

Increased body fat, physical inactivity, and hypertension are associated with poor quality of life in patients with type 2 diabetes

Mayor grasa corporal, inactividad física e hipertensión arterial se asocian a una pobre calidad de vida en pacientes con diabetes tipo 2

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Abstract

Background: Diabetes is a significant health problem that affects quality of life in the medium and long term. **Objective:** To identify the association between quality of life with comorbidity, metabolic control, and lifestyle in patients with type 2 diabetes. **Method:** A cross-sectional study was performed in 392 patients. Glycosylated hemoglobin, fasting glucose, lipid profile, blood pressure, weight, waist circumference and body composition were measured. Diabetic neuropathy, renal disease, visual health, diet and physical exercise were measured. Health-related quality of life (HRQoL) was measured with the 36-item Short Form survey (SF-36). **Results:** The mean age was 54.6 years, 68 % were women, median years of diabetes diagnosis was 7 years. Eighty percent had a good HRQoL (SF-36 $\geq$ 50). The dimension with the highest score was physical function (81.0), and vitality the lowest (46.5). Body fat was associated with more impairments in the SF-36 dimensions ($p < 0.05$). Factors associated with worse HRQoL are physical inactivity (odds ratio [OR]: 2.7; 95% confidence interval [95%CI]: 1.10-6.62; $p = 0.009$), arterial hypertension (OR: 1.78; 95%CI: 1.05-3.02; $p = 0.032$) and being female (OR: 2.7; 95%CI: 1.45-5.27; $p = 0.002$). **Conclusions:** Poor quality of life is associated with higher fat percentage, physical inactivity and hypertension in patients with type 2 diabetes.

Keywords: Type 2 diabetes. Quality of life. Physical inactivity. Body fat. Women health.

Resumen

Antecedentes: La diabetes es un importante problema de salud que afecta la calidad de vida a mediano y largo plazo. **Objetivo:** Identificar la asociación entre la calidad de vida y la comorbilidad, el control metabólico y el estilo de vida de pacientes con diabetes tipo 2. **Método:** Se realizó un estudio transversal en 392 pacientes. Se midieron la hemoglobina glucosilada, la glucosa de ayuno, el perfil de lípidos, la presión arterial, el peso, la circunferencia de la cintura y la composición corporal. Se evaluaron la neuropatía diabética, la enfermedad renal, la salud visual, la dieta y el ejercicio físico. La calidad de vida relacionada con la salud (CVRS) se midió con la encuesta en su versión corta de 36 ítems (SF-36). **Resultados:** La edad promedio fue de 54.6 años, el 68% fueron mujeres y la mediana de años de diagnóstico de diabetes fue de 7 años. Un 80% tienen una buena CVRS (SF-36 $\geq$ 50). La dimensión con mayor puntaje fue función física (81.0), y la más baja fue vitalidad (46.5). La grasa corporal se asoció a más afectaciones en las dimensiones del SF-36 ($p < 0.05$). Los factores asociados a una peor CVRS son la inactividad física (odds ratio [OR]: 2.7; intervalo de confianza del 95% [IC95%]: 1.10-6.62;

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$p = 0.009$), la hipertensión arterial (OR: 1.78; IC95%: 1.05-3.02; $p = 0.032$) y ser mujer (OR: 2.7; IC95%: 1.45-5.27; $p = 0.002$). **Conclusiones:** Una pobre calidad de vida se asocia con mayor porcentaje de grasa, inactividad física e hipertensión en pacientes con diabetes tipo 2.

Palabras clave: Diabetes tipo 2. Calidad de vida. Inactividad física. Grasa corporal. Salud en la mujer.

Introduction

Type 2 diabetes (T2D) is a chronic disease of significant concern for public health due to the relevance of its associated complications¹. There are approximately 463 million people worldwide with T2D², and in Mexico, the prevalence stands at 10.3% among the adult population³.

