# Original Article

## Evaluation of survival in the elderly with diabetes mellitus according to the Clinical Practice Guide

## *Evaluación de supervivencia en el adulto mayor con diabetes mellitus de acuerdo con la Guía de Práctica Clínica*

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***Summary***

**Objective:** to evaluate survival rate in older adults diagnosed with type 2 diabetes mellitus (T2DM) according to Mexico's Clinical Practice Guidelines (CPG) for the diagnosis and treatment of T2DM in vulnerable older adults. **Methods:** A cross-sectional study was carried out, collecting the electronic records of participants matriculated in Family Medicine Unit No. 80 of the Mexican Institute of Social Security in Morelia, Michoacan, Mexico. Electronic files of participants older than 65 years old and diagnosed with T2DM were included. The CPG was used to identify vulnerability, geriatric syndromes, participants complications, as well as T2DM diagnosis and treatment. The Kolmogorov-Smirnov test was applied to evaluate data distribution; Student's t test for independent samples, and Kaplan Meier with Log Rank were assessed to compare survival curves. Statistical significance was established with $p<0.05$. **Results:** 41 vulnerable older adults (28.47%) and 103 non-vulnerable older adults (71.52%) were analyzed; 90.2% of the vulnerable adults presented polypharmacy and 73.2%, cognitive impairment. Nephropathy was the most frequent complication ($p<0.0001$). Survival curves showed that vulnerable adults die before than non-vulnerable adults [Log Rank: 4.180; $p=0.041$]. **Conclusions:** vulnerable older adults have lower survival rate than non-vulnerable ones, and this result is influenced by metabolic control, cognitive impairment, polypharmacy, and depression.

**Keywords:** Survival; Diabetes Mellitus; Elderly

Suggestion of quotation: Álvarez-Torres M, Álvarez-Aguilar C, Gómez-García A. Evaluation of survival in the elderly with diabetes mellitus according to the Clinical Practice Guideline. Aten Fam. 2022;29(3):149-153. http://dx.doi.org/10.22201/fm.14058871p.2022.3.82832

Received: 31/01/2022
Acepted: 11/04/2022

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***Resumen***

**Objetivo:** evaluar la supervivencia en el adulto mayor con diabetes de acuerdo con la Guía de Práctica Clínica (GPC) de México para el diagnóstico y tratamiento de la diabetes mellitus tipo 2 (DM2) en el adulto mayor vulnerable. **Métodos:** estudio transversal, se realizó una búsqueda de expedientes electrónicos de 144 adultos mayores de 65 años, con diagnóstico de DM2, en la Unidad de Medicina Familiar No. 80 del Instituto Mexicano del Seguro Social en Morelia, Michoacán. Con el apoyo del área de información y archivo clínico se identificaron los adultos mayores fallecidos. Se utilizó la GPC para el diagnóstico y tratamiento de la DM en el adulto mayor vulnerable para identificar vulnerabilidad, síndromes geriátricos y complicaciones agudas y crónicas. Se aplicó la prueba Kolmogorov-Smirnov para estimar normalidad de distribución; t de Student para muestras independientes, Kaplan Meier con Log Rank para comparar curvas de supervivencia. Se estableció diferencia estadística significativa con p<0.05. **Resultados:** se analizó a 41 adultos mayores vulnerables (28.47%) y 103, no vulnerables (71.52%); de los adultos mayores vulnerables, 90.2% presentó polifarmacia y 73.2%, deterioro cognoscitivo. La complicación más frecuente fue nefropatía (p<0.0001). El adulto mayor vulnerable fallece antes que el adulto mayor no vulnerable [Log Rank:4.180; p=0.041]. **Conclusiones:** los adultos mayores vulnerables tienen una supervivencia menor que los no vulnerables con influencia del control metabólico, deterioro cognoscitivo, polifarmacia y depresión con las que cursa el adulto mayor.

