

Understanding health-related quality of life trajectories among older adults with diabetes mellitus: Mixed methods research

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Abstract

Aim: To examine health-related quality of life trajectories among older adults with diabetes mellitus (DM).

Design: A sequential explanatory mixed method study protocol.

Methods: In the quantitative phase, health-related quality of life trajectory over 5 years, from 2009 to 2013, of a national representative sample ($N=440$) of older adults with DM was analysed using group-based modelling. Next, a qualitative multiple case study ($N=10$) was conducted between November 2017 and April 2018. In the mixed phase, by linking the quantitative and qualitative data, similarities and differences among the four trajectories were identified.

Results: Four distinctive health-related quality of life trajectories could be distinguished: high then decrease, high stable, medium stable and low then increase. These differed in attitude towards DM, self-management of DM-related tasks, comorbidity-related health-related quality of life, coping with DM and financial concerns about medical needs.

Relevance to Clinical Practice: Our results help illuminate the heterogeneity of health-related quality of life trajectories in older adults with DM. This research may help healthcare providers understand the need to assess the HR-QoL comprehensively and promote HR-QoL for older adults with DM.

KEYWORDS

diabetes mellitus, health-related quality of life, longitudinal data, mixed methods research, older adults

1 | INTRODUCTION

Diabetes mellitus (DM), a chronic degenerative disease, has been on the rise in terms of prevalence and mortality rate (World Health Organization, 2023). The prevalence in Korea was estimated to be 24.4% age 70 years and older in 2014, with a DM-related mortality rate of 20.7 per 100,000 persons in 2015, which has doubled since the previous decade (Korean Statistical Information Service, 2020).

Diabetes mellitus (DM) that demands lifelong lifestyle modifications and adjustment to medication—may significantly impact older adults' HR-QoL (American Diabetes Association, 2023; World Health Organization, 2023). HR-QoL is a self-rated measurement concept regarding one's own mental, physical and social functioning, representing a major outcome of DM management or interventions (American Diabetes Association, 2023; Johansson et al., 2004; WHOQOL Group, 1995). The lives of older adults with DM are more complicated than those of younger adults with DM

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because of a high risk of geriatric syndromes (e.g., depression and falls), pharmacotherapy-related hypoglycaemia, DM complications and psychological and physiological changes associated with ageing (American Diabetes Association, 2023). Therefore, DM care guidelines recognize the importance of individualized approaches to maximize HR-QoL for older adults with DM (American Diabetes Association, 2023).

Older adults with DM have a poorer overall QoL compared with those without DM (Kim et al., 2014; Lee & Kim, 2017). Previous studies have suggested that HR-QoL in older adults with DM is associated with various factors: health behaviours such as nutrition, physical activity, smoking, stress and nutrition; socio-psychological factors such as depression, anxiety, fatigue, social support, self-esteem; demographics and economic status; and glycemic control and DM-related complications (Kim et al., 2014; Lee, 2013; Lim & Oh, 2013; Scollan-Koliopoulos et al., 2013; Shin et al., 2011).

1.1 | Background

Recent studies have identified different patterns of HR-QoL over time in chronic diseases such as COPD, stroke, colon cancer, coronary artery bypass graft surgery and substance abuse (Dunn et al., 2013; Olson et al., 2014; Pan et al., 2008; Yoo et al., 2016). These studies used group-based modelling and they found that the HR-QoL of older adults with chronic diseases can change over time variously depending on individual characteristics (Kojima et al., 2016; Scollan-Koliopoulos et al., 2013; Zaninotto et al., 2009). For colorectal cancer survivors, a study identified four distinct trajectory patterns for quality of life over a 5-year follow-up period. Another study examining self-rated health trajectory in diabetes over a 4-year follow-up period found four distinct trajectories: persistently good (72.2%), persistently poor (10.1%), changed from good to poor (7.3%) and changed from poor to medium/good (10.4%). Furthermore, a study investigating HR-QoL trajectories following COPD surgery over 6 months identified two groups: improvers and non-improvers (Le Grande et al., 2006).

To date, the change overtime in HR-QoL might differ among older adults with DM based on individual characteristics. Only a few studies have reported longitudinal changes in HR-QoL among older adults with DM. Understanding HR-QoL changes when caring for patients with chronic diseases might help identify high-risk groups. Furthermore, exploring similarities and differences among various groups of older adults with DM through qualitative research contributes to a deeper understanding of this population.

2 | METHODS

2.1 | Aims

The overarching aim of the study was to provide an overview of distinctive HR-QoL trajectories among older adults with diabetes. The objectives in support of this aim were to: (1) identify distinctive

HR-QoL trajectory; (2) explore HR-QoL patterns using a qualitative multiple case study approach and (3) interpret the broader and more precise understanding of the similarities and differences in each trajectory group.

