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Mortality to Diabetes Mellitus in Ecuador

Mortalidad por Diabetes Mellitus en Ecuador

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Abstract

Background: Diabetes mellitus is a leading non-communicable disease and an increasingly visible contributor to avoidable mortality in low- and middle-income countries. Ecuador has recently reported diabetes mellitus among the leading causes of death in women and adults, yet detailed descriptive analyses using individual vital registration records remain limited. **Objective:** To characterize deaths attributed to diabetes mellitus in Ecuador in 2024 using a curated database derived from the National Institute of Statistics and Censuses (INEC) death registry. **Methods:** A retrospective, cross-sectional descriptive study was conducted using individual-level mortality records from 2024. Deaths with an underlying ICD-10 code E10-E14 were included; five records coded as diabetes insipidus (E23.2) were excluded. **Results:** A total of 4,652 diabetes mellitus deaths were analyzed. Women represented 2,429 deaths (52.2%) and men 2,223 (47.8%). Mean age at death was 70.9 years (SD 14.3); women died at older ages than men (median 74 vs 70 years; $p<0.001$). Premature mortality before age 70 accounted for 2,030 deaths (43.6%), with a higher proportion among men (48.6%) than women (39.1%). Deaths were concentrated in the Coast region (3,285; 70.6%), particularly Guayas (1,611; 34.6%). **Conclusion:** Diabetes mellitus mortality in Ecuador during 2024 was concentrated among older adults, but more than four in ten deaths occurred before age 70, especially among men. The predominance of home deaths, coastal concentration, frequent chronic complications, and high use of unspecified diabetes codes point to priorities for primary care strengthening, chronic complication surveillance, death certification quality, and geographically targeted prevention strategies.

Keywords: Diabetes mellitus; Mortality; Vital statistics; Premature mortality.

SALUD MEDICINA E INNOVACIÓN

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Resumen

Antecedentes: La diabetes mellitus es una enfermedad no transmisible líder y un factor cada vez más visible en la mortalidad evitable en países de ingresos bajos y medios. Ecuador ha informado recientemente de la diabetes mellitus entre las principales causas de muerte en mujeres y adultos, pero los análisis descriptivos detallados utilizando registros individuales de registro vital siguen siendo limitados. **Objetivo:** Caracterizar las muertes atribuidas a la diabetes mellitus en Ecuador en 2024 utilizando una base de datos seleccionada derivada del registro de defunciones del Instituto Nacional de Estadística y Censos (INEC). Métodos: Se realizó un estudio descriptivo retrospectivo y transversal utilizando registros de mortalidad a nivel individual de 2024. Se incluyeron las muertes con un código CIE-10 subyacente E10-E14; se excluyeron cinco registros codificados como diabetes insípida (E23.2). **Resultados:** Se analizaron un total de 4.652 muertes por diabetes mellitus. Las mujeres representaron 2.429 muertes (52,2%) y los hombres 2.223 (47,8%). La edad media al fallecer era de 70,9 años (DS 14,3); Las mujeres morían a edades mayores que los hombres (mediana de 74 frente a 70 años; p<0,001). La mortalidad prematura antes de los 70 años representó 2.030 muertes (43,6%), con una proporción mayor entre hombres (48,6%) que entre mujeres (39,1%). Las muertes se concentraron en la región costera (3.285; 70,6%), especialmente en Guayas (1.611; 34,6%). **Conclusión:** La mortalidad por diabetes mellitus en Ecuador durante 2024 se concentró entre adultos mayores, pero más de cuatro de cada diez muertes ocurrieron antes de los 70 años, especialmente entre hombres. La predominancia de muertes en casa, la concentración costera, las frecuentes complicaciones crónicas y el alto uso de códigos de diabetes no especificados apuntan a prioridades para el fortalecimiento de la atención primaria, la vigilancia de complicaciones crónicas, la calidad de la certificación de defunciones y estrategias de prevención geográficamente específicas.

Palabras clave: Diabetes mellitus; Mortalidad; Estadísticas vitales; Mortalidad prematura.

