Diabetes mortality in Panama and related biological and socioeconomic risk factors

Jorge A. Motta,[1] Luis G. Ortega-Paz,[1] Carlos A. Gordón,[1] Beatriz Gómez,[1] Eva Castillo,[1] Víctor Herrera Ballesteros,[1] and Manuel Pereira[1]

ABSTRACT

Objective. To estimate mortality from diabetes mellitus (DM) for the period 2001–2011 in the Republic of Panama, by province/indigenous territory, and determine its relationship with biological and socioeconomic risk factors.

Methods. Cases for the years 2001–2011 with DM listed as the principal cause of death were selected from Panama's National Mortality Registry. Crude and adjusted mortality rates were generated by sex, age, and geographic area. Linear regression analyses were performed to determine the relationship between DM mortality and biological and socioeconomic risk factors. A composite health index (CHI) calculated from biological and socioeconomic risk factors was estimated for each province/indigenous territory in Panama.

Results. DM mortality rates did not increase for men or women during 2001–2011. Of the biological risk factors, being overweight had the strongest association with DM mortality. Of the socioeconomic risk factors, earning less than US$ 100 per month had the strongest association with DM mortality. The highest socioeconomic CHI scores were found in a province that is predominantly rural and in areas with indigenous populations. The highest biological CHI scores were found in urban-rural provinces and those with the highest percentage of elderly people.

Conclusions. Regional disparities in the association between DM mortality and DM risk factors reaffirm the heterogeneous composition of the Panamanian population and the uneven distribution of biological and social determinant risk factors in the country and point to the need to vary management strategies by geographic area for this important cause of disability and death in Panama.

Key words Chronic disease; diabetes mellitus; risk assessment; cause of death; impacts on health; women's health; Panama.

In 2008, diabetes mellitus (DM) caused approximately 1.26 million deaths, representing 2.2% of all deaths worldwide (1). In 2011, DM accounted for 5.5% of all deaths in Panama, making it the sixth leading cause of death in the country (2).

While some reports indicate mortality related to DM in the Americas has not changed in recent decades, increases in both men and women have been documented across the Mesoamerican region and in the countries of Cuba and Mexico (3).

In the last 20 years, obesity has increased in Panama, especially among women (4–6). Obesity has been shown to be an important biological risk factor for the development of DM. Socioeconomic risk factors have also been shown to be associated with DM morbidity and mortality (7, 8). Although poverty, poor education, and lack of access to health care appear to have decreased in some parts of Panama, these

[1] Instituto Conmemorativo Gorgas de Estudios de la Salud, Panama City, Panama. Send correspondence to: Jorge Motta, mensajesjorgemotta@gmail.com

constraints continue to affect rural and indigenous areas of Panama in a disproportionate manner. In nonindigenous rural areas, approximately 50.2% of the population is poor and 24.3% suffers from extreme poverty. In indigenous areas, approximately 89.8% of the population is poor and 68.5% suffers from extreme poverty (9).

Although several studies conducted in the Americas have reported on differences in DM-related mortality between countries, information on differences in DM mortality within countries, and its association with biological and socioeconomic risk factors, is scarce. This report aimed to help fill that gap by estimating DM mortality in Panama from 2001–2011 and determining its 1) distribution by province/indigenous territory, 2) trend, and 3) association with socioeconomic and biological risk factors.

MATERIALS AND METHODS

This study is an observational, retrospective study of DM mortality in the Republic of Panama for the years 2001–2011.

The mortality registries generated by the National Institute of Statistics and Census (*Instituto Nacional de Estadística y Censo*, INEC) were obtained for the study period. All registries for which the principal cause of death was DM were included and identified as such using the codes of the 10th revision of the International Classification of Diseases (ICD-10; codes E10–E14) (10, 11). The sex, age, and year of registered DM deaths and the provinces/indigenous territories where the deaths occurred were obtained. Age was expressed in years and divided into five-year ranges, from newborn to 80 years or older. Age statistics were summarized in terms of frequency and median using the 25th and 75th percentiles. A Mann-Whitney U-test was used for the comparison of medians, and the Pearson correlation coefficient was used in the correlation analysis. A level of $P < 0.05$ was considered statistically significant. DM-related deaths occurring between the ages of 0 and 49 years were termed "avoidable deaths" and expressed in absolute frequencies and proportions (12).