2.2 | Design

This study utilized an explanatory sequential mixed methods design characterized by collecting and analysing quantitative data followed by the collection and analysis of qualitative data (Creswell & Plano-Clark, 2011; Tashakkori & Teddlie, 2010). In the first quantitative phase, HR-QoL trajectories over time using a 5-year longitudinal design and the influencing factors among older adults with DM were investigated. To expand, explain and refine the phase I quantitative findings, a phase II qualitative study was conducted. However, while the qualitative data served as an explanation of the quantitative data, both data types were considered equally in the final analysis. Finally, the qualitative findings were integrated with the quantitative findings during the discussion of study outcomes. The quantitative phase of this study was conducted in detail in a related study (Park et al., 2022).

2.3 | Ethical considerations

The study was approved by the Institutional Review Board of the author's institution, specifically the Yonsei University Health System, through a full-board review conducted in November 2017 (No. 4-2017-0901). The participants were provided with written instructions and information concerning informed consent and were assured that their information would remain confidential.

2.4 | Data collection

2.4.1 | Quantitative methods

Data source

In the quantitative phase, we used a nationally representative sample of community-dwelling older adults for longitudinal analysis of HR-QoL scores over 5 years, from 2009 to 2013 (Korea Health Panel Survey [KHPS], 2017). Among the 5200 households and 14,839 participants, the final sample for this study included 440 respondents. The inclusion criteria were those aged ≥ 65 years with a DM diagnosis, and those who responded to the HR-QoL survey on less than two of the five occasions were excluded.

The baseline data consisted of demographic, environmental and health-related factors, including physical status, symptoms, functional status and health perceptions; these were based on the revised Wilson and Cleary (1995) model for HR-QoL (Ferrans et al., 2005; see the supplementary figure for the conceptual model of the quantitative phase).

2.5 | Measurements

2.5.1 | HR-QoL

HR-QoL was measured using the Korean version of the EuroQoL-5 Dimensions (EQ-5D) instrument (Lee et al., 2012; The EuroQoL Group, 1990) at the baseline and over 5 years from 2009 to 2013. The EQ-5D covers five dimensions: mobility, self-care, usual activities, pain/discomfort and anxiety/depression. To analyse the data, the EQ-5D index score was calculated using a scoring algorithm developed by Nam et al. (2007). The index score is derived by summing the scores across all five dimensions and then converting it to a single index score. The results varied between -0.171 and 1, with a score of 1 indicating no problems in any dimension. A higher score reflects a higher HR-QoL. In a previous study (Kang, 2016), a Cronbach's alpha of 0.76 was reported, while in the current study, it was found to be 0.92.

2.5.2 | Demographic factors

Socio-demographic characteristics of sex, age, education status, marital status and DM duration were collected. Educational status was classified into the following three categories: 'no schooling', 'elementary or middle school education' and 'high school or college education or higher'. Having a spouse was classified as either 'yes' or 'no'.

2.5.3 | Environmental factors

Household income was divided into five categories; higher scores indicated more financial stability. Dwelling areas were dichotomized into whether older adults lived in 'urban cities', one of the seven major cities of South Korea. DM duration was calculated from the first diagnosed age. Information on unmet medical needs was obtained through the question: 'During the past 12 months, was there ever a time when you felt you needed healthcare but you did not receive it?' Availability of healthcare or accessibility problems were classified as 'yes' or 'no'.

2.5.4 | Physical status

Weight status was assessed using body mass index (BMI) and calculated by dividing weight (kg) by the squared height (m^2). The BMI was categorized as underweight ($<18.5\text{kg}/m^2$), healthy weight ($18.5\text{--}22.9\text{kg}/m^2$) and overweight ($\geq 23\text{kg}/m^2$) based on the guidelines (Korean Endocrine Society & Korean Society for the Study of Obesity, 2010). The number of chronic diseases was obtained using a single question: 'How many chronic diseases do you have?', and the presence of hypertension and hearing, vision and eating problems were categorized as 'yes' or 'no'.

2.5.5 | Symptoms

Quality of sleep was a related factor of HR-QoL in older adults (Kim & Lee, 2009). In this study, sleep disturbances and stress influencing the participants' disease, family and finances were categorized as 'yes' or 'no'.

2.5.6 | Functional status

Self-reported medication compliance was classified as either 'yes' or 'no'. Activities of daily living (ADLs) and instrumental ADLs (IADLs) were assessed using Katz's (1983) six-item index and the Lawton-Brody Scale (Lawton & Brody, 1969) and recoded dichotomously as independent or dependent. Physical activity levels were assessed using the Korean standardized short form of the International Physical Activity Questionnaire (IPAQ) and categorized into active, minimally active and inactive (Kim, 2006).

