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Exploring Diabetes Wellbeing: A Panel Data Analysis of Physical Activity, Depressive Symptoms, and Health-Related Quality of Life in Korea

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Abstract

Background: Negative health outcome is the result of both physical activity and depressive symptoms aggravating each other. The potential impact of the interaction between physical activity and depressive symptoms on health-related quality of life is not well understood. This study was conducted to investigate the association between physical activity, depressive symptoms, and health-related quality of life in diabetic patients in Korea. Methods: Data was collected from 1,472 participants with diabetes mellitus from the Korea Health Panel Survey (KHPS) in 2020 after missing values were excluded. Sociodemographic characteristics, physical activity, depressive symptoms, and EQ -5D scores were obtained from the KHPS. To determine the association between physical activity, depressive symptoms, and health-related quality of life, linear regression analysis was performed after controlling for confounding variables. Results: Results showed that physical activity and depressive symptoms had a significant impact on health-related quality of life. After adjustment for gender, age, occupation, and alcohol consumption, physical activity and depressive symptoms remained strongly associated. The incidence of depressive symptoms was 0.74 higher with irregular physical activity than among those who took part in regular physical activity ($p < 0.05$). Conclusion: Physical activity and depression symptoms are correlated with health-related quality of life. Physical activity intensity and depressive symptoms should be considered when developing programs to improve health-related quality of life.

Keywords: *Physical Activity, Depressive Symptom, Health-Related Quality of Life, Diabetes.*

INTRODUCTION

Diabetes, a long-term chronic condition affecting millions globally, is becoming a major contributor to increased mortality rates and a decline in quality of life (QoL). According to new projections, the prevalence of type 2 diabetes will increase by over two-fold over the next three decades, rising from 529 million in 2021 to around 1.3 billion in 2050 (Ong et al., 2023). In US, diabetes has been a significant health issue (CDC,

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2020). According to data from the Centers for Disease Control and Prevention (CDC), around 10.5% of the United Stated population had diabetes in 2020. In the same year 2020, 16.7% of Koreans (or one million adults) were living with diabetes. Furthermore, 15.8 million Korean adults have prediabetes and face an increased of risk of developing diabetes (Bae et al., 2022). Although this study centers on South Korea, its findings provide important cross-national insights. For researchers and policymakers in countries experiencing similar rapid epidemiological transitions, such as Indonesia, the Korean context offers a valuable benchmark. Examining how a high-income Asian country with a comprehensive health insurance system addresses the growing dual burden of chronic disease and mental health may inform strategies to enhance integrated health services globally.

The well-being of individuals with diabetes requires a holistic care approach that goes beyond physical health to also include emotional dimension and psychological. In diabetes management, increasing emphasis has been placed on Health-Related Quality of Life (HRQoL), as a chronic disease is known to affect various areas of everyday functioning (Shamshirgaran et al., 2020). HRQoL refer a broad, multidimensional concept that covers physical functioning, emotional state, and social well-being. Research indicates that individuals with diabetes generally experience poorer HRQoL compared to those without the condition. In addition, people with prediabetes and diabetes tend to show a more pronounced decline in HRQoL than individuals with normal blood glucose levels (Zuo et al., 2020). Therefore, evaluating HRQoL is essential for identifying the factors that affect it and for designing targeted interventions aimed at improving patient outcomes, particularly in reducing pain, discomfort, and other negative effects associated with the disease (Etxeberria et al., 2019).

Helplessness, anxiety, and sadness are frequently experienced by individuals with diabetes mellitus and are collectively recognized as depressive symptomatology (Renn et al., 2020). Depressive symptoms are observed in individuals with diabetes at a prevalence of approximately 10% to 15%, which is about twice as high as in those without diabetes.