SALUD MEDICINA E INNOVACIÓN

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Introduction

Diabetes mellitus has become one of the defining chronic disease challenges for contemporary health systems. The World Health Organization (2024) reported that diabetes was the direct cause of 1.6 million deaths in 2021 and that almost half of diabetes-related deaths occurred before 70 years of age. More recent pooled global analyses indicate that the number of adults living with diabetes exceeded 800 million by 2022, with the largest absolute and relative increases occurring in low- and middle-income countries where diagnosis, treatment, and complication control remain uneven (NCD Risk Factor Collaboration [*NCD-RisC*], 2024). In Ecuador, the International Diabetes Federation (2024) estimated 552,800 adults with diabetes in 2024, corresponding to an adult prevalence of 4.9%. These figures underscore the need for national analyses capable of translating registry data into actionable public health evidence.

Mortality statistics are particularly informative because diabetes often reflects the cumulative failure of prevention, early detection, sustained glycemic control, cardiovascular and renal risk management, and access to timely care. National death registries can identify not only the number of deaths attributed to diabetes but also the demographic, geographic, and clinical coding patterns that shape the burden observed by health services. In Ecuador, INEC vital statistics for 2024 show diabetes mellitus among the leading causes of death in women, and among major causes in working-age adults and older adults (Instituto Nacional de Estadística y Censos [INEC], 2025a, 2025b). However, aggregated rankings alone do not fully reveal where deaths occur, which age groups are most affected, how diabetes subtypes are coded, or whether deaths are clustered in specific territories.

International evidence suggests that diabetes mortality is modified by social conditions, multimorbidity, and health-system access. Frailty increases cardiovascular and all-cause mortality risks among people with prediabetes and diabetes (He et al., 2022), while lower vitamin D status has been associated with cardiovascular outcomes and mortality in people with dysglycemia (Zhang et al., 2022). Studies using national or large administrative databases have also linked diabetes mortality to racial and economic segregation (Saelee et al., 2024), subsidized housing and municipal deprivation (Flores-Ortiz et al., 2023), transportation noise (Vienneau et al., 2024),

SALUD MEDICINA E INNOVACIÓN
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physical inactivity (Beltran-Valls et al., 2023), chronic kidney disease (Rashid et al., 2024), cardiovascular disease (Jain et al., 2023), tuberculosis and renal impairment (Kaur et al., 2023), and COVID-19 complications (Kantroo et al., 2021; Long et al., 2022; Sharma et al., 2022). These studies support the relevance of examining mortality data through both clinical and structural lenses.

The present study analyzes individual-level 2024 mortality records from an INEC-derived diabetes mortality database. The objective was to characterize deaths attributed to diabetes mellitus in Ecuador by sex, age, place of death, province and region of residence, urban-rural residence, education, ethnicity, marital status, diabetes subtype, and coded complication profile. The analysis was designed to provide a Springer-style descriptive epidemiological manuscript that can serve as a foundation for future rate-based, spatial, or trend analyses.

Methods

Study design and data source

This was a retrospective, cross-sectional descriptive study based on individual mortality records for Ecuador in 2024. The analytic file was the uploaded database derived from the INEC Registro Estadístico de Defunciones Generales 2024. INEC (2025a, 2025b) publishes annual mortality statistics and technical documents for the national death registry, including provisional 2024 results and methodological notes.

The registry is based on death certificates and administrative registration processes. For this analysis, the unit of analysis was the individual death record. Because the file contains anonymized registry data and no direct identifiers, the study involved secondary analysis of administrative data.

Case definition and eligibility criteria

The outcome was death attributed to diabetes mellitus as the underlying cause. Records were included when the ICD-10 code extracted from the cause-of-death field belonged to E10-E14: E10 type 1/insulin-dependent diabetes mellitus, E11 type 2/non-insulin-dependent diabetes mellitus, E12 malnutrition-related diabetes mellitus, E13 other specified diabetes mellitus, and E14 unspecified diabetes mellitus. The uploaded file contained 4,657 diabetes-labeled records. Five

SALUD MEDICINA E INNOVACIÓN
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deaths coded as E23.2 (diabetes insipidus) were excluded because this condition is etiologically and clinically distinct from diabetes mellitus. The final analytic sample included 4,652 deaths.

The fourth ICD-10 character was used to classify complication categories: coma, ketoacidosis, renal complications, ophthalmic complications, neurological complications, peripheral circulatory complications, other specified complications, multiple complications, unspecified complications, and without mention of complication.