2.5.7 | General health perception

Self-rated health was assessed with one item of the 36-item Short-Form Health Survey (Ware & Gandek, 1998): 'How would you say your health is in general?' Participants answered on a 5-point Likert-type scale ranging from 0 (*poor health*) to 4 (*excellent health*).

2.6 | Qualitative methods

2.6.1 | Multiple case study approach

We used a qualitative multiple case study design because this method allows for a detailed exploration of real-life cases, contemporary contexts and settings (Yin, 2003) and helps researchers recognize the uniqueness of each case while also helping contrast similarities and differences (Creswell, 2013a; Yin, 2003).

2.6.2 | Participants

Participants were recruited through the distribution of flyers posted in the outpatient units of a tertiary hospital and a local haemodialysis clinic in Seoul. The recruitment focused on individuals who paid regular visits to the outpatient clinic for the diagnosis of DM. The recruitment process was facilitated by physicians and nurses at both sites. Prior to the author's visit, physicians from both institutions screened potential patients who expressed interest and intentionally selected those who demonstrated sufficient cognitive abilities to provide informed consent and were physically capable of participating in 45–60-min semi-structured interviews. The sample size was not assumed when selecting participants; however, we recognized the need to include various HR-QoL patterns and

considered saturation in each pattern. The inclusion criteria were as follows: (1) aged ≥ 65 years, (2) Korean-speaking, (3) diagnosed with DM by a physician and taking medications, (4) cognitively intact and able to grant informed consent and (5) physically able to engage in a 45–60-min semi-structured interview. Older adults with Type 1 DM or those on insulin shots were excluded. Ten of the eleven participants met the inclusion criteria and had similar four HR-QoL patterns as the quantitative results for the past 5 years.

2.6.3 | Data collection

Data were collected between November 2017 and April 2018 from participants who regularly visited outpatient clinics and a haemodialysis unit following their physician appointments. Face-to-face interviews were conducted in a separate space of the clinic, involving only the first author, who possessed extensive experience in qualitative research. This arrangement ensured a comfortable environment for the participants, with no presence of family members or guardians during the interviews.

The participants' HR-QoL patterns were obtained using the HR-QoL-overtime graphing method (HOT graph) before conducting them in the semi-structured interview. The method used in this study was an adaptation of the behaviour-over-time (BOT) graph, also known as a time series or trend graph. A BOT graph is a simple tool used to visually depict patterns of behaviour for investigation from a systems perspective (Calancie et al., 2018). In this study, the vertical axis represented HR-QoL scores ranging from 1 to 10, while the horizontal axis represented time (in years). The HOT graph displays the participants' HR-QoL experiences for the past 5 years (Figure S1). From their HOT graph patterns, the participants were allocated into four groups based on the quantitative phase results: (1) high then increase; (2) high stable; (3) medium stable and (4) low then increase.

During the interviews, we utilized an HR-QoL framework to develop a semi-structured interview topic guide. The patients were asked how their DM affected their HR-QoL over the past 5 years and were prompted to talk about contexts that they thought were related to their HR-QoL: their health perception, family tightness, socio-economic status, physical status, presence of comorbidity or obesity, functional status, compliance or self-management and stressors. The semi-structured interviews were designed to elicit the patients' perspectives on the sociocultural, contextual and individual factors that they believed contributed to their HR-QoL pattern. Theoretical sampling continued until the researcher was satisfied that data saturation had been reached within each HR-QoL pattern group.

Interviews lasted between 35 and 45 min, and all interviews were audio-recorded and transcribed verbatim using two recorder applications: an internalized application on an iPhone and an iPad. These recordings were transcribed verbatim, capturing the interviews conducted in the Korean language. Detailed field notes were taken to identify the author's biases and experiences that may have influenced the interviews and data interpretation. We provided a cash incentive of USD \$25 after completing the interview as a token of gratitude.

2.7 | Data analysis

2.7.1 | Quantitative data analysis

We performed descriptive statistics to understand the participants' characteristics and compare trajectory groups. We employed a latent class growth analysis to identify the HR-QoL trajectory classes over 5 years, a multivariate statistical method within the structural equation modelling framework (Nagin, 2014). In this study, we used trajectory analysis to distinct latent classes after the installation of 'Traj' within Stata 14. The optimal number of latent classes was determined using the adjusted Bayesian information criterion (Muthén & Muthén, 2000). Next, a multinomial logistic regression analysis was conducted to identify factors that affected the different trajectories over time. The analyses were performed using SPSS Statistics 24.0 and Stata version 14.0., and a 0.05 (5%) critical level of significance was applied. The methodological quality of quantitative phase was evaluated by using the STROBE (strengthening the reporting of observational studies in epidemiology) statement of checklist.