Patients with T2D face a 26% higher risk of mortality compared to those without it and up to a 3-fold risk of developing cardiovascular diseases⁴. The main microvascular complications associated with T2D are nephropathy, neuropathy, and retinopathy, which can reduce life expectancy by a mean 10.5 years compared to individuals without the disease⁵.

Health-related quality of life (HRQoL) refers to an individual's perception of his/her physical, emotional, and social well-being and the impact this has on his/her own health⁶. In patients with diabetes, the association between glycemic control and HRQoL remains controversial. While a positive association has been identified between glycemic control and a better HRQoL⁷⁻⁹, there have also been reports of no association at all, or even lower HRQoL scores with intensive glycemic control^{10,11}. Additionally, comorbidity with > 2 diseases, a 10-year history of diabetes, and glycosylated hemoglobin A1c (HbA1c) levels > 8% are predictors of poor HRQoL¹². Also, advanced comorbidities, the number of years elapsed since diagnosis, and depression have been found to affect HRQoL as well¹³. However, the impact lifestyle factors such as diet and exercise, anthropometric, and body composition indicators have on HRQoL has been less extensively studied too. Also, association among HRQoL, glycemic control, comorbidities, and sociodemographic variables among patients with T2D at the primary care level remains inconclusive to this date. Therefore, this study aimed to identify the association among HRQoL, comorbidities, metabolic control, lifestyle, and sociodemographic variables in patients with T2D.

Method

This was a cross-sectional analytical study conducted among patients with T2D who received primary care at

Instituto Mexicano del Seguro Social (IMSS) in Mexico City, Mexico. Patients were invited to participate during their routine follow-up visits and gave their prior written informed consent to participate in such study, which was approved by the IMSS National Research Ethics Committee with registration no. R-2012-785-059.

Participant selection criteria

The study included patients aged ≤ 70 years with a previously diagnosed T2D by their treating physician, with or without pharmacological treatment for the management of diabetes. Patients with advanced or severe diabetes-related complications, such as amputation following peripheral neuropathy, blindness, kidney disease requiring dialysis or hemodialysis, as well as pregnant women were excluded from the study.

Sociodemographic, clinical, and comorbidity data

The patients' sociodemographic data and health records were collected by a research physician who conducted a complete physical examination. Systemic arterial hypertension (SAH) was diagnosed if the patient had been previously diagnosed by his/her treating physician or prescribed antihypertensive drugs. Blood pressure was measured twice in the left arm using a mercury sphygmomanometer. Peripheral neuropathy was assessed using the DN4 questionnaire (4-item neuropathic pain questionnaire), in addition to the use of a 128 Hz tuning fork¹⁴. Visual impairment was defined as difficulties performing activities of daily living with reduced visual acuity (< 20/40), or visual field loss, determined by fundus examination¹⁵. Renal disease was diagnosed using the CKD-EPI (Chronic Kidney Disease Epidemiology Collaboration) equation to estimate the glomerular filtration rate, with values < 60 mL/min/1.73 m² being indicative of kidney failure¹⁶.

Lifestyle

Physical exercise was defined as engaging in, at least, 150 min/week of moderate-intensity aerobic

physical activity on an, at least, 3 days/week basis¹⁷. Nutritional therapy was considered if the patient received personalized nutritional counseling from a registered dietitian on, at least, 2 occasions in the year prior to the study.

Biochemical, anthropometric, and body composition data

HbA1c levels were measured in venous blood after 12-hour fast using high-performance liquid chromatography. Glucose, creatinine, triglycerides, total cholesterol, and high- and low-density lipoprotein cholesterol levels were measured using automated photometry (Roche Cobas 800 c701). Anthropometric parameters were recorded by 2 certified nutritionists following the method proposed by Habicht¹⁸, and the specifications made by Lohman et al.¹⁹.

Waist circumference was measured at the midpoint between the last rib and the iliac crest superior border on the right side. A total of 3 measurements were taken, and the mean of the second and third measurements was used for analysis.

Body mass index (BMI) was calculated based on weight and height measurements. Body fat percentage was determined using the bioelectrical impedance method for lower limbs with a TANITA™ TBF-215 body composition analyzer.