**Palabras clave:** supervivencia, diabetes mellitus, adulto mayor

***Introduction***

Type 2 Diabetes mellitus (T2DM) is a heterogeneous metabolic disorder whose main characteristic is chronic hyperglycemia.[1] Globally, it is estimated that cases of T2DM will reach 592 million by 2030, which will represent 8.8% of the world population. The Health and Nutrition Survey (Ensanut) reported that Mexico's prevalence of T2DM was 13.7%[2], which continues to increase. T2DM is also a common comorbidity in older adults and its treatment represents a great burden for patients and their family.[3]

Vulnerable older adults are defined as those with a high risk of losing their autonomy and independence; older adults are characterized by frailty, multiple pathologies and geriatric syndromes,[4,5] the more common clinical condition in these subjects are cognitive impairment, falls, polypharmacy, depression and frailty.[6] T2DM complications can affect micro and macro vasculature, the former has greater clinical importance since neuropathy, nephropathy and diabetic retinopathy, added to geriatric syndromes, increase morbidity and mortality in the elderly.[7]

Given that T2DM is a growing disease related to other comorbidities, life expectancy is reduced in older adults who suffer from it.[8,9] For this reason, it is necessary to control blood glucose, to improve the health and quality of life of this population.

The Clinical Practice Guideline (CPG) for the diagnosis and treatment of T2DM in vulnerable older adults mentions four recommendations to establish therapeutic goals in this age group, which are similar to what has been reported by American Diabetes Association (ADA)[10]: 1. Older adults with one or two coexisting chronic diseases, intact cognitive status, and preserved functionality: HbA1c <7.5%, fasting blood glucose 90-130 mg/dl, blood pressure <140/80 mmHg. 2. Older adults with three or more chronic diseases or mild functional dependence or cognitive impairment: HbA1c <8.0%, fasting blood glucose 90-150 mg/dl, blood pressure <140/80 mmHg. 3. Older adults with chronic disease in severe stages, or moderate-severe functional dependence, or dementia syndrome: HbA1c <8.5%, fasting blood glucose 100-180 mg/dl, blood pressure <140/80 mmHg. 4. Frail older adults with functional dependence, geriatric syndromes, systemic disease or institutionalized: HbA1c between 7.6 and 8.5%, fasting blood glucose 136-165 mg/dl and blood pressure <150/90 mmHg.[5]

Given this scenario, the objective of this article was to analyze the survival of vulnerable and non-vulnerable older adults with T2DM, according to the CPG for the diagnosis and treatment of T2DM in vulnerable older adults.

***Methods***

A cross-sectional study was carried out, in which electronic records of vulnerable and non-vulnerable older adults with T2DM matriculated in the Family Medicine Unit (FMU) No. 80 of Morelia, Michoacan were collected. One hundred forty-four records of patients over 65 years old, were selected. While records from patients who had pathologies such as cancer, were excluded.

This study was approved by Hospital Ethics Committee. And was authorized by FMU Director. Electronic clinical records were identified, and patients' information was collected, such as general data, established diagnoses, coexisting diseases, complications, laboratory test results (fasting glucose, HbA1c, lipid

profile, etc.). Subsequently, dead patients were identified and subsequent analyzes were carried out with this information. The geriatric syndromes and cognitive impairment referred in the GPC were obtained from the electronic record and used to identify vulnerability and non-vulnerability in the study patients.

The Kolmogorov-Smirnov test was applied to estimate the normality of the data distribution; Student's t-test was used to compare continuous numerical variables between groups of vulnerable and non-vulnerable older adults. Kaplan Meier and Log Rank tests were performed to compare the survival curves of the two groups. Significant statistical difference was established with $p<0.05$. The data was analyzed in SPSS 23.0 for Windows.

### Results

Of the 144 older patients included in this study, 63 were male (43.75%) and 81 female (56.25%), with median age of 73 years old. According to GPC 41 patients were classified as vulnerable and 103 as non-vulnerable older adults.

Vulnerable adults had higher serum creatinine and Hb1Ac, than non-vulnerable older adults ($p<0.005$), see Table 1.

Polypharmacy was present in 90.2% of vulnerable older adults ($p=0.0001$), as well as cognitive impairment syndrome (73.12%), diabetic nephropathy (85.4%), and retinopathy (63.4%) ($p=0.0001$). While only 28 non-vulnerable older adults presented polypharmacy ($p= 0.0001$), 31 patients' nephropathy ($p= 0.0001$), see Table 2.