2.7.2 | Qualitative data analysis

Thematic analysis was conducted for each case, followed by a cross-case analysis. The analysis process consisted of four stages. First, all interviews were carefully read multiple times to gain a comprehensive understanding of the content. Second, the units of meaning identified in the interviews were grouped into thematic clusters. Third, the units of meaning were condensed to reveal overarching themes and subthemes, which were used to construct a comprehensive description of the participants' experiences. Finally, the descriptions derived from the analysis were returned to the original sources for validation and confirmation.

Each transcript was compared repeatedly with itself and to the others to identify similarities and differences in the HR-QoL patterns and generate meaningful concepts (Creswell, 2013b). No software was used in this process. Meaningful concepts were first generated in Korean, and edited and revised in English by an English-Korean bilingual editor. After these revisions, they were reviewed and finalized by the authors of this article.

2.8 | Validation

Two validation procedures were used to determine the credibility of the information and whether it accurately reflected reality: first, an inter-coder agreement was estimated by making two independent researchers code the same transcript, and their results were subsequently compared (Creswell, 2013a). After the independent coding, the researchers met and compared the codes, participants' numbers, and text segments to ascertain whether a consensus was reached. Second, another researcher conducted a constant and careful auditing of all research procedures and data analyses.

3 | RESULTS

3.1 | Quantitative results

In total, 440 older adults with DM participated in the quantitative phase ($M_{\text{age}} = 72.2 \pm 4.9$ years). Mean HR-QoL scores increased from the baseline to the first two follow-ups and decreased minimally thereafter ($F = 4.587, p < 0.001$).

Using group-based modelling, we determined four distinct classes or groups of HR-QoL trajectories. Class 1, the smallest group ($n = 5, 1.3\%$), was labelled 'low then increase' (LI); it steadily worsened from medium to severe and increased 4 years after the estimation. Class 2 ($n = 157, 36.3\%$), 'medium stable' (MS), maintained a medium HR-QoL level across the 5 years. Class 3, the largest group ($n = 232, 52.7\%$), was labelled 'high stable' (HS); it had consistently high HR-QoL levels across the 5 years. Class 4 ($n = 46, 9.7\%$), 'high then decrease' (HD), maintained a stable HR-QoL score, which was the highest among the four trajectory groups but began to decrease slightly at the third follow-up point after estimation (Table S1).

3.1.1 | Predictors of HR-QoL trajectories

To identify the predictors of membership to the four latent classes, multinomial logistic regression analyses were used (Table 1). The HD class was used as the reference group for the model; its characteristics were compared with those of the MS class and HS classes at the baseline. The LI class was excluded from analyses owing to its small number of members.

The predictors of the MS class, in comparison to the HD class, included older age, lower education status, higher proportion of women, and solitary lifestyle. Impaired vision and insufficient medical needs were the differentiating factors for the HR-QoL trajectory classes. Many chronic diseases, dependency regarding ADL and IADL, lower self-rated health, and poor medication compliance were the predictors of MS and HS classes compared with HD class. Higher stress regarding finances was the characteristic of the HS class compared with the HD class. No difference was observed regarding household income, dwelling area, duration DM, BMI, hypertension, hearing problems, eating problems, sleep disturbances, stress regarding disease or International Physical Activity Questionnaire score.

3.2 | Qualitative results

3.2.1 | Overview of cases

Ten older adults with DM (five men and five women) participated in the qualitative phase of the study (age range = 65–80 years). Their HR-QoL

patterns were divided into two HD, three HS, four MS, and one LI. The participants' demographics and HR-QoL trajectory are listed in Table 2.

The interview data provided rich descriptions of participants' perspectives about their HR-QoL trajectories with five overarching themes: attitude towards DM, self-management of DM-related tasks, comorbidity-related HR-QoL, coping strategies for DM, and financial concerns about medical needs (Table 3).

3.2.2 | Attitude towards DM

Older adults with DM expressed positive or negative attitudes towards DM. Some older adults with HD and HS groups had a positive attitude, explaining DM as a 'companion' to live with or a 'shadow following them'. Although they knew DM was an incurable chronic illness that would need to be managed for the rest of their lives, they accepted the lifestyle change. MS and LI understood DM as an illness that had ruined their lives. They had negative DM outcomes and expressed self-blame for having DM and its complications and anxiety about the development of complications or about taking insulin shots in the future.

I am exhausted with DM and want to get rid of it from my life if I can. I can do nothing with diabetes.

(participant 10_LI)

3.2.3 | Self-management of DM-related tasks

All the participants had the burden of self-management, including regular exercise, medication compliance, recommended diet, and routine self-monitoring of blood sugar level, and they spent a large part of the interview discussing their DM-related tasks. The participants demonstrated the four types of code, which specified the self-management of DM-related tasks.

3.2.4 | Daily routine versus carelessness

Some could lead a more or less normal life because they were more likely to prioritize DM-related activities. In contrast, there were participants who expressed a lack of concern and avoidance towards their DM.