According to Jeong (2021), findings from the 2014, 2016, and 2018 Korea National Health and Nutrition Examination Surveys reveal that 9.6% of Korean individuals diagnosed with diabetes suffered from moderate to severe depression. Consistent with previous evidence, this study indicates that depression occurs at a higher rate among diabetic patients than in the broader public. Furthermore, inadequate and fragmented healthcare services might partially account for the high incidence of this comorbidity (Cheng et al., 2019). The presence of depressive symptoms has a substantial impact on diabetes management, as it complicates glycemic control, increases the risk of complications, reduces medication adherence, exacerbates psychological distress, and leads to greater healthcare utilization. In addition, depression has been shown to significantly reduce HRQoL (Zurita-Cruz et al., 2018).

Evidence suggests that staying physically active improves HRQoL for those managing diabetes by strengthening both body and mind. Similarly, a systematic analysis identified a consistent positive trend between increased physical activity and better HRQoL among adults in general (Marquez et al., 2020). Furthermore, consistent physical activity serves as a vital intervention for stress management, thereby fostering enhanced psychological well-being. Subsequent evidence highlights that such exertion correlates with a reduction in depressive symptoms, ultimately playing a crucial role in elevating HRQoL (Puciato et al., 2023).

Although depressive symptoms are significantly associated with physical activity and HRQoL, limited research has examined these relationships specifically among individuals with diabetes mellitus. Most existing studies have investigated the effects of

physical activity on either depressive symptoms or HRQoL in isolation. The benefits of physical activity for individuals with diabetes remain unclear due to insufficient evidence supporting its role in reducing depressive symptoms. This knowledge gap persists because most exercise interventions for diabetes prioritize physiological outcomes, such as glycemic control measured by HbA1c levels, while often overlooking the psychological mechanisms by which physical activity may alleviate emotional distress related to chronic disease management. Consequently, there is a scarcity of robust empirical evidence examining physical activity as a viable non-pharmacological strategy to mitigate the deterioration of HRQoL among populations experiencing depressive symptoms. Additionally, research examining the associations among physical activity, depressive symptoms, and HRQoL in individuals with diabetes mellitus (DM) in Korea is scarce. The present study addresses these gaps by utilizing data from the Korean Health Panel Study (KHPS), which provides a large, diverse sample suitable for subgroup analyses and longitudinal assessment of changes over time. Therefore, the primary objective of this research is to examine the interrelationships among physical activity, depressive symptoms, and HRQoL within the diabetic population in Korea.

METHODS

Data for this research were sourced from the 2020 Korea Health Panel Survey (KHPS), a collaborative initiative administered by the Korea Institute for Health and Social Affairs and the National Health Insurance Corporation. This survey offers nationally representative data on healthcare utilization and health expenditure in Korea. Although the KHPS is a longitudinal panel study, the present research utilized a cross-sectional design focusing exclusively on the 2020 wave. This approach was chosen to allow a timely evaluation of the association between physical activity and mental health in the context of the COVID-19 pandemic, a period that significantly altered public health behaviors and quality of life. Focusing on this specific time point minimizes the confounding effects of pre-pandemic behavioral patterns and offers a more relevant perspective for current public health policy-making.

In the KHPS, every household and individual is given a unique identification code that is kept confidential within the dataset. The database and data collection procedures are designed to safeguard participant privacy by ensuring that these ID numbers cannot be linked to any personal identifying information. Within the KHPS, computer-assisted personal interviews are conducted during home visits by trained interviewers. . All participants gave informed consent allowing their data to be used for future scientific studies. In February 2020, the Institutional Review Board of the Korea Institute for Health and Social Affairs approved this research (IRB No. 2020-05), which was conducted following the Declaration of Helsinki guidelines. As the KHPS dataset contains non-identifiable, open-access secondary data, the KHPS consortium granted permission to utilize the dataset subsequent to the filing of a standard data use agreement. Supplementary survey details are provided on the KHPS web portal (https://www.khp.re.kr:444/eng/main.do, retrieved January 20, 2026).

Comprising household, individual, and disease components, the KHPS offers a comprehensive dataset. The household instrument is designed to elicit information concerning general household attributes, routine living and medical expenses, alongside private health insurance policies and premium payments. In distinction, the individual survey zeroes in on the personal demographic details of the participants. Data collection begins with the submission and approval of a data use agreement. Once approved and the dataset is received via email, data extraction is carried out using SPSS.