Figure 1 shows survival rate between vulnerable and non-vulnerable older adults with a Log Rank (Mantel-Cox) of 4.180 ($p= 0.041$), highlighting a median survival rate of 23 years after T2DM

***Table 1. Clinical and biochemical variables of older adults with diabetes***

| Variable | Vulnerable older adults (n= 41) | Non-vulnerable older adults (n= 103) | p |
|---|---|---|---|
| Age (years) | 75.93 ± 8.80 | 73.53 ± 6.24 | 0.258 |
| SBP (mmHg) | 122.37 ± 16.73 | 120.22 ± 14.69 | 0.84 |
| DBP (mmHg) | 74.68 ± 9.13 | 73.18 ± 8.47 | 0.28 |
| Weight (kg) | 70.91 ± 13.82 | 67.23 ± 14.0 | 0.139 |
| Height (m) | 1.58 ± 0.1 | 2.93 ± 1.40 | 0.125 |
| BMI (kg/m2) | 28.28 ± 4.79 | 27.42 ± 5.60 | 0.309 |
| Waist (cm) | 88.27 ± 12.28 | 86.0 ± 13.72 | 0.177 |
| Glucose (mg/dL) | 145.34 ± 58.60 | 128.88 ± 75.63 | 0.072 |
| Creatinine (mg/dL) | 5.50 ± 6.60 | 3.24 ± 6.62 | *0.001 |
| Cholesterol (mg/dL) | 173.29 ± 59.89 | 173.84 ± 39.5 | 0.813 |
| Triglycerides (mg/dL) | 153.17 ± 65.33 | 164.05 ± 64.91 | 0.229 |
| HDL (mg/dL) | 48.76 ± 14.19 | 47.63 ± 16.81 | 0.553 |
| LDL (mg/dL) | 82.66 ± 21.19 | 86.74 ± 25.74 | 0.511 |
| VLDL (mg/dL) | 34.49 ± 16.46 | 33.25 ± 21.46 | 0.364 |
| HbA1c (%) | 7.69 ± 1.32 | 7.02 ± 1.16 | *0.003 |

SBP: systolic blood pressure; PAD: diastolic blood pressure; BMI: body mass index; HDL: high density lipoproteins; LDL: low density lipoproteins; VLDL: very low-density lipoproteins.

***Table 2. Association of complications and geriatric syndromes with vulnerability in older adults with diabetes***

| Characteristic | Vulnerable older adults (n= 41) | Non-vulnerable older adults (n= 103) | p |
|---|---|---|---|
| Frailty syndrome | 14 (34.1%) | 1 (0.9%) | 0.0001 |
| Cognitive impairment syndrome | 30 (73.2%) | 3 (2.9%) | 0.0001 |
| Polypharmacy | 37 (90.2%) | 28 (27.2%) | 0.0001 |
| Depression syndrome | 16 (39%) | 25 (24.3%) | 0.105 |
| Hypoglycemia | 1 (2.3 %) | 7 (6.8 %) | 0.303 |
| Diabetic retinopathy | 26 (63.4 %) | 30 (29.1 %) | 0.0001 |
| Diabetic nephropathy | 35 (85.4 %) | 31 (30.1 %) | 0.0001 |
| Diabetic foot | 14 (34.1 %) | 13 (12.6 %) | 0.003 |