I always take diabetes pills with other medications every morning and exercise regularly for an hour each day. It's a habit, and I rarely skip it.

(participant 2_HD)

I have been neglecting my diabetes self-care. Despite knowing the risks, I continued to

TABLE 1 Class comparison (multinomial logistic regression analyses).

	Trajectory class					
	MS class vs. HD class (ref.)			HS class vs. HD class (ref.)		
	RRR	95% CI	<i>p</i>	RRR	95% CI	<i>p</i>
Demographic factors						
Sex (male)	0.015	0.003–0.089	<0.001	0.032	0.006–0.165	<0.001
Age (years)	1.264	1.093–1.461	0.002	1.229	1.077–1.404	0.002
Education	0.288	0.101–0.824	0.02	0.546	0.216–1.381	0.201
Spouse (yes)	16.36	2.896–92.387	0.002	17.2	3.324–89.030	0.001
Environmental factors						
Household income	0.973	0.684–1.385	0.881	1.192	0.903–1.575	0.215
Dwelling area (urban)	0.968	0.300–3.130	0.957	1.62	0.584–4.499	0.354
Duration of DM	0.993	0.915–1.076	0.858	0.992	0.920–1.068	0.824
Unmet medical needs (yes)	12.22	1.149–129.963	0.038	8.141	0.837–79.172	0.071
Health-related factors						
Physical status						
Body mass index	0.996	0.685–1.449	0.983	1.074	0.775–1.490	0.668
Weight status (underweight)	2.752	0.066–115.442	0.595	2.7	0.103–70.557	0.551
Weight status (normal)	0.510	0.073–3.580	0.498	1.045	0.193–5.645	0.959
Number of chronic diseases	1.384	1.038–1.845	0.027	1.086	0.832–1.418	0.542
Hypertension (yes)	0.935	0.272–3.217	0.915	1.167	0.389–3.496	0.783
Hearing problems (yes)	1.687	0.377–7.550	0.494	2.253	0.558–9.097	0.254
Vision problems (yes)	5.836	1.503–22.657	0.011	4.406	1.248–15.549	0.021
Eating problems (yes)	0.893	0.168–4.742	0.894	0.863	0.188–3.963	0.85
Symptoms						
Sleep disturbances (yes)	1.453	0.497–4.249	0.495	1.504	0.587–3.852	0.395
Stress on disease (yes)	2.613	0.595–11.469	0.203	0.985	0.336–2.887	0.979
Stress on family (yes)	2.900	0.821–10.246	0.098	2.782	0.878–8.816	0.082
Stress on finances (yes)	2.879	0.805–10.296	0.104	3.09	1.030–9.270	0.044
Functional status						
ADLs (independent)	0.140	0.032–0.611	0.009	0.713	0.184–2.768	0.625
IADLs (independent)	0.000	0.000–0.000	<0.001	-	-	-
Medication compliance (high)	0.06	0.005–0.787	0.032	0.039	0.003–0.446	0.009
IPAQ (inactive)	0.792	0.151–4.162	0.783	0.686	0.168–2.794	0.599
IPAQ (minimally active)	0.309	0.064–1.487	0.143	0.486	0.135–1.752	0.27
Health perceptions						
Self-rated health	0.285	0.139–0.581	0.001	0.542	0.284–1.035	0.063

Note: Reference values: sex (female), spouse (no), dwelling area (rural), unmet (no), hypertension (no), hearing problems (no), vision problems (no), eating problem (no), stress about diseases (no), stress about family (no), stress about finances (no), ADL (dependent), IADL (dependent), compliance (low), weight status (overweight), IPAQ (active).

Abbreviations: ADL, activities of daily living; HD, high then decrease; HS, high stable; IADL, instrumental activities of daily living; IPAQ, international physical activity questionnaire; MS, medium stable; Ref, reference group (HD class); RRR, relative risk ratio.

consume excessive amounts of alcohol and soda. Reliance on medication has led me to believe that I can avoid the challenges of engaging in complex self-management.

(participant 9_MS)

3.2.5 | Internal versus external motivation

The HD and HS groups had strong internal motivation for DM self-management in the hope of overcoming DM and participated in self-management voluntarily.

TABLE 2 Demographic description and allocation of health-related quality of life.

No	Case	Sex/age (years)	Family	Years with DM	Religion	Region	HR-QoL trajectory allocation
1	Kim J	M/74	Spouse and daughter's family	25	Buddhist	Seoul	High decrease
2	Kwon	F/70	Spouse	12	Soka Gakkai	Seoul	High decrease
3	Park	M/80	Spouse	25	None	Seoul	High stable
4	Seo	M/73	Spouse	10	Christian	Gyeonggi	High stable
5	Sung	F/68	Son	40	None	Seoul	High stable
6	Han	F/71	Spouse	12	Christian	Gimcheon	Medium stable
7	Jung	F/74	Son and grandson	40	None	Seoul	Medium stable
8	Kim K	M/67	Spouse and two daughters	30	None	Seoul	Medium stable
9	Lim	M/69	Spouse and son	15	None	Seoul	Medium stable
10	Lee	F/65	Elder and younger sisters	20	None	Seoul	Low then increase

Abbreviations: DM, diabetes mellitus; F, female; HR-QoL, health-related quality of life; M, male.