For diabetes mellitus, respondents were asked whether they had a "chronic diabetes" condition, with response options of yes or no. The 2020 health panel survey identified 1,543 participants with diabetes mellitus from a total sample of 14,844. To ensure data integrity and minimize bias, individuals with missing or incomplete information regarding the primary variables were excluded. Specifically, respondents who did not report physical activity (40 individuals) and those who did not answer the alcohol consumption question (31 individuals) were excluded. After further removal of cases with missing data across other covariates, the final analytic sample comprised 1,472 respondents.

Covariates included in the analysis were gender (male and female), age, education level, occupation, family composition, smoking status, high-risk alcohol consumption, and body mass index (BMI). Age was summarized using means and standard deviations. Education was initially measured on a 6-point Likert scale according to KHPS classification, but responses were reclassified into four categories: elementary school or lower, junior high school, senior high school, and college degree or higher. Both education and occupation were assessed using a 6-point Likert scale; however, occupation was dichotomized into "employed" and "unemployed" following the method of Kim et al. (Noh et al., 2015). Family composition was determined by the KHPS question, "Do you currently live in this household together?" and categorized as "living alone" or "living with others." Participants' BMI was determined by calculating their weight (kg) per square meter of height (m^2). Based on the parameters outlined by the Korean Society for Obesity Studies (Oh et al., 2004), a BMI cutoff of over 25 was utilized to define obesity in this study.

Smoking behavior was divided into three groups: individuals who had never smoked, those who had quit smoking, and those who currently smoke. Current smokers were defined as people who had smoked within the last 30 days, while former smokers referred to those who had stopped smoking for more than one year (M.-C. Kim, 2011). Alcohol consumption was classified into two levels based on drinking frequency and amount. High-risk alcohol consumption was operationalized as the intake of more than seven alcoholic beverages for males, or exceeding five for females, occurring on at least a monthly basis. Low-risk drinking included individuals who either did not consume alcohol or drank less than once a month (World Health Organization, 2000).

The data used for physical activity and depressive symptoms were obtained from the 2020 KHPS wave. Physical activity levels were assessed by asking participants whether they had maintained a regular exercise regimen over the preceding twelve months. Based on their responses, individuals were dichotomized into two distinct categories: those engaging in routine sports or exercise, and those who were inactive." Regular and irregular physical activity were defined exclusively by the regularity of participation, regardless of the type or intensity of activity. Related to the question, "In the past year, have you felt so sad or unhappy for more than two weeks in a row that it disrupted your daily life?" Participants responded with either "yes," meaning they experienced depressive symptoms, or "no," meaning they did not report any depressive symptoms.

HRQoL was assessed utilizing the European Quality of Life 5 Dimension (EQ-5D) questionnaire, a metric embedded within the KHPS framework since 2009 and widely recognized as a standard evaluative tool. The instrument captures five core health domains: mobility, self-care, usual activities, pain or discomfort, and anxiety/depression. For the purpose of this analysis, participants rated their current health status across these parameters on a three-point scale as 1 (no problems), 2 (moderate problems), and 3 (severe problems). Consequently, elevated cumulative scores reflect a more profound impairment in an individual's health-related quality of life.

RESULTS

Respondents mean age was 67.79 – 68.08 in both of group physical activities. Of the two physical activities groups, the regular physical activities group had lowest percentage of females (45.9%) and highest number of occupation categories as currently working (81.3%).