***Figure 1. Comparison of survival between vulnerable and non-vulnerable older adults***

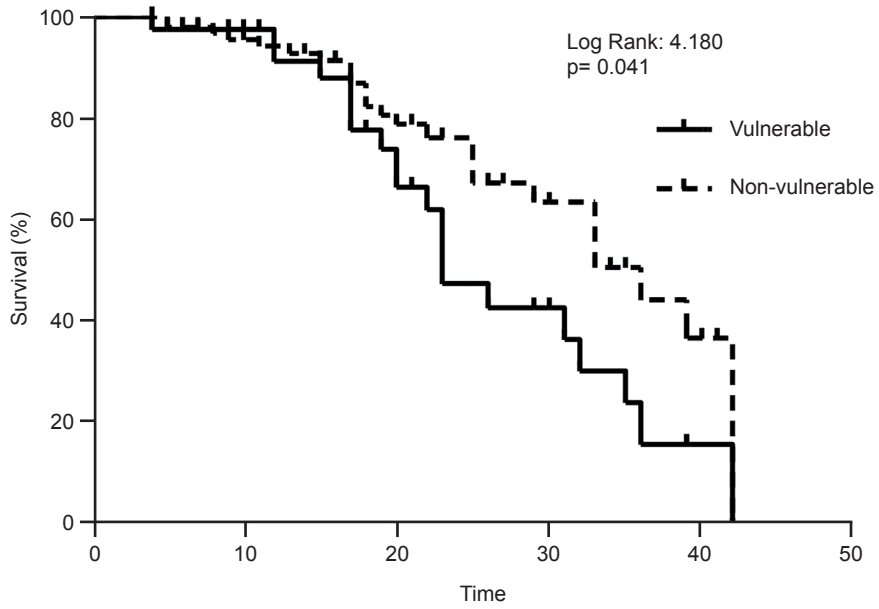


***Table 3. Survival for each recommendation of the CPG for vulnerable and non-vulnerable older adults***

| | | Vulnerable older adults n=41 | Non-vulnerable older adults n=103 | Log Rank | p |
|---|---|---|---|---|---|
| Recommendation 1 | Deceased | --- | 8 | 2.945 | 0.086 |
| | Live | --- | 26 | | |
| Recommendation 2 | Deceased | 1 | 1 | 1.868 | 0.172 |
| | Live | --- | 6 | | |
| Recommendation 3 | Deceased | --- | 1 | 3.412 | 0.065 |
| Recommendation 4 | Deceased | 1 | 10 | 3.51 | 0.061 |
| Belongs to two or more recommendations | Deceased | 19 | 15 | | |
| | Live | 21 | 43 | | |
| Does not belong to any recommendation | Deceased | --- | 1 | | |
| | Live | --- | 2 | | |
| Total | Deceased | 20 | 26 | | |
| | Live | 21 | 77 | | |
| | Total | 41 | 103 | | |

diagnosis and progression in vulnerable adults, vs 36 years in non-vulnerable older adults.

The CPG for the diagnosis and treatment of T2DM in the vulnerable older adult has four main recommendations however, when performing the Log Rank analysis, none of the above recommendations showed greater survival, see Table 3.

### *Discussion*

In the present study, it was shown that a vulnerable older adult has lower survival rate after T2DM diagnosis and progression. T2DM and the vulnerability in older adults, are currently challenging Mexico's health system, as they represent a great economic burden. It is well known that reaching metabolic control is a main goal in T2DM patients, however, in older adults, cognitive impairment and frailty increase the risk of poor metabolic controls this has been reported in other studies.[11]

Here, we did not evaluate metabolic control, however, CPG supports the ADA guidelines that recommend changes in lifestyle once T2DM is diagnosed, aimed to prevent complications in older adults such as frailty. Careful drug prescription and monitoring in older adults are essential to reduce the risk of nocturnal hypoglycemia. In this study, polypharmacy was the most reported geriatric syndrome in vulnerable older adults (90.2%). This has also been pointed out in similar studies in which older adults participated[12,13]

It has been pointed out that cognitive impairment is related to poor glycemic control,[14,15] however, these observations have not been fully validated, since there are long-term studies that have not found sufficient evidence that supports this

association, so this area requires further research.[16]

People with T2DM have a higher risk of premature death (up to 10%) compared to the general population, and this risk increases if T2DM is associated with kidney disease,[18,19] the latter is concerning since in our participants, the main complication was nephropathy, so a regular comprehensive evaluation of older adults with T2DM is essential to contain its negative impact on health.

One of the strengths of this study is its design since it can be reproduced in every MFU allowing further comparative analysis. However, the main limitation of this study was the inadequate data recording in the medical electronic records, reducing the availability of participants to be included in the study.

### *Conclusion*

T2DM vulnerable older adults die sooner than non-vulnerable ones, a situation that is influenced by metabolic control, cognitive impairment, polypharmacy, and depression. The CPG recommendations of the should be analyzed since none of the four showed a higher survival rate.

### *Authors contribution*

M A-T: writing, conceptualization, analysis, and discussion of results. A G-G: data analysis, conceptualization, writing and discussion. C A-A: data analysis, conceptualization, and discussion. All authors approve the publication of this paper.

### *Financing*

This research was not funded.

### *Conflicts of interest*

The authors declare no conflicts of interest.