Variables

Demographic and social variables included sex, age, ethnicity, marital status, and level of instruction. Geographic variables included province of residence, province of death, urban-rural residence, and natural region of residence. Regions were operationalized as Coast, Highlands, Amazon, Insular, and abroad/unknown based on the province of residence. The place of death was categorized as home, Ministry of Health facilities, IESS facilities, private hospitals/clinics/consulting rooms, Junta de Beneficencia facilities, other public facilities, and other locations.

Age was analyzed as a continuous variable and in groups: <1 year, <18 years, 18-29, 30-44, 45-64, 65-74, 75-84, and 85+ years. Premature mortality was defined as death before 70 years of age, consistent with international non-communicable disease mortality monitoring practice. One record coded in months was retained in the <1 year group.

Statistical analysis

Analyses were performed using Python and *R*. Categorical variables were summarized as frequencies and percentages. Continuous age was summarized using means and standard deviations, as well as medians and interquartile ranges. Differences in age by sex were assessed using the Mann-Whitney U test because of the skewed age distribution. Associations between sex and categorical characteristics were assessed with chi-squared tests. A two-sided p value <0.05 was considered statistically significant.

The study did not estimate crude, age-specific, or age-standardized mortality rates because the uploaded analytic file did not include population denominators by age, sex, and province. Therefore, all geographic results are interpreted as proportional distributions among diabetes mellitus deaths.

SALUD MEDICINA E INNOVACIÓN

e-ISSN: 3121-2980

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Results

After excluding five E23.2 diabetes insipidus records, 4,652 deaths attributed to diabetes mellitus (ICD-10 E10-E14) were analyzed. Women accounted for 2,429 deaths (52.2%), and men accounted for 2,223 deaths (47.8%). The mean age at death was 70.9 years (SD 14.3), and the median was 72 years (IQR 62-82). Women died at significantly older ages than men: median 74 years (IQR 64-83) versus 70 years (IQR 61-79; p<0.001) (Table 1).

Table 1.

Age and sex profile of diabetes mellitus deaths in Ecuador, 2024.

Characteristic	Total (N=4,652)	Men (n=2,223)	Women (n=2,429)	p value
Age, years, mean (SD)	70.9 (14.3)	69.2 (13.9)	72.5 (14.4)	<0.001
Age, years, median (IQR)	72 (62-82)	70 (61-79)	74 (64-83)	<0.001
Premature death (<70 years)	2,030 (43.6)	1,080 (48.6)	950 (39.1)	<0.001
<1 year	1 (0.0)	0 (0.0)	1 (0.0)	<0.001
<18 years	5 (0.1)	2 (0.1)	3 (0.1)	
18-29 years	35 (0.8)	16 (0.7)	19 (0.8)	
30-44 years	152 (3.3)	88 (4.0)	64 (2.6)	
45-64 years	1,254 (27.0)	689 (31.0)	565 (23.3)	
65-74 years	1,220 (26.2)	612 (27.5)	608 (25.0)	
75-84 years	1,154 (24.8)	505 (22.7)	649 (26.7)	
85+ years	831 (17.9)	311 (14.0)	520 (21.4)	

Note: Values are n (%) unless otherwise indicated. P values compare men and women. Age p value from Mann-Whitney U test; categorical p values from chi-squared tests.

Deaths before age 70 represented 2,030 records (43.6%). Premature death was more frequent among men (1,080; 48.6%) than women (950; 39.1%; p<0.001). The largest age groups were 45-64 years (1,254; 27.0%), 65-74 years (1,220; 26.2%), and 75-84 years (1,154; 24.8%).

Figure 1.

Age distribution by sex.