Health-related quality of life

HRQoL was assessed using the Short Form-36 (SF-36) questionnaire, validated in the Mexican population²⁰. This questionnaire includes 36 items and 8 different dimensions: physical functioning, physical role, bodily pain, general health, vitality, social functioning, emotional role, and mental health. Scores for the overall instrument and from each dimension (0-100) were obtained. For the purposes of this study, the HRQoL was categorized into 2 groups: low and high (scores ≤ 50 and ≥ 51 , respectively), and quartiles (scores ≤ 50 , 51-74.9, and ≥ 75 , respectively).

Statistical analysis

Frequency and proportion measures, as well as measures of central tendency and dispersion, were calculated. The quantitative variables with parametric distribution were expressed as mean and standard

deviation, while the non-parametric ones were expressed as medians and interquartile ranges.

The Student's t-test was used to compare HRQoL divided into 2 categories (sociodemographic, clinical, and comorbidity variables) while the 1-way ANOVA test was used to compare HRQoL while divided into 3 categories. The Kruskal-Wallis test was used for glucose and triglyceride data. Pearson's correlation test was performed to evaluate the correlation between the SF-36 score and the indicators of metabolic control.

A multiple logistic regression model was used to estimate the risk of having a HRQoL ≤ 50 , associated with other sociodemographic and clinical variables. The odds ratio (OR) with a 95% confidence interval (95%CI) was estimated as a measure of association for all variables included in the model. P values < 0.05 were considered statistically significant.

Results

Table 1 shows the patients' sociodemographic and comorbidity data. A total of 392 patients were included, 68% of whom were women, with a mean age of 54.6 years and a median time elapsed since the diagnosis of diabetes of 7 years.

A total of 80% of the study population had HRQoL scores > 50 . Women were more likely to have scores < 50 ($p = 0.001$), as well as patients with SAH ($p = 0.051$) and those with renal disease ($p = 0.044$). Additionally, patients who engaged in physical exercise had scores > 50 ($p = 0.022$) (Table 2).

It was identified that patients with lower body fat and triglyceride levels were in the third quartile (Q3) of the SF-36 instrument ($p = 0.005$) (Table 3).

Figure 1 illustrates the overall mean and dimensions of the SF-36. Patients had a good HRQoL (mean score of 65.4). The dimensions of HRQoL most widely impacted were vitality and the general state of health.

Table 4 illustrates the correlation between the total scores and dimensions of the SF-36 instrument with HbA1c, BMI, waist circumference, and percentage of body fat. The total instrument score correlated negatively with the percentage of body fat ($p < 0.05$). The physical functioning dimension had a negative correlation with BMI, waist circumference, and body fat percentage. A higher body fat percentage was more strongly associated with lower scores in the physical functioning, vitality, and mental health dimensions ($p < 0.05$).

Table 1. Sociodemographic and clinical characteristics of the study population (n = 392)

	n (%)
Women/Men	267 (68)/125 (32)
Education	
– Basic	203 (52)
– Intermediate	133 (34)
– High	55 (14)
Diabetes treatment	
– No drugs	15 (4)
– Oral hypoglycemic	300 (76)
– Insulin	35 (9)
– Oral hypoglycemic and insulin	42 (11)
– Smoking	88 (22)
– Alcohol consumption	84 (21)
– Diabetes education	127 (32)
– Follow a diet	65 (17)
– Engage in physical exercise	63 (16)
Mean ± standard deviation	
– Age (years)	54.6 ± 8.6
– Weight (kg)	75.4 ± 14.9
– BMI (kg/m ²)	30.5 ± 5.3
– WC (cm)	100.5 ± 12.5
– HbA1c (%)	8.45 ± 2.25
– Total cholesterol (mg/dL)	196.1 ± 41.3
– LDLc (mg/dL)	112.7 ± 31.9
– HDLc (mg/dL)	41.7 ± 11.2
– SBP (mmHg)	124.5 ± 15.9
– DBP (mmHg)	83.3 ± 11.1
Median and interquartile range (2575)	
– Diagnosis of diabetes (years)	7 (311)
– Fasting glucose (mg/dL)	146 (117201)
– Triglycerides (mg/dL)	179 (133251)

BMI: body mass index; DBP: diastolic blood pressure; HbA1c: glycated hemoglobin; HDLc: high-density lipoprotein cholesterol; LDLc: low-density lipoprotein cholesterol; SBP: systolic blood pressure; WC: waist circumference.