Table 1. General Characteristics of the subject (N=1,472)

	PA classification		
	Regular (n=739)	Irregular (n=733)	*p* value
Gender			.001
Male	400 (54.1)	331 (45.2)	
Female	339 (45.9)	402 (54.8)	
Age (years)	68.08 ± 10.44	67.79 ± 11.17	.611
Education			.060
Elementary school or lower	262 (35.5)	294 (40.1)	
Junior high school	139 (18.8)	139 (19.0)	
Senior high school	223 (30.2)	218 (29.7)	
College degree or above	115 (15.6)	82 (11.2)	
Occupation			.545
Employed	601 (81.3)	587 (80.1)	
Unemployed	138 (18.7)	146 (19.9)	
Family composition			.672
Living alone	11 (1.5)	14 (1.9)	
Living with others	728 (98.5)	719 (98.1)	
Smoking status			.450
Current smoker	346 (46.8)	309 (42.2)	
Ex-Smoker	30 (4.1)	356 (48.6)	
Never smoking	364 (49.1)	68 (15.8)	
High-risk alcohol drinking			.000
Yes	125 (16.9)	136 (18.6)	
No	614 (83.1)	597 (81.4)	
BMI			.000
Non-Obese	499 (67.5)	402 (54.8)	
Obese	240 (32.5)	331 (45.2)	

Abbreviations: N, total sample; *n*, sub-group size; *M*, mean; *p*, *p*-value; BMI, Body Mass Index; PA, Physical Activity. Descriptive statistics are provided as $M \pm SD$ for continuous measures and as counts with proportions [*n* (%)] for categorical factors. The reported *p*-values were calculated via Chi-square tests of independence or independent *t*-tests

The regular physical activity group had twice as much as the non-obese group (67.5%) compared than obese respondents, and BMI was significantly different across groups. Demographically, the current respondents constituted the highest percentage of individuals who had never smoked (49.1% and 48.6%), alongside the largest proportion of those avoiding high-risk alcohol intake. As anticipated, within the four distinct groups analyzed for lifestyle and psychological well-being, these patients similarly demonstrated the highest frequency of habitual exercise coupled with a complete lack of depressive indicators. Most of the respondents who have symptoms of depression are employed in both of groups. Prevalence depressive symptom in regular physical activities group

42.7% compared than 57.3% in irregular physical activities. Based on gender characteristics, females were highest number have depressive symptom (64.3%) and lower health-related quality of life ($M = 0.83 \pm 0.13$) compare than male.

Table 2. Participant characteristics by PA and depressive symptom (N=1,472)

Characteristics	PA and depressive symptom group: Regular PA and depressive symptom (n = 73)	Regular PA and No Depressive symptom (n = 666)	Irregular PA and Depressive symptom (n = 98)	Irregular PA and No Depressive symptom (n = 635)
Gender				
Male	33 (45.2)	367 (55.1)	28 (28.6)	303 (47.7)
Female	40 (54.8)	299 (44.9)	70 (71.4)	332 (52.3)
Age (years)	66.49 ± 10.23	68.32 ± 10.47	68.91 ± 10.59	67.61 ± 11.29
Education				
Elementary school or lower	32 (43.8)	230 (34.5)	45 (45.9)	249 (39.2)
Junior high school	10 (13.7)	129 (19.4)	19 (19.4)	120 (18.9)
Senior high school	19 (26.0)	204 (30.6)	24 (24.5)	194 (30.6)
College degree or above	12 (16.4)	103 (15.5)	10 (10.2)	72 (11.3)
Occupation				
Employed	64 (87.7)	537 (80.6)	78 (79.6)	509 (80.2)
Unemployed	9 (12.3)	129 (19.4)	20 (20.4)	126 (19.8)
Family composition				
Living alone	2 (2.7)	9 (1.4)	1 (1.0)	12 (2.0)
Living with others	71 (97.3)	657 (98.6)	97 (99.0)	622 (98.0)
Smoking status				
Current smoker	30 (41.1)	316 (47.4)	29 (29.6%)	280 (44.1)
Ex-Smoker	3 (4.1)	27 (4.1)	1 (1.0)	355 (55.9)
Never smoking	40 (54.8)	323 (48.5)	68 (69.4)	0 (0.0)
High-risk alcohol drinking				
Yes	8 (10.7)	117 (16.9)	8 (8.2)	128 (20.2)
No	65 (86.7)	549 (79.3)	90 (91.8)	507 (79.8)
BMI				
Non-Obese	52 (71.2)	447 (67.1)	59 (60.2)	343 (54.0)
Obese	21 (28.8)	219 (32.9)	39 (39.8)	292 (46.0)

N = overall sample size; *n* = group size; *M* = mean value; *SD* = standard deviation; % = percentage; BMI = Body Mass Index; PA = Physical Activity. Continuous data regarding age are provided as means with standard deviations (*M* ± *SD*), while the other demographic features are presented as absolute numbers and frequencies [*n* (%)].