SALUD MEDICINA E INNOVACIÓN

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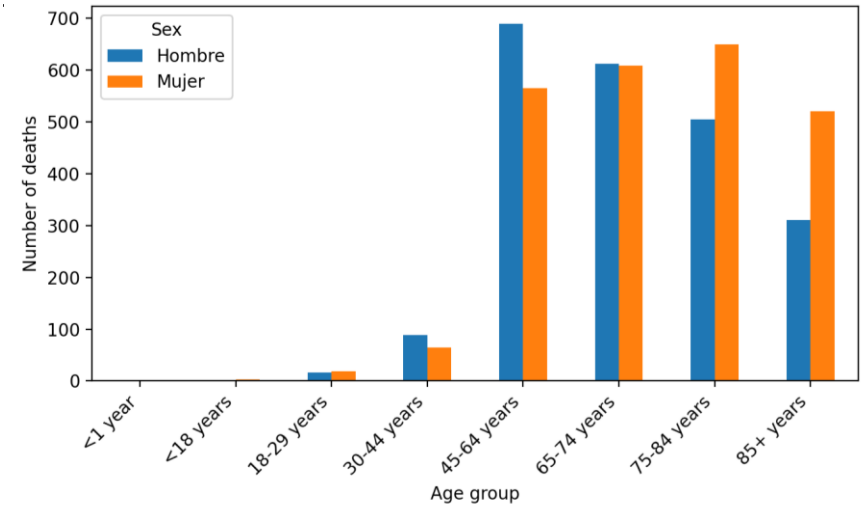

Geographic concentration and urban-rural distribution

Deaths were strongly concentrated in the Coast region (3,285; 70.6%), followed by the Highlands (1,216; 26.1%) and Amazon (148; 3.2%). Guayas alone accounted for 1,611 deaths (34.6%), followed by Manabí (551; 11.8%), Pichincha (393; 8.4%), and Los Ríos (346; 7.4%).

Most deaths occurred among people residing in urban areas (3,669; 78.9%). The sex distribution differed by region (p = 0.012) and urban-rural residence (p=0.001). Premature deaths were proportionally more frequent in the Coast (48.6%) and Amazon (46.6%) than in the Highlands (29.7%) (Table 2).

Table 2.
Geographic distribution of diabetes mellitus deaths by residence.

	n	%
Geographic variable		
Coast	3,285	70.6
Highlands	1,216	26.1
Amazon	148	3.2
Insular	1	0.0
Abroad/unknown	2	0.0
Urban residence	3,669	78.9
Rural residence	983	21.1
Top provinces of residence		
Guayas	1,611	34.6
Manabí	551	11.8
Pichincha	393	8.4
Los Ríos	346	7.4
Santa Elena	233	5.0
El Oro	204	4.4
Santo Domingo de los Tsáchilas	181	3.9
Esmeraldas	159	3.4

SALUD MEDICINA E INNOVACIÓN

e-ISSN: 3121-2980

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Loja	153	3.3
Azuay	153	3.3

Note: Percentages are calculated over the analytic sample of 4,652 diabetes mellitus deaths.

Place of death and social profile

The most common place of death was home, accounting for 2,878 deaths (61.9%). Ministry of Health facilities represented 1,079 deaths (23.2%), IESS facilities 350 (7.5%), and private hospitals, clinics, or consulting rooms 267 (5.7%). Place of death differed by sex ($p = 0.001$). Mestizo ethnicity was recorded in 4,023 deaths (86.5%), followed by Montubio (209; 4.5%) and Indigenous (91; 2.0%). Educational attainment was concentrated in low schooling categories: primary education, basic education, or no schooling together represented 3,278 deaths (70.5%). Educational distribution differed substantially by sex ($p < 0.001$) (Table 3).

Table 3.
Place of death and selected social characteristics.

	n	%
Place of death		
Casa	2,878	61.9
Establecimientos del Ministerio de Salud	1,079	23.2
Establecimientos del IESS	350	7.5
Hospital, clínica o consultorio privado	267	5.7
Otro	34	0.7
Establecimientos de la Junta de Beneficencia	25	0.5
Otros establecimientos públicos	19	0.4
Ethnicity		
Mestizo (a)	4,023	86.5
Montubio (a)	209	4.5
Sin información	185	4.0
Indígena	91	2.0
Blanco (a)	50	1.1
Afroecuatoriano (a) /Afrodescendiente	47	1.0
Negro (a)	25	0.5
Mulato (a)	13	0.3
Educational level		
Primaria	1,367	29.4
Educación Básica	1,196	25.7
Ninguno	715	15.4
Educación Media / Bachillerato	441	9.5
Secundaria	345	7.4
Sin información	295	6.3
Superior universitario	194	4.2
Centro de alfabetización	64	1.4
Superior no universitario	27	0.6
Postgrado	6	0.1
Marital status		
Soltero (a)	1,721	37.0
Casado (a)	1,647	35.4
Viudo (a)	771	16.6
Divorciado (a)	311	6.7
Sin información	137	2.9
Unión Libre	37	0.8
Unión de hecho	26	0.6
Separado (a)	2	0.0