Table 5 illustrates the logistic regression model for the risk of having a worse HRQoL (score < 50). It was identified that being a woman was associated with a higher risk (OR, 2.7; 95%CI, 1.45-5.27; p = 0.002), as well as lack of physical exercise (OR, 2.7; 95%CI, 1.10-6.62; p = 0.009) and a diagnosis of SAH (OR, 1.78; 95%CI, 1.05-3.02; p = 0.032).

Discussion

Our results highlight the importance of body composition indicators and the impact they have on HRQoL

Table 2. Comparison between sociodemographic and clinical indicators with health-related quality of life in studied patients (n = 392)

Variable	HRQoL		p
	SF-36 ≤ 50	SF-36 ≥ 51	
	n = 79 (20%)	n = 313 (80%)	
Age	54.7 ± 8.7	54.1 ± 7.7	0.608*
Years since diagnosis	4 (2-11)	6 (3-11)	0.032†
n (%)‡			
– Men	13 (10%)	112 (90%)	0.001
– Women	66 (25%)	201 (75%)	
Tobacco use	20 (25%)	68 (22%)	0.494
Education			0.588
– Basic	45 (57%)	158 (50%)	
– Intermediate	24 (30%)	109 (35%)	
– High or Professional	10 (13%)	46 (15%)	
Alcohol consumption	26 (33%)	105 (33%)	0.776
Follows a diet	10 (13%)	55 (18%)	0.294
Physical exercise	6 (8%)	57 (18%)	0.022
Comorbidity			
– Peripheral neuropathy	18 (23%)	59 (19%)	0.416
– Arterial hypertension	44 (56%)	136 (43%)	0.051
– Blurred vision	47 (60%)	188 (60%)	0.975
– Elevated UACR > 30 mg/g	14 (18%)	53 (17%)	0.868
– Reduced GFR < 60 mL/min/1.73m ²	7 (9%)	11 (4%)	0.044

GFR: glomerular filtration rate; HRQoL: Health-related quality of Life; SF-36: Short Form-36; UACR: urinary albumin creatinine ratio.

*Student's t-test (mean and standard deviation).

†Mann-Whitney U test (median and interquartile range).

‡χ² test.

dimensions in patients with type 2 diabetes (T2D). We identified that indicators such as BMI, waist circumference, and, to a greater extent, body fat are negatively associated with the overall instrument scores obtained, physical functioning, vitality, and mental health dimensions of HRQoL. It has been reported that higher obesity and the presence of metabolic syndrome are associated with poor HRQoL²¹. Additionally, a higher perception of body weight has been associated with lower overall health and vitality scores²². These findings are clinically relevant, as a higher level of body fat could be playing an important role on both the patients' mental health and physical functioning and vitality required for managing the disease. Regarding HRQoL and glycemic control, we did not identify any correlations, which is consistent with former studies by other authors⁷⁻²³. This lack of association could be explained by the prevailing glycemic control issues in the studied population, with mean HbA1c levels of 8.4%. Additionally, the studied

Table 3. Comparison of metabolic indicators in the studied population using 3 categories of the SF-36 Instrument