TABLE 3 Five themes identified among participants.

Codes	Theme
Companion vs. destroyer of life Feeling like a victim	Attitude towards DM
Daily routine vs. carelessness Internal vs. external motivation Concern about glycaemia Diet struggles	Self-management of DM-related tasks
Comorbidity-related HR-QoL	Comorbidity-related HR-QoL
Self-confidence and creating a new sense of pride Prayer and religious faith Relationship with health professionals Having a social network	Coping strategies for DM
Financial burden Can financially manage health problems National beneficiary	Financial concerns about medical needs

Abbreviations: DM, diabetes mellitus; HR-QoL, health-related quality of life.

I take good care of myself, saying, 'I will see if DM wins or if I win'.

(participant 1_HD)

In contrast, the MS class expressed difficulty managing DM and had an internal struggle with the demand for lifestyle changes. Although all were aware of the importance of physical activity, they expressed ambivalence towards making behavioural changes. Finally, feeling pressure from external factors, such as the development of complications or doctor's warnings, resulted in initiating self-management.

3.2.6 | Concerns about glycaemia

Most participants monitored their glycaemia based on the self-test or laboratory test. Some participants in the HS and MS groups expressed concerns about hyperglycaemia and believed that uncontrolled DM made them physically weak. They considered uncontrolled DM as a threat to their HR-QoL. To mitigate this threat, they self-checked their blood sugar levels regularly and endeavoured to maintain proper blood sugar levels.

I am always worried about having hypoglycemia. I always carry candy or chocolate in my pocket and drink milk before I exercise at dawn.

(participant 6_MS)

I eat anything for fear of having low blood sugar even if I do not have an appetite.

(participant 5_HS)

3.2.7 | Diet struggles

Regardless of HR-QoL patterns, most older adults reported that they had difficulties in restricting food and moderating and integrating dietary recommendations. They deviated from recommended diets and did not care about them.

Cooking is hard as I am getting older. Bread or noodles is usual and convenient for me nowadays.

(participant 3_HS)

3.3 | Comorbidity-related HR-QoL

Acute illness or comorbidity such as operations, cancer diagnosis, pain, or hearing problems caused changes in HR-QoL patterns.

Particularly, pain was the most influential factor for HR-QoL patterns and could evoke substantial suffering for some participants.

DM is no problem for me. In fact, when I had cancer, it [HR-QoL] went down like this. It [was] not because of DM.

(participant 4_HS)

It restricts my activity, and I cannot sleep well at night. This pain is a big problem for me; however, I am not sick from DM.

(participant 7_MS)

3.4 | Coping strategies for DM

The participants used various strategies to effectively cope with DM in their lives, as discussed below as four codes.

3.4.1 | Self-confidence and creating a new sense of pride

Some older adults in the HD and HS groups expressed self-confidence that they could control their illness through force of will. Older adults expressed that problematic situations pertaining to physical and psychological health created a new sense of pride. One older adult in the LI group revealed that they were proud of still being alive.

3.4.2 | Prayer and religious faith

Prayer and religious faith were cited by the HD and HS participants. They had a strong faith in God and regularly prayed and read the Bible. There were different types of religions; however, the way they practiced religion was very similar.

3.4.3 | Relationships with health professionals

Older adults with DM visited primary care physicians regularly to check up on their DM and changes to their medication. Choice of the clinic was based predominantly on geography. Some maintained good communication with the physicians and felt close to them, while others did not.

3.4.4 | Having a social network

Some older adults had good social networks in which much information was exchanged, and they gained vitality as a result. The spouse was sometimes a stressor or supporter for the participants. An older adult in the LI group did not have any social network except two sisters. She spent all day alone and complained about isolation.

3.5 | Financial concerns about meeting medical needs

Regardless of the group, older adults experienced significant financial burdens. A low-income participant in the MS group reported being unable to afford the required medical services or purchase recommended food, like fresh fruit.

My doctor always taught me about what to eat and what not to eat, but I did not care that much. I know what to eat, like fresh fruit or vegetable; however, I cannot spend money to eat right.

(participant 7_MS)

However, one participant in the HS group had sufficient financial resources to manage their health problems and received the necessary services. They reached out to healthcare providers to manage their various problems. Additionally, as national Medicaid beneficiaries, the LI participants could meet their medical needs adequately.