SALUD MEDICINA E INNOVACIÓN

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ICD-10 diabetes subtype and complication profile

Type 2/non-insulin-dependent diabetes mellitus (E11) was the most frequent subtype, with 2,456 deaths (52.8%). Unspecified diabetes mellitus (E14) accounted for 1,724 deaths (37.1%), and type 1/insulin-dependent diabetes mellitus (E10) for 453 deaths (9.7%). Diabetes subtype distribution did not differ significantly by sex ($p = 0.225$) (Table 4).

Table 4.
ICD-10 subtype and complication profile of diabetes mellitus deaths.

ICD-10 classification	*n*	*%*
Diabetes mellitus subtype		
Type 2 / non-insulin-dependent diabetes mellitus	2,456	52.8
Unspecified diabetes mellitus	1,724	37.1
Type 1 / insulin-dependent diabetes mellitus	453	9.7
Malnutrition-related diabetes mellitus	13	0.3
Other specified diabetes mellitus	6	0.1
Complication category		
Other specified complications	1,718	36.9
Multiple complications	1,093	23.5
Renal complications	747	16.1
Without mention of complication	703	15.1
Ketoacidosis	205	4.4
Peripheral circulatory complications	103	2.2
Unspecified complications	44	0.9
Coma	33	0.7
Ophthalmic complications	3	0.1
Neurological complications	3	0.1
Most common specific ICD-10 underlying-cause codes		
E116 Diabetes mellitus no insulinodependiente, con otras complicaciones especificadas	1,075	23.1
E117 Diabetes mellitus no insulinodependiente, con complicaciones múltiples	568	12.2
E146 Diabetes mellitus no especificada, con otras complicaciones especificadas	568	12.2
E149 Diabetes mellitus no especificada, sin mención de complicación	350	7.5
E112 Diabetes mellitus no insulinodependiente, con complicaciones renales	344	7.4
E147 Diabetes mellitus no especificada, con complicaciones múltiples	334	7.2
E142 Diabetes mellitus no especificada, con complicaciones renales	314	6.7
E119 Diabetes mellitus no insulinodependiente, sin mención de complicación	298	6.4
E107 Diabetes mellitus insulinodependiente, con complicaciones múltiples	181	3.9
E141 Diabetes mellitus no especificada, con cetoacidosis	99	2.1

Note: ICD-10 E10-E14 records were retained. E23.2 diabetes insipidus was excluded from the analytic sample.

The most frequent complication category was other specified complications (1,718; 36.9%), followed by multiple complications (1,093; 23.5%), renal complications (747; 16.1%), and diabetes without mention of complication (703; 15.1%). The leading specific ICD-10 code was E11.6, type 2/non-insulin-dependent diabetes mellitus with other specified complications, representing 1,075 deaths (23.1%) (Figures 2 and 3).

SALUD MEDICINA E INNOVACIÓN

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Figure 2.
Top provinces of residence.

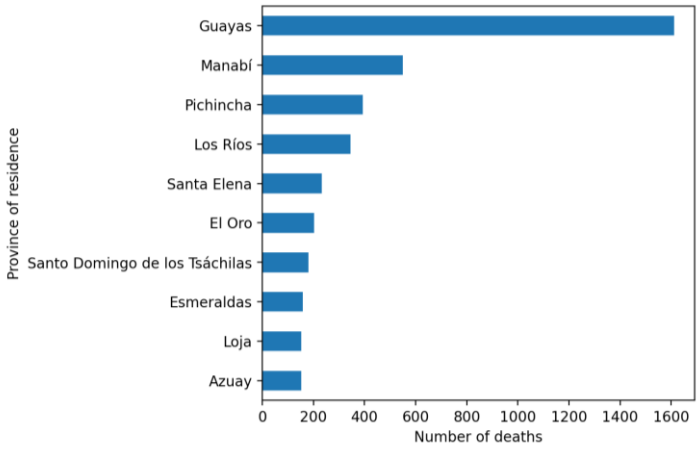
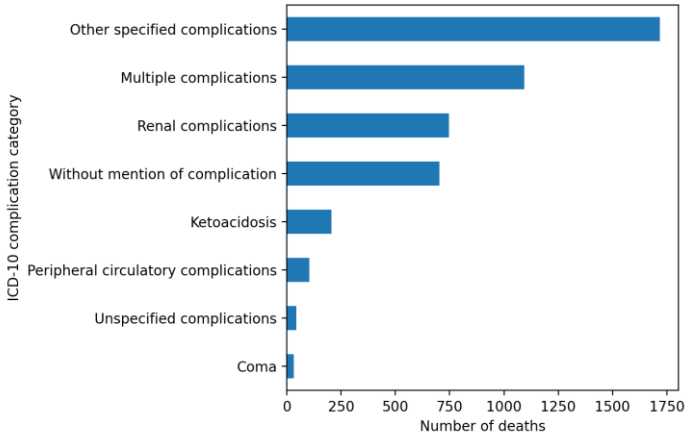