Crude, age-adjusted, and specific DM mortality rates were generated by year, age, sex, and geographic area using standard methodology and presented

as deaths per 100 000 persons (13). The United Nations standard population was used for the calculation of the adjusted death rates (14).

The 2007 National Health and Quality of Life Survey (*Encuesta Nacional de Salud y Calidad de Vida*, ENSCAVI) (15), which sampled 25 478 individuals out of a total national population of 3.1 million, was used to estimate the prevalence of hypercholesterolemia, systemic arterial hypertension, DM, and overweight in the country. These variables, which are considered biological risk factors for DM mortality, were analyzed by province/indigenous territory and by district.

The 2010 Population and Household Census (*Sexto Censo de Población y Segundo de Vivienda*) (16) was used to obtain the number and proportion of males and females; people ≥ 55 years old; people ≥ 65 years old; people with Amerindian and African ethnicity; unemployed persons; people with a monthly income less than US$ 100; and people with less than six years of education. All of these variables (except being male) were considered socioeconomic risk factors for DM mortality and were identified by province/indigenous territory and by district.

Simple linear regressions were constructed for both biological risk factors and socioeconomic risk factors using the crude DM mortality rate as the dependent variable. All variables were transformed to their natural logarithm. The results of the linear regressions were presented by correlation coefficients (*rs*). A level of $P < 0.05$ was considered statistically significant.

A composite health index (CHI) for biological and socioeconomic risk factors was estimated based on "Z-scores," which were calculated as the difference of the variable minus the mean, divided by the standard deviation. The CHI is the weighted sum of all Z-scores for a specific variable, using the correlations obtained from a factorial analysis as relative weights (17). The CHI was divided into five strata and represented in hierarchical thematic maps by type of risk factor and geographic area. Negative CHI values are associated with a lower level of risk factors and positive CHI values indicate a higher level of the risk factors.

In the province of Darién and in the indigenous territories of the country, the rate of unregistered deaths was 43.8% and 53% respectively (10). Therefore,

data from these areas, which collectively represent approximately 7.3% of the country's population (16), were only included in the calculation of the country's crude mortality rates and the CHI scores (i.e., they were not included in the calculation of age-adjusted mortality or avoidable deaths).

Statistical analysis was performed with SPSS Statistics version 20 (IBM, Dallas, TX, USA); the CHI calculation was made with SIGEpi, version 1.4 (Pan American Health Organization); and the thematic maps were made with the Manifold® System Release 8.x Geographic Information System (GIS) package (Manifold Software Limited, Hong Kong).

RESULTS

Mortality

The age-adjusted DM mortality rate countrywide for the years 2001–2011 was 23.3 per 100 000. By province, the highest age-adjusted rates were found in Colón and Bocas del Toro (35.8 and 28.1 per 100 000 respectively) (Table 1). The highest crude mortality rate was found in the province of Los Santos (32.2 per 100 000). During the study period, age-adjusted mortality for DM did not show an upward trend for males or females (Figure 1).

There were a total of 8 893 DM deaths countrywide over the study period, 56.8% of which occurred in females. Most of the deaths by DM (89.0%) occurred in people ≥ 55 years old.

The DM-related death rate was 29.5 per 100 000 for females and 18.0 per 100 000 for males, representing 7.7% of all female deaths and 4.2% of all male deaths. The difference in age-adjusted mortality rates for females versus males widened after age 55, with females showing a faster increase in adjusted DM-related mortality than males as they aged (Figure 2).

The median age of death attributed to DM countrywide was 73 (63–82) years. By province, the lowest median age of death (68) was found in Bocas del Toro (57–77; $P = 0.001$). By sex, the median age of death countrywide was 71 (62–80) for males and 75 (65–83) ($P = 0.001$) for females.