Table 3. Differences of depressive symptom and HRQoL based on gender (N=1,472)

Characteristics	Categories	Male		Female		*p*-value
		n / M±SD	%	n / M±SD	%	
Depressive symptom	Yes	61	35.7	110	64.3	.000
	No	670	51.5	631	48.5	
HRQoL		0.88 ± 0.12		0.83 ± 0.13		.000

P-values are derived from *Chi-square* or t-test tests, *M* = Mean, *SD* = Standard Deviation, HRQoL = Health-Related Quality of Life

Differences in mean HRQoL of life scores were assessed using an independent-samples *t*-test, specifically comparing the regular physical activity cohort (n = 739) with the irregular physical activity group (n = 733). The t test was statistically significant, with the regular physical activity group (M = 0.89, SD = 0.09), 95% CI [.041, .067], than the irregular physical activity group (M = 0.83, SD = 0.15), $t(1470) = 8.309$, $p < .05$.

Table 4. Comparison HRQoL between regular physical activity and irregular physical activity (N=1,472)

Variable	Regular physical activity		Irregular physical activity				95% CI	
	M	SD	M	SD	t (1,472)	*p*	LL	UL
Health related QoL	0.89	0.09	0.83	0.152	8.29	0.000	.414	.670

M denotes the mean, *SD* represents the standard deviation, and 95% CI indicates the 95% confidence interval (*LL*, lower limit; *UL*, upper limit). All *p*-values were calculated via standard *t*-tests.

The primary findings of this investigation underscore the interactive effects of physical activity and depressive symptoms on health-related quality of life (HRQoL). Initial analyses revealed a significant association between this interaction and HRQoL (B = -0.051, 95% CI: -0.063 to -0.038 and B = 0.102, 95% CI: 0.083 to 0.121; $p < 0.05$). This relationship retained its statistical significance in Model 2, following adjustments for demographic variables including gender, age, and occupation (B = -0.053, 95% CI: -0.070 to -0.035; $p < 0.05$). Conversely, the inclusion of lifestyle covariates—specifically smoking and alcohol consumption—in Model 3 attenuated these effects to non-significance, with only alcohol intake demonstrating a significant, independent correlation with HRQoL (B = -0.018, 95% CI: -0.035 to -0.002; $p < 0.05$).

Table 5. Association of physical activities, depressive symptom and HRQoL in diabetes mellitus (N=1,472)

Variables	B (95%-CI)	β	*p*-value
Model 1			
Physical activities	-0.051 (-0.063; -0.038)	-0.198	.000
Depressive symptoms	0.102 (0.083 – 0.121)	0.255	.000
Model 2	-0.048 (-0.060; -0.037)	-0.188	.000
Physical activities	0.099 (0.08; 0.117)	0.249	.000
Depressive symptoms	-0.030 (-0.041; -0.018)	-0.207	.000
Gender	-0.002 (-0.003; -0.002)	-0.116	.000
Age	-0.054 (-0.071; -0.036)	-0.166	.000
Occupation			

Model 3			
Physical activities	-0.046 (-0.058; -0.033)	-0.178	.000
Depressive symptoms	0.101 (0.082; 0.119)	0.252	.000
Gender	-0.033 (-0.051; -0.015)	-0.203	.000
Age	-0.002 (-0.003; -0.002)	-0.130	.000
Occupation	-0.053 (-0.070; -0.035)	-0.163	.000
Drink alcohol	-0.018 (-0.035; -0.002)	-0.055	.028
Smoking	0.007 (-0.004; 0.018)	0.046	.207

B, unstandardized regression coefficient (reflecting the absolute change in the dependent variable for each one-unit increase in the predictor); *CI*, confidence interval; *b*, standardized regression coefficient.