Figure 3.
Complication profile coded as underlying cause.



Discussion

This national descriptive analysis provides a detailed profile of diabetes mellitus deaths in Ecuador using 2024 INEC-derived vital registration data. Four findings are particularly important. First, diabetes mellitus deaths were concentrated among older adults, but premature mortality before age 70 accounted for 43.6% of all deaths and was markedly higher among men. Second, deaths were geographically concentrated in the Coast, especially Guayas, Manabí, Los Ríos, Santa Elena, El Oro, Esmeraldas, and Santo Domingo de los Tsáchilas. Third, nearly two thirds of deaths occurred at home. Fourth, the ICD-10 coding profile was dominated by type 2/non-insulin-dependent and unspecified diabetes, with frequent coding of other specified, multiple, and renal complications.

The age-sex pattern is consistent with the broader international observation that diabetes remains a major cause of premature non-communicable disease mortality (NCD-RisC, 2024; World Health Organization, 2024). Women represented a slightly larger share of deaths and died at older ages, while men had a higher proportion of deaths before 70. This pattern may reflect sex differences in cardiometabolic risk, occupational exposures, health-seeking behavior, adherence to long-term care, or competing causes of mortality. The finding deserves further study using denominators, comorbidity information, and longitudinal trends because premature death from diabetes indicates

SALUD MEDICINA E INNOVACIÓN
e-ISSN: 3121-2980
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missed opportunities for prevention, early detection, complication control, and timely emergency response.

The geographic concentration of deaths in coastal provinces should be interpreted cautiously because this analysis did not calculate population-based mortality rates. Guayas and Manabí are populous provinces, and their large contribution to the national count may partly reflect demographic size. Nevertheless, the proportion of premature deaths was higher in the Coast than in the Highlands, suggesting that coastal diabetes mortality may involve younger age structures, differential access to care, socioeconomic vulnerability, or differences in the distribution of obesity, hypertension, kidney disease, and vascular complications. International ecological and administrative-data studies have shown that diabetes mortality is shaped by social and spatial inequities, including racial and economic segregation (Saelee et al., 2024), subsidized housing and low municipal development (Flores Ortiz et al., 2023), and environmental exposures (Vienneau et al., 2024). A follow-up Ecuadorian study should estimate age-standardized mortality rates by province and canton using INEC (2024) population projections.

The predominance of home deaths is one of the most policy-relevant findings. Home death may reflect family preference and chronic disease trajectories, but it may also indicate delayed care seeking, insufficient continuity of primary care, limited access to transport or emergency services, unrecognized metabolic decompensation, or insufficient integration between outpatient diabetes management and palliative or end-of-life services. The high proportion of deaths at home suggests that diabetes mortality reduction cannot depend only on hospital-based interventions. Community-based models are needed, including risk stratification in primary care, home follow-up for high-risk patients, telehealth, medication access, family education about warning signs, and rapid referral pathways for hyperglycemic crises, infection, cardiovascular symptoms, and renal decompensation.