During the study period, there were a total of 564 DM deaths in persons 0–49 years old (the age group for which DM-related deaths were considered

TABLE 1. Age-adjusted diabetes mellitus (DM) mortality and avoidable deaths[a] by year and geographic area, based on cases with DM listed as principal cause of death in the National Mortality Registry, Panama, 2001–2011

Geographic area	Age-adjusted DM mortality (per 100 000)												Avoidable deaths (%)
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2001–2011	2001–2011
Province[b]													
Bocas del Toro	44.4	21.8	26.3	38.4	12.9	31.6	33.8	30.3	28.2	10.5	35.2	28.1	13.6
Chiriquí	26.1	34.1	30.3	21.7	23.5	21.7	22.9	29.0	25.7	27.8	21.3	25.6	4.6
Coclé	17.7	11.0	16.6	20.9	22.2	21.0	24.2	19.0	16.6	14.4	17.5	18.4	6.0
Colón	27.5	45.5	35.0	41.1	35.5	39.2	36.9	45.9	38.9	22.2	30.1	35.8	7.3
Herrera	23.4	25.0	16.0	18.6	16.4	15.9	14.8	14.2	12.9	13.5	13.9	16.4	6.2
Los Santos	19.6	23.0	20.3	20.8	27.7	17.3	18.2	17.8	16.5	14.7	6.7	18.1	7.0
Panamá	30.0	31.8	32.1	28.4	26.0	30.3	26.1	27.7	20.7	22.8	24.9	26.9	6.3
Veraguas	13.5	10.7	11.6	16.0	16.6	13.0	15.3	13.4	10.4	15.0	14.0	13.6	3.7
Country	25.1	27.5	26.2	24.9	23.6	25.0	23.5	24.8	20.0	19.1	21.3	23.3	6.3

[a] DM-related deaths among those aged 0–49 years.
[b] The province of Darién and the indigenous territories Emberá-Wounaan, Guna Yala, and Ngäbe-Bugle, which collectively represent about 7.3% of the country's population (16), were not included due to deficient registry data.

"avoidable"), representing 7.7% of all DM-related male deaths and 5.3% of all DM-related female deaths. The largest percentage of "avoidable deaths" was found in the province of Bocas del Toro (13.6%).

Biological and socioeconomic risk factors

The biological risk factor with the strongest correlation to death from DM was being overweight ($r = 0.96$, $P > 0.001$). Hypercholesterolemia and hypertension were also found to be associated with DM mortality ($P > 0.001$).

The socioeconomic risk factor with the strongest correlation to DM mortality was having a monthly income of less than US$ 100 ($r = 0.6$, $P < 0.001$). Having less than six years of education and being unemployed were also found to be associated with death from DM ($P < 0.001$).

Composite health index score

Within the country, large differences were found in the CHI scores calculated from the biological and socioeconomic risk factors related to DM (Table 2, Figures 3 and 4). Provinces with the highest

socioeconomic risk scores did not have the highest biological scores and vice versa.

The provinces of Herrera and Los Santos had the highest biological CHI scores but relatively low socioeconomic CHI scores. The highest contributor to the CHI score in these provinces was age ("being ≥ 55 years old"), which represented 45.7% of the score (Herrera and Los Santos have the highest percentage of elderly in the country). The other contributors were hypertension (35.2%), hypercholesterolemia (14.5%), and obesity (13.0%).

The province of Darién and the areas inhabited by indigenous tribes (Ngäbe-Bugle, Emberá-Wounaan, and Guna Yala) had the highest socioeconomic CHI scores (Table 2). The province of Colón, which had the highest age-adjusted DM death rates, had intermediate biological and socioeconomic risk scores. In the provinces of Panamá, Chiriquí, and Coclé, the biological CHI scores were higher than the socioeconomic CHI scores.

DISCUSSION

Diabetes is one of the principal causes of death in Panama. Relative to other countries in the Americas, Panama ranks among those with a medium DM mortality risk (18).