### *References*

1. Petersmann A, Müller-Wieland D, Müller UA, Landgraf R, Nauck M, Freckmann G, et al. Definition, Classification and Diagnosis of Diabetes Mellitus. Exp Clin Endocrinol Diabetes. 2019;127(S01):S1-S7. DOI: 10.1055/a-1018-9078
2. Basto-Abreu A, Barrientos-Gutiérrez T, Rojas-Martínez R, Aguilar-Salinas CA, López-Olmedo N, De la Cruz-Góngora V, et al. Prevalencia de diabetes y descontrol glucémico en México: resultados de la Ensanut 2016. Salud Pública Mex. 2020;62(1):50-59. DOI: 10.21149/10752
3. Gopalraj R. The Older Adult with Diabetes and The Busy Clinicians. Prim Care. 2017;44(3):469-479. DOI: 10.1016/j.pop.2017.04.011
4. Jin X, Liu Y, Hu Z, Du W. Vulnerable Older Adults' Identification, Geographic Distribution, and Policy Implications in China. Int J Environ Res Public Health. 2021;18(20):10642. DOI: 10.3390/ijerph182010642
5. Diagnóstico y tratamiento de diabetes mellitus en el adulto mayor vulnerable. Catálogo Maestro [Internet]. [Citado 2022 Mar 10]. Disponible en: https://cenetec-difusion.com/gpc-sns/?p=744
6. Kim J, Miller S. Geriatric Syndromes: Meeting a Growing Challenge. Nurs Clin North Am. 2017;52(3):ix-x. DOI: 10.1016/j.cnur.2017.06.001
7. Papatheodorou K, Banach M, Bekiari E, Rizzo M, Edmonds M. Complications of Diabetes 2017. Journal of Diabetes Research. 2018;2018:3086167. DOI: 10.1155/2018/3086167
8. Guerrero-Godínez JM, Barragán-Vigil AM, Navarro-Macias CL, Murillo-Bonilla LM, Uribe-González RP, Sánchez-Cruz MA. Diabetes mellitus en el adulto mayor. Rev Med Clin. 2017;1(2):81-94. DOI: 10.5281/zenodo.1186879
9. Adu-Sarkodie NY. Clinical Management of Diabetes Mellitus in the Older Adult Patient. Curr Diabetes Rev. 2017;13(3):225-238. DOI: 10.2174/1573399812666161206151706
10. American Diabetes Association Professional Practice Committee. 13. Older Adults: Standards of Medical Care in Diabetes 2022. Diabetes Care. 2022;45(Suppl.1):S195-S207. DOI:10.2337/dc22-S013
11. Galván Ojeda I, Álvarez Aguilar C, Gómez García A. Control metabólico en adultos mayores con diabetes mellitus tipo 2 vulnerables y no vulnerables. Aten Fam. 2019;26(3):95-99. DOI:10.22201/facmed.14058871p.2019.3.70035
12. Romero-Medina JL, González-López AM, Vázquez-Cruz E, Gutierrez-Gabriel I, Montiel-Jarquín Á, Córdova-Soriano JA, et al. Síndromes Geriátricos en pacientes de primer nivel de atención médica. Prensa Méd Argent. 2014;28(5):287-290.
13. Becerra-Partida EN, Medina-Millan R, Riquer-Arias DR. Depresión en pacientes con diabetes mellitus tipo 2. Rev CONAMED. 2019;24(4):174-178
14. Petersen RC, Lopez O, Armstrong MJ, Getchius TSD, Ganguli M, Gloss D, et al. Practice guideline update summary: Mild cognitive impairment: Report of the Guideline Development, Dissemination, and Implementation Subcommittee of the American Academy of Neurology. Neurology. 2018;90(3):126-135. DOI:10.1212/WNL.0000000000004826
15. Rawlings AM, Sharrett AR, Schneider AL, Coresh J, Albert M, Couper D, et al. Diabetes in midlife and cognitive change over 20 years: a cohort study. Ann Intern Med. 2014;161:785-793. DOI: 10.7326/M14-0737
16. Papunen S, Mustakallio-Könönen A, Auvinen J, Timonen M, Keinänen- Kiukaanniemi S, Sebert S. The association between diabetes and cognitive changes during aging. Scand J Prim Health Care. 2020;38(3):281-290. DOI: 10.1080/02813432.2020.1802140
17. Forbes A. Reducing the Burden of Mortality in Older People With Diabetes: A Review of Current Research. Front Endocrinol (Lausanne). 2020;17(11):133. DOI: 10.3389/fendo.2020.00133
18. Tang O, Matsushita K, Coresh J, Sharrett AR, McEvoy JW, Windham BG, et al. Mortality Implications of Prediabetes and Diabetes in Older Adults. Diabetes Care. 2020;43(2):382-388. DOI: 10.2337/dc19-1221
19. Alegre-Díaz J, Herrington W, López-Cervantes M, Gnatiuc L, Ramirez R, Hill M, et al. Diabetes and Cause-Specific Mortality in Mexico City. N Engl J Med. 2016;375(20):1961-1971. DOI: 10.1056/NEJMoa1605368