I can get as many treatments as I want. The country supports it. I am going to the hospital tomorrow to get an MRI because of back pain.

(participant 10_LI)

3.6 | Mixed methods findings and implications

By linking the quantitative and qualitative data, similarities and differences among the four trajectories were identified, and further understanding was gained about the factors influencing each trajectory. The quantitative statistics demonstrated four distinct HR-QoL trajectories among older adults with DM, as noted: HD, HS, MS and LI. The qualitative data provided a rich description of the participants' voices and perspectives on their HR-QoL, revealing five key themes: attitude towards DM, self-management of DM-related tasks, comorbidity-related HR-QoL, coping with DM and financial concerns about medical needs. [Figure 1](#) illustrates the emergence of HR-QoL trajectories from the quantitative and qualitative results. The figure is divided into two sections or levels; the first illustrates the qualitative themes, while the second demonstrates the quantitative categories of HR-QoL trajectories. [Figure 1](#) can be followed from the first to the second level to see how the qualitative findings explain the quantitative trajectories of HR-QoL.

3.6.1 | HD group

Among the four trajectories, the two older adults in the HD trajectory group maintained the highest HR-QoL. They held positive attitudes towards DM and accepted it as a part of aging, similar to other chronic diseases like hypertension. They had strong internal motivation and hoped to improve their health status and exercise regularly. They gained self-confidence by controlling their DM. They

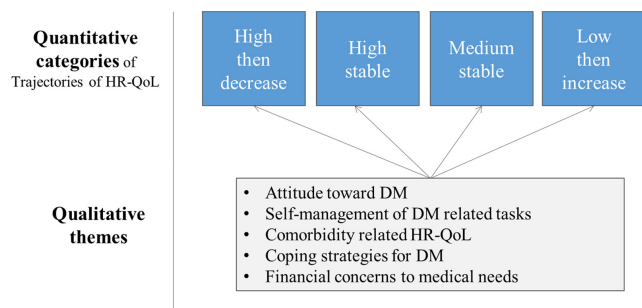


FIGURE 1 Demonstration of mixed methods findings: linking quantitative and qualitative data. DM, diabetes mellitus; HR-QoL, health-related quality of life.

regularly prayed and read the Bible, had a strong faith in God, and were satisfied with their present life. Good relationships with health professionals and spouses provided them with support. However, diet control and preparing meals were difficult for them and their spouses; sometimes, they neglected to control their diet. They were also financially stable.

3.6.2 | HS group

Throughout the 5-year period, three older adults in the HS group constantly had high HR-QoL. The HS group held positive attitudes towards DM and accepted it as a companion, like a 'faint shadow that followed them'. Sometimes, they were frustrated with DM-related tasks and had inner struggles. However, they overcame these difficulties and frustrations and retained their willingness to maintain their health status. They felt competent enough to manage DM with medication compliance and physical exercise. They were proud of maintaining their bodies and being long-term survivors of DM. They also positively embraced lifestyle changes required because of their disease or aging, like the HD participants. They wanted to sustain (rather than improve) their present health status.

3.6.3 | MS group

It was found that four older adults in the MS class consistently maintained a medium HR-QoL level, consistent with prior research on older South Korean adults with DM (Shin et al., 2011). In contrast to previous groups, the MS group held negative attitudes towards DM. They regarded DM as an illness and destroyer of their lives and were pessimistic about the future owing to their DM. Older adults in the MS group were aware of the importance of physical activity; however, they were ambivalent about making behavioural changes, were careless, and avoided measures to control DM. They did not have any confidence in their DM self-management ability and felt guilty about their illness because of their carelessness. They were supported by health professionals; however, they were not satisfied with the health professionals, and they blamed them for their illness.

3.6.4 | LI group

Only one participant was included in the LI class, and this individual demonstrated fluctuating levels of HR-QoL over 5 years. This participant's anxiety/depression score was relatively high compared with the HD and HS groups and she was exhausted because of DM. Back pain and blindness limited her physical activity and worsened her ability to control her DM. She depended on her primary health professionals for treatment and depended on her caregivers for her wellbeing. She was socially isolated, and her two pet animals were her only companions, which she noted added vitality to her life. She felt DM had ruined her life; however, she was proud to be still living with DM after 25 years.

4 | DISCUSSION

The primary objective of this study was to identify distinct trajectories of HR-QoL and explore the patterns of similarities and differences within each trajectory group.

4.1 | HR-QoL trajectories patterns

One interesting finding was that approximately half of the participants had high levels of HR-QoL over 5 years. This supports prior research that dispelled the myth that older adults with DM have poor HR-QoL and are worsening (Choi et al., 2011; Lee & Kim, 2017). This study adds to the current literature as it demonstrates the breadth of individual variations in HR-QoL. Our charge is now to focus on maintaining a high HR-QoL level while being cautious about positive attitudes and internal motivation factors that these older adults already possess.