Recent trends in mortality associated with DM have not been studied in Panama. Although DM mortality in many countries has increased (19), this study showed no increase in DM mortality in Panama from 2001 to 2011.

FIGURE 1. Diabetes mellitus (DM) age-adjusted mortality rate by sex, based on cases with DM listed as principal cause of death in the National Mortality Registry, Panama, 2001–2011
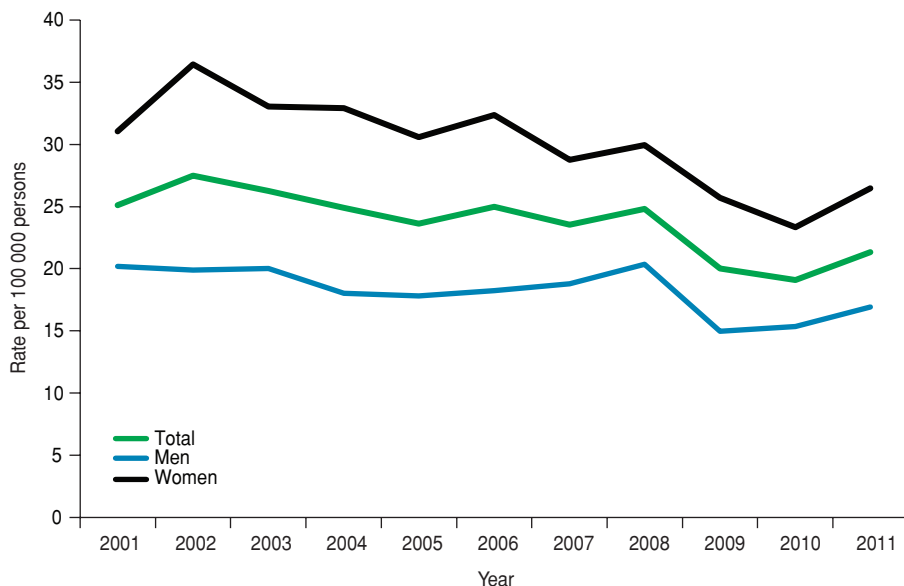
FIGURE 2. Diabetes mellitus (DM) age-adjusted mortality rate by sex and age, based on cases with DM listed as principal cause of death in the National Mortality Registry, Panama, 2001–2011
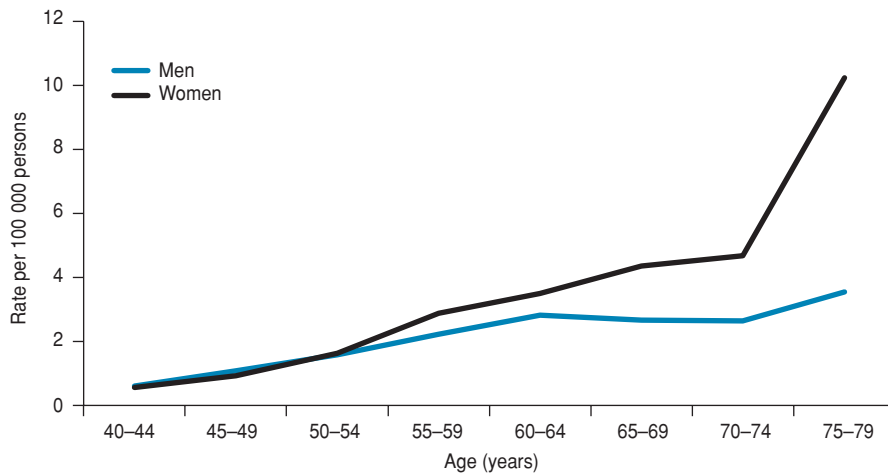
TABLE 2. Estimated composite health index based on biological and socioeconomic risk factors related to mortality from diabetes mellitus, by geographic area, Panama, 2001–2011

