of older persons with diabetes mellitus tend to experience significant burdens and strain (Adianta & Wardianti, 2018; Kovacs Burns et al., 2016). Rezaei et al. (2020) found that diabetes is one of four chronic disorders most associated with the burden of care for Iranian caregivers, following dialysis, mental disorders, and Alzheimer's disease. Similarly, a study in Mexico revealed that 48.2% of informal caregivers of older adults with T2DM experienced intense overload (del Campo Navarro et al., 2019). Liu et al. (2020) further demonstrated that caregiver burden leads to a decline in QoL. In this study, caregiver burden was conceptualized as a psychological symptom within the WCM HRQOL framework. Caregiving is a challenging task that demands significant time, effort, attention, and dedication. Research has consistently acknowledged that informal caregivers of older persons with diabetes mellitus tend to be burdened (Kovacs Burns et al., 2016). Therefore, reducing the caregiver burden can directly enhance QoL.

Social support indirectly affects family caregivers' QoL through depression symptoms. When individuals receive higher social support, they can build resilience to stress, reducing the risk of elevated depressive symptoms (Zhong et al., 2020). Previous studies support this finding, showing that when individuals receive higher social support, they are better able to manage stress and lower their risk of depression (Aplizuddin et al., 2020; Wan et al., 2023). Caregivers with high social support report greater life satisfaction and are more likely to experience positive emotions (Liao et al., 2020). Additionally, caregivers who receive support from family, significant others, friends, and healthcare providers can provide better care and demonstrate greater understanding when caring for sick family members (Scarton et al., 2016). Furthermore, they are more likely to recover from stress and depression, while individuals without adequate social support may experience worsened psychosocial distress and depression (Zhong et al., 2020). Additionally, lower self-efficacy in family caregivers is associated with higher levels of depression symptoms, which, in turn, leads to lower QoL. This

finding aligns with prior studies that also reported a relationship between lower self-efficacy and higher depression symptoms in caregivers of patients with chronic diseases (Warapornmongkholkul et al., 2018). Rabinowitz et al. (2011) revealed that caregivers with high self-efficacy in caregiving tend to have positive emotional responses to caregiving, which, over time, reduces their susceptibility to depression. Self-efficacy is associated with the ability to cope with challenging situations, such as managing disruptive behaviors and providing safe and competent care (Leow et al., 2015).

In the context of T2DM care, self-efficacy refers to the confidence of family caregivers in performing caregiving tasks for patients with T2DM (Wichit et al., 2018). An individual's ability to complete caregiving tasks can help reduce anxiety and stress, forming a positive cycle that improves QoL (Faronbi, 2018). Family caregivers of older adults with T2DM assist with daily activities, including meal preparation, blood sugar control, hypoglycemia management, diabetic complications, foot care, psychological support, exercise, weight management, medication administration, hospital visits, and financial, mental, and physical support (Wichit et al., 2018). These findings support previous research suggesting that increasing self-efficacy in caregivers provides numerous benefits to FCs of dependent older persons with T2DM.

Moreover, this study found that religiosity can enhance the QoL of family caregivers of dependent older persons with T2DM by reducing caregiver burden. Caregiving is a stressful responsibility, and caregivers may experience feelings of despair, anger, or even blame toward their God (Koenig, 2012; Salehi et al., 2020). Family caregivers participating in religious activities, such as praying, are more likely to experience a higher overall QoL (Netchang, 2012). A similar study by Tavares et al. (2020) on 139 family caregivers of care-dependent patients in Brazil and found that caregivers with stronger religious faith and practices had higher levels of QoL.

Knowledge about T2DM care—such as recognizing the signs and symptoms of hypoglycemia, preparing appropriate diets, providing foot care, and controlling blood sugar—is critical because it helps caregivers alleviate anxiety, worry, and hopelessness when assisting family members with diabetes in self-care at home (Kovacs Burns et al., 2016; Siregar et al., 2023; Thongduang et al., 2022). Inadequate knowledge among FCs about T2DM management contributes to an increased caregiving burden, leading to depression and, subsequently, reduced QoL (Yaslina et al., 2018). Therefore, increasing family caregivers' knowledge about T2DM care is essential for improving their QoL.

Implications for Nursing Practice

Given the significant negative relationship between depression symptoms and QoL, health policymakers and healthcare providers should prioritize enhancing mental health support services for family caregivers. This can be achieved by implementing accessible counseling programs, providing resources through healthcare providers, and fostering community-based support groups. To address the negative impact of caregiver burden on QoL, it is essential to establish caregiver support programs that reduce the burden by strengthening social support networks, offering respite care, and incorporating religious-based interventions. Recognizing the positive relationship between social support and QoL,

particularly in reducing depressive symptoms, policies should build robust social support networks through community initiatives, healthcare collaboration, and family involvement, encompassing emotional, informational, material, and financial assistance. Additionally, to strengthen self-efficacy among family caregivers, policymakers should develop training programs focused on caregiving and diabetes management for older persons with moderate to severe functional dependency. Educational programs that increase health literacy and disease management knowledge are also crucial, as perceived knowledge positively impacts QoL.

Furthermore, given the significant effect of religiosity on QoL through its influence on caregiver burden, support for religious activities should be integrated into caregiver support programs. These programs should provide spaces for spiritual practices and offer spiritual support to help alleviate the burden of caregiving. Specifically, for community nurses, our study offers inputs for developing targeted interventions to support family caregivers who care for dependent older persons with T2DM at home. These interventions should focus on reducing depression symptoms and caregiver burden, enhancing social support, self-efficacy, perceived knowledge of T2DM care, and providing support for religious activities.

Limitations

This study has several limitations that should be considered. Firstly, it is a cross-sectional study, meaning causal relationships should be interpreted cautiously. Longitudinal data would be more appropriate for understanding how variables change over time and establishing causal connections. Secondly, the findings may be specific to the Indonesian population and cannot be generalized to other populations or settings, as cultural differences can significantly influence the relationships between variables. Despite these limitations, the study focuses on unpaid family caregivers responsible for older individuals with T2DM, associated comorbidities, and chronic complications.

Conclusion

Depression symptoms were the strongest factor negatively influencing the QoL of family caregivers caring for dependent older persons with T2DM. Social support and self-efficacy had positive indirect effects on the QoL of family caregivers through depression symptoms. The study findings highlight the importance of strengthening social support and self-efficacy in reducing depression symptoms and caregiver burden. These strategies could be valuable for promoting the QoL of family caregivers, in addition to improving the well-being of their dependents.

Declaration of Conflicting Interest

There is no conflict of interest to declare.

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Authors' Contributions

RS, CK, and TC contributed substantially to the study's conception, design, and data acquisition. RS, CK, TC, and JML were involved in the analysis and interpretation of the data. RS, CK, TC, and JML were involved in critically drafting or revising the manuscript for important intellectual content. RS, CK, TC, and JML agreed to be accountable for all aspects of the manuscript to ensure that questions related to the accuracy or integrity of any part of the manuscript are appropriately investigated and resolved. RS, CK, TC, and JML approved publishing the final version.

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Data Availability

Datasets analyzed for the current study results are available from the first and corresponding authors upon reasonable request.

Declaration of Use of AI in Scientific Writing

There is nothing to declare.

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