Variable	HRQoL			p
	Q1 (≤ 50) 79 (20%)	Q2 (51-74.9) 177 (45%)	Q3 (≥ 75) 136 (34%)	
Mean ± standard deviation*				
Age	54.0 ± 8.8	55.3 ± 8.7	54.1 ± 7.7	0.367
Weight (kg)	75.9 ± 15.7	74.8 ± 15.8	75.9 ± 13.2	0.792
BMI (kg/m²)	31.3 ± 5.7	30.5 ± 5.7	30.0 ± 4.4	0.249
Waist circumference (cm)	101.7 ± 13.3	100.7 ± 13.0	99.4 ± 11.1	0.389
Body fat (%)	44.4 ± 11.5	41.9 ± 11.8	40.5 ± 11.7	0.065
HbA1c (%)	8.5 ± 2.4	8.5 ± 2.1	8.4 ± 2.2	0.980
Total cholesterol (mg/dl)	200.6 ± 45.2	192.8 ± 33.4	197.7 ± 47.5	0.320
LDL-C (mg/dl)	114.9 ± 38.9	113.8 ± 27.7	109.7 ± 32.6	0.413
HDL-C (mg/dl)	41.2 ± 10.3	43.1 ± 12.6	40.1 ± 19.5	0.054
SBP (mmHg)	125.5 ± 14.5	123.8 ± 14.6	125.4 ± 14.2	0.551
DBP (mmHg)	83.5 ± 9.7	83.1 ± 10.7	83.8 ± 10.0	0.840
Median and interquartile range**				
Years since diabetes diagnosis (years)	4 (210)	7 (312)	5 (29)	0.009
Glucose (mg/dL)	137 (111-199)	152 (119-212)	142 (119-197)	0.521
Triglycerides (mg/dL)	203 (137-267)	160 (129-221)	185 (138-269)	0.005

BMI: body mass index; DBP: diastolic blood pressure; HbA1c: hemoglobin A1c; HDL-C: high-density lipoprotein cholesterol; HRQoL: health-related quality of life; LDL-C: low-density lipoprotein cholesterol; SBP: systolic blood pressure.

*1-way ANOVA test.

**Kruskal-Wallis test.

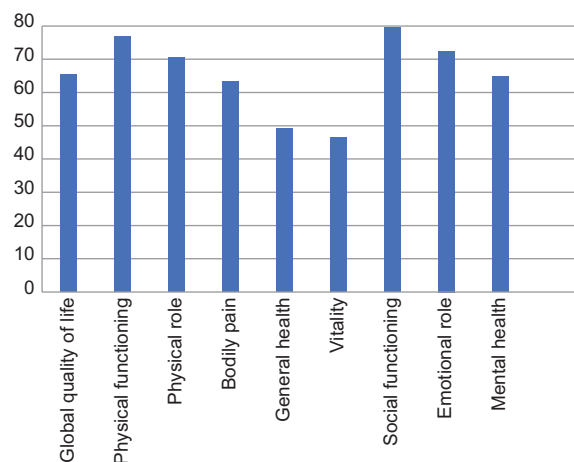


Figure 1. Mean health-related quality of life scores both overall and in its dimensions for the studied population.

population did not show any severe complications that would lead to an unfavorable quality of life, such as amputations or chronic kidney disease that would require

dialysis or hemodialysis. Nevertheless, it has been reported that intensive therapies aimed at achieving strict goals (HbA1c levels < 6.5%) in certain populations or age groups can deteriorate HRQoL²¹.

In patients with diabetes, poor HRQoL has been reported with scores of 50.1, along with older age, depression, and comorbidity²². In our results, the mean SF-36 score was 65.4, with the highest score for social functioning and the lowest for vitality. More years elapsed since diagnosis were associated with better HRQoL. Therefore, we should mention that this is a population that has not developed severe complications associated with the disease yet, which are known to be associated with poor HRQoL, such as amputations or chronic kidney disease requiring dialysis or hemodialysis²³.