	Composite health index	
Geographic area	Biological risk factors	Socioeconomic risk factors
Province		
Bocas del Toro	−0.52	0.38
Chiriquí	0.19	−0.07
Coclé	0.11	−0.05
Colón	0.15	0.26
Darién	−0.61	0.29
Herrera	0.63	−0.13
Los Santos	0.40	−0.10
Panamá	0.09	−0.15
Veraguas	0.01	−0.11
Indigenous territory		
Emberá-Wounaan	−1.03	0.15
Guna Yala	−1.04	0.20
Ngäbe-Bugle	−0.89	0.42
Country	−0.21	0.09

While there are no national studies of the change in DM prevalence in Panama in recent decades, there are studies that indicate the country has experienced a marked increase in the prevalence of obesity. This study showed that the increase in obesity in Panama has not been accompanied, in the last decade, with an increase in mortality from DM. This was an unexpected finding in view of the relationship between obesity and DM and the relationship between being overweight and DM-related mortality found in this study. However, a higher DM mortality was found in females versus males, which may be partly explained by the much higher prevalence of obesity seen in Panamanian women

versus men. Panama's national Living Standards Survey (*Encuesta de Niveles de Vida*, ENV) for 2003 found a prevalence of obesity among Panamanian females of 21.8% (versus 14% among males) (3). The difference in overweight between females and males was demonstrated again in the 2007 ENSCAVI survey in which female participants self-reported an excess weight prevalence of 12.1% while males reported a prevalence of 6.4% (15). The most recent information, derived from the 2010 PREFEC study (6), which was conducted among subjects older than 18 years of age in the provinces of Panamá and Colón, revealed a prevalence of obesity of 30.9% in females and 18.4% in males.

A higher mortality from DM in females has also been documented in other countries in the Americas, but in some, such as Argentina, Canada, Chile, and the United States, males are reported to have higher mortality from DM than females (20). In the United States, this trend is reversed among Hispanics, among whom females have been found to have a higher mortality from DM than males (21, 22).

This study identifies important differences in DM risk factors and mortality in different geographic areas of Panama. The province of Colón had the highest age-adjusted DM mortality rates. This province is predominantly urban and has the largest concentration of people of African descent (23). The higher DM mortality documented in this province could be explained by moderately elevated biological and socioeconomic CHI risk scores. Furthermore, people of African descent in Panama have been shown to have higher odds of suffering from obesity, diabetes, and hypertension (5).

The province of Bocas del Toro, which comprises mostly rural areas and has a large population of Amerindians and people of African descent, had the second-highest age-adjusted DM mortality rate. Considering this area's low biological CHI score, the surprisingly high level of DM mortality could be explained by the high socioeconomic CHI risk score. DM mortality in this province seems to be influenced more by social determinants than by the classical biological factors.

The highest socioeconomic CHI scores were documented in areas inhabited by Amerindian tribes and in the province of Darién, which is predominantly rural. Unfortunately, DM mortality could not be reliably determined in these areas because of the poor quality of the mortality registries. The low education and income levels in these areas most likely lead to poor access to health services, inadequate nutrition, and other unhealthy practices that make death from diabetes more likely. If biological risk were to increase and socioeconomic risks were to remain unchanged in Panama's rural and indigenous areas, there would probably be a dramatic increase in cases of DM and DM-related mortality.

The areas with the highest biological CHI scores were found in the provinces of Los Santos and Herrera, probably because they contain the highest percentage of people ≥ 65 years old in the country.