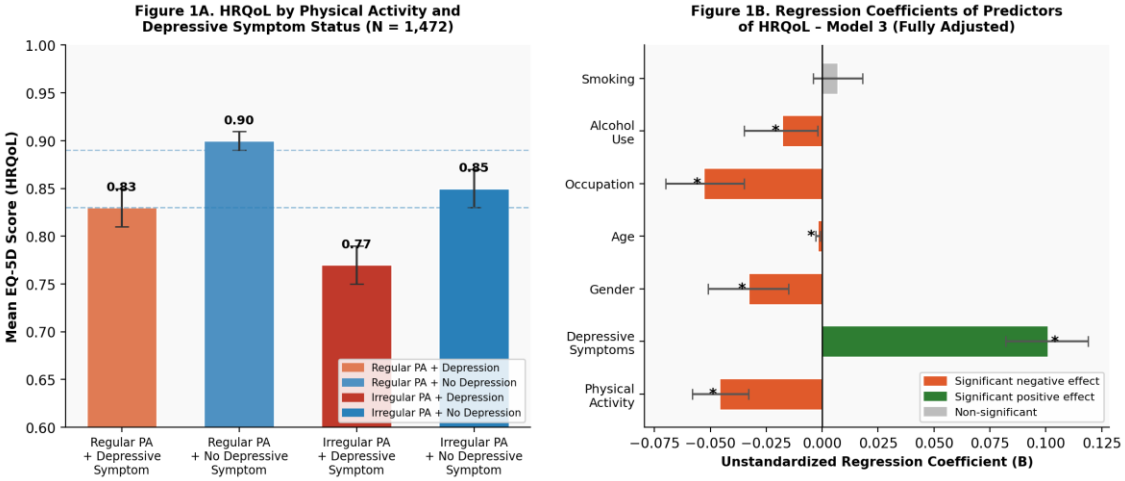

Figure 1. Visualization of main findings. Panel A (left): Mean EQ-5D health-related quality of life (HRQoL) scores across four groups defined by physical activity (PA) status and depressive symptom presence (N = 1,472). Panel B (right): Unstandardized regression coefficients (B) with 95% confidence intervals from the fully adjusted Model 3. Significant predictors are shown in red (negative association) or green (positive association); non-si.gnificant predictors are shown in grey. Asterisks (*) indicate statistical significance ($p < 0.05$). PA = Physical Activity; HRQoL = Health-Related Quality of Life; CI = Confidence Interval.

DISCUSSION

This study was designed to assess how routine physical activity and depressive symptoms correlate with HRQoL in patients managing diabetes. The results indicated that both physical activity and depressive symptoms were associated with HRQoL. Furthermore, sociodemographic factors (gender, age, occupation, and alcohol consumption) were associated with health-related quality of life.

Consistent with the diabetes management literature (Williams et al., 2022), Physical activity plays a fundamental role in diabetes management because it helps lower the risk of comorbidities, including cardiovascular disease, and reduces the likelihood of other complications such as chronic kidney disease (Shi et al., 2023). The results of this study suggest that regular physical activity is associated with lower depressive symptoms in diabetes mellitus. Physical activity has been shown to elevate endorphin levels and regulate the hypothalamic-pituitary-adrenal (HPA) axis response to stress, which may help explain its role in alleviating depressive symptoms (Pilozzi et al., 2020). In addition, factors like knowledge of the benefits of physical activities and diseases and self-efficacy may influence physical activity levels in patients with diabetes mellitus (Shi et al., 2013).