In our findings, women had an almost 3-fold higher risk of having poor HRQoL. It has been reported that women with diabetes tend to be more affected in HRQoL dimensions compared to men²⁴. Gender-specific care strategies should be considered for patients with diabetes for better disease

Table 4. Correlation of overall and dimension scores of the SF-36 instrument with Hemoglobin A1c and anthropometric and body composition indicators (n = 392)

Indicator	HbA1c (%)	BMI (kg/m ²)	WC (cm)	Body fat (%)
Overall SF-36 score	Pearson correlation: -0.028 p: 0.580	Pearson correlation: 0.580 p: 0.086	Pearson correlation: -0.087 p: 0.137	Pearson correlation: 0.086 p: 0.023
Physical function	Pearson correlation: -0.021 p: 0.681	Pearson correlation: 0.681 p: 0.009	Pearson correlation: -0.132 p: 0.038	Pearson correlation: 0.009 p: 0.017
Physical role	Pearson correlation: -0.014 p: 0.783	Pearson correlation: 0.783 p: 0.314	Pearson correlation: -0.051 p: 0.494	Pearson correlation: 0.314 p: 0.136
Bodily pain	Pearson correlation: -0.025 p: 0.627	Pearson correlation: 0.627 p: 0.063	Pearson correlation: -0.094 p: 0.032	Pearson correlation: 0.063 p: 0.294
General health	Pearson correlation: -0.029 p: 0.562	Pearson correlation: 0.562 p: 0.318	Pearson correlation: -0.051 p: 0.124	Pearson correlation: 0.318 p: 0.190
Vitality	Pearson correlation: -0.041 p: 0.417	Pearson correlation: 0.417 p: 0.356	Pearson correlation: -0.047 p: 0.393	Pearson correlation: 0.356 p: 0.009
Social functioning	Pearson correlation: -0.052 p: 0.304	Pearson correlation: 0.304 p: 0.472	Pearson correlation: -0.036 p: 0.558	Pearson correlation: 0.472 p: 0.699
Emotional role	Pearson correlation: 0.007 p: 0.893	Pearson correlation: 0.893 p: 0.689	Pearson correlation: -0.020 p: 0.941	Pearson correlation: 0.689 p: 0.101
Mental health	Pearson correlation: -0.003 p: 0.950	Pearson correlation: 0.950 p: 0.208	Pearson correlation: -0.064 p: 0.213	Pearson correlation: 0.208 p: 0.001

BMI: body mass index; HbA1c: hemoglobin A1c; SF-36: short Form-36; WC: waist circumference.

Table 5. Logistic regression model to identify the association between poor health-related quality of life and sociodemographic and metabolic variables

Variable	OR	95%CI	p
Age	0.99	0.951.02	0.588
Years since diabetes diagnosis	0.97	0.911.01	0.199
Sex			
Man	1		
Woman	2.82	1.326.05	0.007
Physical exercise			
Yes	1		
No	2.76	1.176.82	0.028
SAH			
Without SAH	1		
With SAH	1.93	1.103.40	0.022
GFR			
> 60 mL/min/1.73 m ²	1		
< 60 mL/min/1.73 m ²	2.2	0.796.2	0.128

95%CI: 95% confidence interval; GFR: glomerular filtration rate; OR: odds ratio;

SAH: systemic arterial hypertension.

A health-related quality of life score of ≤ 50 on the SF-36 instrument was considered as a health-related poor quality of life.

management and, consequently, improved HRQoL for both men and women.

Renal disease is a complication that impacts the HRQoL of patients with diabetes significantly²⁵. When comparing the population with renal disease, we found that this condition was associated with poor HRQoL, even when it had not progressed into kidney failure. Therefore, preventive medical actions should be directed towards early prevention of this complication.

In Mexico, 67.4% of adults with T2D have been diagnosed with SAH, and both diseases increase the risk of cardiovascular complications³. The studied population with SAH had nearly twice the risk of perceiving poor HRQoL. Proper follow-up of patients with SAH is crucial, as poor disease control may negatively impact HRQoL, in addition to increasing the risk of other diabetes-related complications.

Part of the patient's comprehensive treatment should be focused on lifestyle. We identified that

patients who do not engage in physical exercise have a nearly 3-fold higher risk of having their HRQoL affected. Other authors have found a similar association, with increased physical activity and glycemic control being linked to better HRQoL¹¹.