FIGURE 3. Estimated composite health index calculated from biological risk factors related to mortality from diabetes mellitus, by province/indigenous territory, Panama, 2001–2011
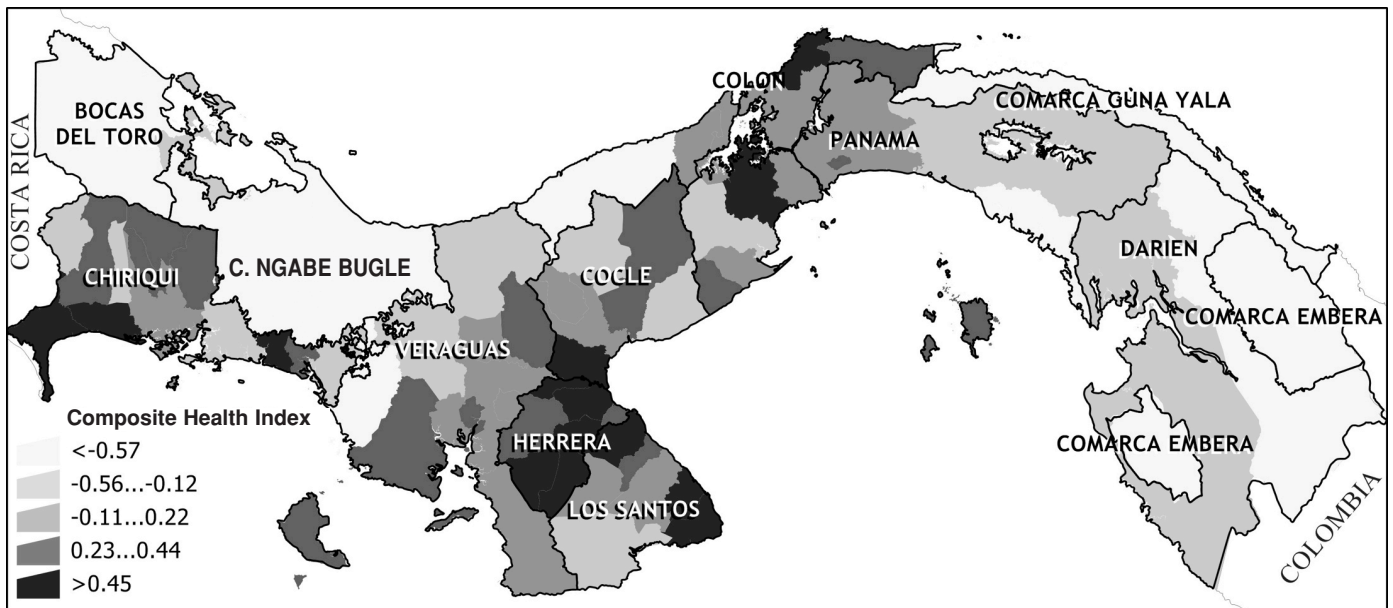
FIGURE 4. Estimated composite health index calculated from socioeconomic risk factors related to mortality from diabetes mellitus, by province/indigenous territory, Panama, 2001–2011
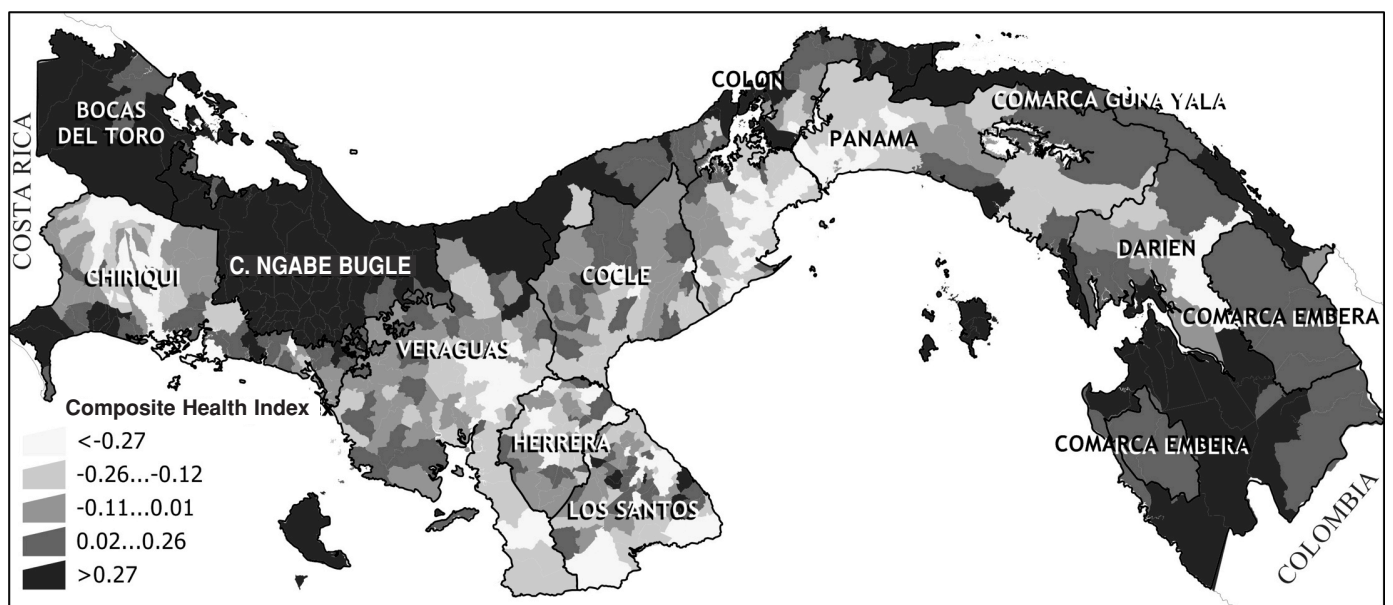
This finding underscores the in-country variations in risk due to demographic and other factors that may occur even in small countries like Panama.