The most common psychiatric condition among individuals with diabetes mellitus is depression, which is often triggered by difficulties in coping with the disease (Eker, 2018). The coexistence of depression among individuals diagnosed with type 2 diabetes correlates with higher mortality, poor therapeutic adherence, increased work-related absences, and generally inferior health prognoses. In addition, it contributes to a greater likelihood of developing both macrovascular and microvascular complications. (Ghandour et al., 2018). Furthermore, depression has been consistently identified as a factor that substantially reduces quality of life. A notable strength of this study lies in its examination of the combined effect of depression and physical activity, which showed a strong relationship with health-related quality of life. These findings align with prior research, as at least two previous studies have also reported similar results. In particular, individuals with diabetes who suffer from depression tend to experience markedly lower quality of life (Ranjan et al., 2020). For patients managing type 2 diabetes, the manifestation of co-occurring depression is significantly associated with elevated mortality rates, suboptimal disease management, greater occupational absenteeism, and an overall deterioration in clinical outcomes, exhibited lower HRQoL (AlSawahli et al., 2021). Overall, these results indicate that the presence of comorbid depression adds further burden to chronic illness and contributes to a decline in QoL. Accordingly, depression among individuals with diabetes is linked to poorer HRQoL.

HRQoL represents a person's capacity to effectively manage diabetes care and meet treatment objectives. Poor HRQoL has been associated with a higher likelihood of psychological distress, lower adherence to treatment regimens, reduced compliance, and suboptimal metabolic control (McIntyre et al., 2019). Consistent with our current observations, historical data repeatedly indicate that a diabetes diagnosis is associated with a marked reduction in HRQoL when contrasted with healthy populations. Additionally, the present investigation revealed pronounced sex-based variations; specifically, male respondents demonstrated more favorable HRQoL profiles. Such gender divergence strongly echoes previous studies highlighting that diabetic females are more susceptible to poorer health-related quality of life than males (Alshayban & Joseph, 2020; Krzemińska et al., 2023). The observed gender disparity in HRQoL may be explained by both biological and sociocultural factors. In addition, hormonal differences may contribute, as higher testosterone levels in males have been linked to increased energy and vitality, which may lead to more positive self-perceptions of well-being (Zare et al., 2020).

From a physiological standpoint, maintaining an active regimen is instrumental in regulating cardiovascular parameters (e.g., lipid profiles and blood pressure) and improving vascular endothelium health. Alongside heightened insulin sensitivity and boosted functional fitness, physical activity also serves as a vital catalyst for sustaining psychological wellness in patients. Collectively, these effects help improve glycemic control in individuals with diabetes (Cannata et al., 2020). This study identified that physical activity and depressive symptoms were associated with HRQoL. Similarly, previous research has reported that physical activity is linked to improved HRQoL and facilitates better disease management (Domínguez-Domínguez et al., 2021).The finding of associations between physical activities and depression in our study suggests that physical activities might improve depression scores in people with diabetes mellitus. However, previous studies have also reported conflicting results related to the impact of physical activities on HbA1c, with a lowering effect in some and no effect in others (Martins et al., 2018). Unfortunately, much of the treatment of DM is aimed at achieving optimal glycemic control and treating associated medical complications. However, because more than 50% of the patients in this study did not engage in regular physical

activity, they had significant depressive symptoms. These were significantly related to their emotional and physical health. Therefore, proactive depression screening in patients with DM is necessary, followed by referral for treatment via a multidisciplinary team approach addressing both medical and psychological requirements.

The outcomes of this investigation must be viewed through the lens of South Korea's distinct sociocultural environment. Such regional dynamics act as significant determinants of exercise adherence and psychological well-being in individuals confronting chronic health challenges. South Korean society is characterized by the pervasive "ppalli-ppalli" (hurry-hurry) ethos, a cultural emphasis on rapid productivity that often results in chronic time scarcity and elevated occupational stress (Park et al., 2009). As South Korean adults consistently report some of the highest working hours among Organization for Economic Co-operation and Development (OECD) nations, significant structural barriers to leisure-time physical activity exist (Kim et al., 2023). These socio-temporal constraints likely contribute to the high prevalence of irregular PA observed in this cohort; occupational demands frequently limit opportunities for sustained exercise, even among patients with high health literacy regarding its benefits. he fact that occupational status sustained its predictive significance for HRQoL within the fully adjusted model accentuates the paramount importance of occupational settings in the ongoing management of chronic illnesses.