Dyslipidemia is a common comorbidity in patients with diabetes, with up to 63% developing it³. In this regard, we found SF-36 scores < 50 in patients with higher triglyceride levels. We should prescribe pharmacological and lifestyle treatment for dyslipidemia in primary care.

The limitations of this study include its cross-sectional design, the overrepresentation of women, and the lack of evaluation of diabetic retinopathy, or cataracts in the studied population. Additionally, it is a limitation that the SF-36 instrument does not include aspects such as sleep disorders, cognitive function, family function, and sexual dysfunction, which are relevant aspects that should be studied in patients with diabetes in primary care.

The patients studied without severe diabetes-related complications have good quality of life; however, general health and vitality are affected. Future cohort studies or studies with larger sample sizes are necessary to evaluate the association between SF-36 instrument scores and metabolic variables in patients attending primary care clinics.

Conclusions

HRQoL is affected by the presence of SAH, lack of physical exercise, higher body fat percentage, and female gender in patients with T2D in the primary care setting. We should assess HRQoL in patients without severe disease-related complications to implement early strategies aimed at improving metabolic control, comorbidity control, and preventing diabetes complications, ultimately leading to better HRQoL.

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Conflicts of interest

None declared.

Ethical disclosures

Protection of human and animal subjects. The authors declare that the procedures followed were in accordance with the regulations of the relevant clinical research ethics committee and with those of the Code of Ethics of the World Medical Association (Declaration of Helsinki).

Confidentiality of data. The authors declare that they have followed the protocols of their work center on the publication of patient data.

Right to privacy and informed consent. The authors declare that no patient data appear in this article.

References

1. Zghebi SS, Steinke DT, Carr MJ, Rutter MK, Emsley RA, Ashcroft DM. Examining trends in type 2 diabetes incidence, prevalence and mortality in the UK between 2004 and 2014. *Diabetes Obes Metab*. 2017;19:1537-45.
2. Cho NH, Shaw JE, Karuranga S, Huang Y, da Rocha Fernandes JD, Ohlrogge AW, et al. IDF Diabetes Atlas: global estimates of diabetes prevalence for 2017 and projections for 2045. *Diabetes Res Clin Pract*. 2018;138:271-81.
3. Rojas-Martínez R, Basto-Abreu A, Aguilar-Salinas CA, Zárate-Rojas E, Villalpando S, Barrientos-Gutiérrez T. [Prevalence of previously diagnosed diabetes mellitus in Mexico.]. *Salud Publica Mex*. 2018;60:224-32.
4. Rosenzweig JL, Bakris GL, Berglund LF, Hivert MF, Horton ES, Kalyani RR, et al. Primary prevention of ASCVD and T2DM in patients at metabolic risk: an Endocrine Society Clinical Practice Guideline. *J Clin Endocrinol Metab*. 2019 Jul 31;jc.2019-01338. doi: 10.1210/je.2019-01338. Online ahead of print.
5. Wang Z, Liu M. Life years lost associated with diabetes: an individually matched cohort study using the U.S. National Health Interview Survey data. *Diabetes Res Clin Pract*. 2016;118:69-76.
6. Rubin RR, Peyrot M. Quality of life and diabetes. *Diabetes Metab Res Rev*. 1999;15:205-18.
7. Svedbo Engström M, Leksell J, Johansson UB, Borg S, Palaszewski B, Franzén S, et al. Health-related quality of life and glycaemic control among adults with type 1 and type 2 diabetes — a nationwide cross-sectional study. *Health Qual Life Outcomes*. 2019;17:141.
8. Kuznetsov L, Griffin SJ, Davies MJ, Lauritzen T, Khunti K, Rutten GE, et al. Diabetes-specific quality of life but not health status is independently associated with glycaemic control among patients with type 2 diabetes: a cross-sectional analysis of the ADDITION-Europe trial cohort. *Diabetes Res Clin Pract*. 2014;104:281-7.
9. Dogan H, Harman E, Kocoglu H, Sargin G. Can metabolic control variables of diabetic patients predict their quality of life? *J Am Soc Hypertens*. 2016;10:81-8.
10. Jing X, Chen J, Dong Y, Han D, Zhao H, Wang X, et al. Related factors of quality of life of type 2 diabetes patients: a systematic review and meta-analysis. *Health Qual Life Outcomes*. 2018;16:189.
11. Goh SG, Rusli BN, Khalid BA. Diabetes quality of life perception in a multiethnic population. *Qual Life Res*. 2015;24:1677-86.
12. López-Carmona JM, Rodríguez-Moctezuma R. [Adaptation and validation of quality of life instrument Diabetes 39 for Mexican patients with type 2 diabetes mellitus]. *Salud Publica Mex*. 2006;48:200-11.
13. Dhillon H, Nordin RB, Ramadas A. Quality of life and associated factors among primary care asian patients with type 2 diabetes mellitus. *Int J Environ Res Public Health*. 2019;16:3561.