The ICD-10 profile points to a substantial burden of chronic complications. Renal complications were explicitly coded in 16.1% of deaths, and multiple complications in 23.5%. This aligns with evidence that kidney disease and cardiovascular comorbidity strongly shape diabetes mortality

SALUD MEDICINA E INNOVACIÓN

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(Jain et al., 2023; Rashid et al., 2024). Studies of tuberculosis-diabetes comorbidity also show that renal dysfunction can mediate higher hospitalization and mortality risk (Kaur et al., 2023). Ecuadorian diabetes programs should therefore prioritize integrated cardiorenal-metabolic care: routine albuminuria and estimated glomerular filtration screening, blood pressure and lipid management, foot examination, retinopathy screening, and prompt treatment of infections. These strategies are especially important among patients with low educational attainment, who constituted a large proportion of deaths in this study and may experience barriers to diabetes self-management.

The high proportion of E14 unspecified diabetes and broad categories such as “other specified complications” also has implications for mortality surveillance. Death certificates are essential for national monitoring, but limited diagnostic detail can obscure the specific clinical pathways leading to death. Improving death certification quality and coding specificity would allow better separation of type 1 diabetes, type 2 diabetes, renal complications, peripheral vascular disease, acute metabolic crises, and deaths in which diabetes is a contributing rather than underlying condition. Better coding would also facilitate international comparisons and improve the targeting of clinical guidelines and public health programs.

The findings are compatible with the wider literature showing that diabetes mortality is not determined by glycemia alone. Frailty (He et al., 2022), vitamin D deficiency (Zhang et al., 2022), physical inactivity (Beltran-Valls et al., 2023), depression (Cai et al., 2024; Prigge et al., 2022), infection (Kantroo et al., 2021; Kaur et al., 2023; Long et al., 2022; Sharma et al., 2022), air pollution (Yin et al., 2023), liver disease (Irfan et al., 2025), pneumonia (Krithika et al., 2025), and socioeconomic vulnerability (Flores-Ortiz et al., 2023; Saelee et al., 2024) all interact with diabetes mortality risk. Although the INEC dataset used here does not include clinical biomarkers, treatment status, or individual socioeconomic measures beyond education and residence, the observed patterns provide a strong rationale for linking mortality data with hospital discharge, primary care, medication, dialysis, and population projection datasets.

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This study has several strengths. It uses individual-level national vital registration data, applies a transparent ICD-10 case definition, excludes diabetes insipidus records, and describes demographic, geographic, place-of-death, and complication patterns using reproducible statistical procedures. The analysis also distinguishes between count distributions and population mortality risks, reducing the risk of overinterpreting provinces with large populations.

Several limitations must be acknowledged. First, the analysis is restricted to deaths in the uploaded diabetes mortality file and may differ from final official counts if INEC updates provisional records or applies alternative grouping rules. Second, the dataset does not include population denominators by age, sex, province, and year; therefore, crude or age-standardized mortality rates could not be estimated. Third, death certificate coding may misclassify diabetes subtype or complications, and diabetes may be omitted when it contributes to deaths attributed primarily to cardiovascular, renal, infectious, or cerebrovascular causes. Fourth, the dataset does not include clinical variables such as diabetes duration, glycemic control, body mass index, kidney function, medication use, health insurance coverage, or comorbidity. Finally, because the design is descriptive and cross-sectional, observed differences by sex, region, or education cannot be interpreted as causal.

Conclusion

In 2024, deaths attributed to diabetes mellitus in the analyzed INEC-derived database were concentrated among older adults but included a substantial premature mortality burden, particularly among men. The mortality profile was strongly concentrated in coastal provinces, mostly urban, frequently occurring at home, and dominated by type 2/non-insulin-dependent and unspecified diabetes with chronic complications. These findings support strengthening primary care-based diabetes control, cardiorenal risk management, complication surveillance, community follow-up, and death certification quality. Future analyses should incorporate population denominators to estimate age-standardized mortality rates and identify provinces and cantons with excess diabetes mortality risk.

SALUD MEDICINA E INNOVACIÓN

e-ISSN: 3121-2980

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Declarations

Ethics approval and consent to participate: This study used anonymized secondary mortality registry data. No individual consent was required.

Consent for publication: Not applicable.

Availability of data and materials: The analysis was based on an INEC-derived 2024 diabetes mortality database provided for this manuscript. Official mortality outputs are available from INEC.

Competing interests: The author declares no competing interests.

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Vanessa de los Ángeles Belloso de Noriega[2]: Diseño metodológico, resultados, discusión, validación de contenidos, revisión crítica, corrección académica y gestión del proyecto, análisis de la literatura científica y redacción del borrador original.

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