4.2 | Factors influencing HR-QoL trajectories patterns

In this study, we observed that changes in the HR-QoL of older adults with DM were influenced by factors beyond DM itself, including health conditions such as cancer, chronic pain, or recent surgical procedures. These findings align with previous literature, supporting the notion that geriatric syndromes and DM-related complications, including diabetic retinopathy, neuropathy and nephropathy, are contributors to the decreased HR-QoL among this population (Kim, 2013; Laiteerapong et al., 2011; Yim & No, 2010). Thus, our results reinforce the existing body of knowledge regarding the multifactorial nature of decreased HR-QoL in older adults with DM, highlighting the significance of considering comorbid health conditions in understanding and addressing their overall well-being.

Supportive healthcare providers may help enhance adherence to self-care management and HR-QoL among older adults with DM in this study. Physicians' empathy, support, and respect for patients' autonomy contribute to older adults' satisfaction with their diabetes

management (Adolfsson et al., 2008) and may help older adults stay connected with their healthcare providers and foster HR-QoL. Nurses are typically the main providers of diabetes education, and they are recognized as useful case managers (Beck et al., 2018). Therefore, nursing experts or monitoring systems that ensure self-care management for older adults should be disseminated in primary care clinics.

Some older adults with DM in the study were not financially well-off, and monetary concerns restricted appropriate diagnosis and subsequent treatment. General financial factors influenced the implementation of some of the required lifestyle adjustments in DM because items such as test strips or needles, fresh food and medications are costly. Underuse of these items is associated with severe health consequences and decrements in self-reported health status. Inadequate and inconsistent access to diabetes-appropriate food is likely an important factor in the association between food insecurity and poor glycemic control among adults with diabetes (Seligman et al., 2015). Without proper care, DM cannot be controlled, and HR-QoL will be compromised. Therefore, for financially vulnerable individuals, the government should provide financial and systematic support, and nurses should facilitate access to public resources.

4.3 | Strengths and limitations

Our methodological approaches challenge our underlying assumptions. In this mixed-methods explanatory sequential design, we elucidated how linking quantitative and qualitative results led to a formation of a quantitative typology (Creswell & Plano-Clark, 2011) in which we integrated qualitative themes and visuals and we revealed four distinct, latent trajectory groups—in contrast to the conventional view in which older adults with DM have been mainly considered a homogeneous group with identical characteristics. The integration of qualitative methods in our study enriches the depth and comprehensiveness of our findings, thus enabling a more detailed understanding of the changes in HR-QoL over time among older adults with DM. The combination of quantitative and qualitative data through our mixed methods approach highlights the importance of customized interventions that cater to the unique HR-QoL trajectories of older adults with DM. By considering the diverse experiences and needs of this population, we can develop tailored interventions that address their specific challenges and promote improved HR-QoL.

There are several limitations to this study. First, in the phase I quantitative study, respondents' ADL and IADL were somewhat likely to be independent. As the data used in this study were from a nationwide face-to-face survey, frail older adults may not have participated. Therefore, possible non-responses of physically dependent older adults with DM may have contributed to an overestimation of HR-QoL. Second, in the qualitative phase, samples were selected from different populations and times of the quantitative phase, although we could not identify the possibility of participating in the survey historically. Their views may differ from those in long-term care hospitals or nursing homes, or rural settings. Third,

we examined short-term (rather than long-term) changes in HR-QoL among older adults with DM. Future research should identify subgroups by considering diagnosis time and participants' age, which could inform individualized nursing interventions.

Nonetheless, this study employed a valuable mixed method design, which allowed us to explore, clarify and extend our analyses of each HR-QoL trajectory class. The emotional, psychological and spiritual dimensions—known to strongly influence HR-QoL—that were not included in the quantitative phase could be explored in this study's qualitative phase.

5 | CONCLUSION

By bridging the quantitatively analysed data with rich interview data of older adults' HR-QoL trajectory, we articulated categories in the form of profiles, which can help health providers visualize the specific heterogeneity in the seemingly homogenous group of older adults with DM. These categories enabled us to offer specific recommendations to healthcare providers to clarify the complexity of individuals and provide tailored interventions. A future application of this research may help healthcare providers understand the need to assess the HR-QoL comprehensively and promote HR-QoL for older adults with DM.

6 | RELEVANCE TO CLINICAL PRACTICE

Health professionals should focus on maintaining a high level of HR-QoL while being cautious about positive attitudes and internal motivation factors that these older adults with DM already possess.

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The authors declared no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

ETHICS STATEMENT

This study was exempt from the ethical review by the institutional review board of the author's university (Institutional Review Board Approval No. Y-2017-0011) due to de-identified data use.

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SUPPORTING INFORMATION

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