14. Pérez C, Gálvez R, Huelbes S, Insausti J, Bouhassira D, Díaz S, et al. Validity and reliability of the Spanish version of the DN4 (Douleur Neuropathique 4 questions) questionnaire for differential diagnosis of pain syndromes associated to a neuropathic or somatic component. *Health Qual Life Outcomes*. 2007;5:66.
15. Klein R, Klein BEK. Epidemiology of ocular functions and diseases in persons with diabetes. En: Cowie CC, Casagrande SS, Menke A, Cissell MA, Eberhardt MS, Meigs JB, et al., editores. *Diabetes in America*. Bethesda (MD): National Institute of Diabetes and Digestive and Kidney Diseases (US); 2018. p. 21.1-21.49.
16. Levey AS, Stevens LA, Schmid CH, Zhang YL, Castro AF 3rd, Feldman HI, et al. A new equation to estimate glomerular filtration rate. *Ann Intern Med*. 2009;150:604-12.
17. Foster C, Shilton T, Westerman L, Varney J, Bull F. World Health Organisation to develop global action plan to promote physical activity: time for action. *Br J Sports Med*. 2018;52:484-5.
18. Habicht JP. [Standardization of quantitative epidemiological methods in the field]. *Bol Oficina Sanit Panam*. 1974;76:375-84.
19. Lohman TG, Roche AF, Martorell R, editores. *Anthropometric standardization reference manual*. Champaign, IL: Human Kinetics; 1988.
20. Durán-Arenas L, Gallegos-Carrillo K, Salinas-Escudero G, Martínez-Salgado H. [Towards a Mexican normative standard for measurement of the short format 36 health-related quality of life instrument]. *Salud Publica Mex*. 2004;46:306-15.
21. Goh SG, Rusli BN, Khalid BA. Evolution of diabetes management in the 21st century: the contribution of quality of life measurement in Asians. *Asia Pac J Clin Nutr*. 2015;24:190-8.
22. Stojanović M, Cvetanović G, Anđelković Apostolović M, Stojanović D, Rancić N. Impact of socio-demographic characteristics and long-term complications on quality of life in patients with diabetes mellitus. *Cent Eur J Public Health*. 2018;26:104-10.
23. Cepeda Marte JL, Javier A, Ruiz-Matuk C, Paulino-Ramirez R. Quality of Life and Nutritional Status in diabetic patients on hemodialysis. *Diabetes Metab Syndr*. 2019;13:576-80.
24. Raya-Tena A, Fernández-San-Martín MI, Martín-Royo J, Casañas R, Psicodop G, Jiménez-Herrera MF. Quality of life in people with depression and physical comorbidity from a gender perspective. *Atencion Primaria*. 2021;53(2):101946.
25. Rebollo-Rubio A, Morales-Asencio JM, Pons-Raventos ME, Mansilla-Francisco JJ. Review of studies on health related quality of life in patients with advanced chronic kidney disease in Spain. *Nefrologia*. 2015;35:92-109.