Additionally, the persistent stigma associated with mental health in Korea represents a significant barrier to comprehensive diabetes care. Depression is frequently perceived as a personal weakness rather than a clinical condition, a perception reinforced by the cultural norm of "nunchi" (social tact) and the societal pressure to maintain "social face," both of which discourage open expression of psychological distress (Kim & Kim, 2025). This tendency toward emotional suppression may result in systematic underreporting of depressive symptoms, thereby concealing the actual psychiatric burden in this population (Kim et al., 2020). The observed association between irregular PA and unaddressed emotional distress indicates that current screening protocols may be inadequate (Roh et al., 2024). These findings highlight the necessity for culturally sensitive depression screening tools that extend beyond traditional self-report measures, which are often influenced by social desirability bias in the Korean context.

Traditional Confucian values, which emphasize collective family responsibility and filial piety, exert a complex and dualistic influence on health outcomes (Kim & Park, 2000). While strong family networks can provide essential social capital for disease self-management, these patriarchal norms often place disproportionate domestic and caregiving responsibilities on women, limiting their autonomy and opportunities for structured exercise. This gender-based societal expectation corresponds with the higher prevalence of depressive symptoms and lower HRQoL scores observed among female participants in this study (Kim et al., 2023). The intersection of gender roles, restricted access to community-based exercise programs, and domestic fatigue underscores the need for gender-specific public health interventions that address the distinct vulnerabilities of women with diabetes.

The systemic orientation of the South Korean National Health Insurance (NHI) system requires critical evaluation. Although the NHI offers comprehensive universal coverage, its historical focus has been primarily biomedical, emphasizing clinical indicators such as glycemic control (HbA1c) rather than behavioral and psychosocial factors (Park et al., 2025). This biomedical emphasis has led to a fragmented care model in which physical activity promotion and mental health counseling are peripheral to standard diabetes management (Kim, 2018). The present findings, which show that physical inactivity and depressive symptoms independently and collectively diminish

HRQoL, support the need for a paradigm shift. Incorporating structured behavioral interventions and psychological support into the standard NHI diabetes protocol is essential for optimizing long-term functional outcomes in an increasingly aging population.

Certain limitations must be acknowledged when evaluating the outcomes of this study. First, the cross-sectional design precludes the determination of causal pathways, restricting the interpretation solely to associative relationships. Second, the current models were exclusively reliant on the KHPS framework to explore the interactions between behavioral and psychological determinants of HRQoL. However, referencing prior comparative research on Korean cohorts, it has been well-documented that overall EQ-5D indices and specific facets, such as daily functional activities, physical activity, and self-care is poorer among individuals with diabetes. Another limitation is that depressive symptoms were assessed using a single yes/no question, which may reduce measurement accuracy. Future studies are recommended to employ standardized instruments to better identify depressive symptoms. Moreover, further comparative studies with larger sample sizes using similar methodologies may enhance clinical applicability.

Despite these limitations, this study also has several strengths. The data were derived from nationally representative surveys, which enhances the reliability of the findings. In addition, as the survey was conducted at the national level rather than a single site, the results are generalizable to the broader population. Furthermore, unlike previous studies, this research examined the combined effects of physical activity and depressive symptoms on HRQoL.

CONCLUSION AND SUGGESTIONS

In summary, this study demonstrates that physical activity levels and depressive symptoms are critical determinants of HRQoL among patients with diabetes. Additionally, sociodemographic and lifestyle factors, specifically age, gender, occupational status, and alcohol intake, exert a statistically significant influence on HRQoL outcomes ($p < 0.05$). Failure to address these contributing factors may substantially hinder optimal diabetes management. Given the established therapeutic benefits of regular physical activity, there is an urgent need to develop personalized interventions that optimize both physiological capacity and psychological well-being in this population. Future research should clarify how specific types of physical activity affect depression and overall quality of life. Furthermore, subsequent studies should systematically assess the dose-response relationship by incorporating exercise intensity, frequency, and duration into their analytical frameworks.

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