This study shows that the highest age-adjusted DM mortality rates were found mostly in provinces with predominantly urban development. A study by Sánchez-Barriga from Mexico also found higher age-adjusted DM mortality in urban areas (24). One exception in Panama, however, was the province with the second-highest age-adjusted DM mortality in the country (Bocas del Toro), which is predominantly rural but had elevated socioeconomic risk. This finding points to the important association of social determinants with the risk of death related to DM in rural areas in Panama. The different distribution of biological and socioeconomic risk factors found in the country needs to be studied further to better understand the different rates of DM-related mortality seen in the

different provinces and indigenous territories of Panama.

Limitations

Limitations of this study include the use of DM mortality registries for the estimation and analyses of the mortality rates. Because the data only included cases for which the principal cause of death was DM, the total contribution of DM to mortality was most likely underestimated. The mortality rate estimates for the province of Darién and the indigenous territories were also most likely underestimated, due to deficient registries. Another study limitation was the relatively short study period, which is not optimal for a time series analysis. A longer study period may have resulted in more accurate estimates of changes in mortality trends.

Conclusions

Based on the study results, there was no increase in DM-related mortality in Panama during the last decade. This finding contrasts with the marked increase in the prevalence of obesity seen in recent decades. A higher mortality from DM was found among women as opposed to men, however, which may be partially attributable to a much higher prevalence of obesity in women versus men.

The regional disparities in DM mortality and DM risk factors in Panama reaffirm the heterogeneous composition of the population and the uneven distribution of biological and social determinants of DM mortality in the country. These wide variations of DM mortality and DM risk factors underscore the need to develop different strategies for different geographic areas of the country to manage this important cause of disability and death in Panama.

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RESUMEN

Mortalidad por diabetes en Panamá y factores de riesgo biológicos y socioeconómicos relacionados con la enfermedad

Objetivo. Calcular la mortalidad por diabetes sacarina durante el período del 2001 al 2011 en la República de Panamá por provincias o comarcas indígenas, y determinar su relación con los factores de riesgo biológicos y socioeconómicos de aparición de la enfermedad.

Métodos. Se escogieron del Registro Nacional de Mortalidad de Panamá del 2001 al 2011 los casos en los cuales la diabetes constituyó la principal causa de muerte. Se calcularon las tasas de mortalidad brutas y ajustadas desglosadas por sexo, edad y zona geográfica. Mediante análisis de regresión lineal se determinó la relación entre la mortalidad por diabetes y los factores de riesgo socioeconómicos y biológicos y se calculó un índice de salud compuesto con base en cada tipo de factores de riesgo en cada provincia o comarca indígena de Panamá.

Resultados. Las tasas de mortalidad por diabetes no aumentaron en los hombres ni las mujeres del 2001 al 2011. De los factores de riesgo biológicos, el exceso de peso exhibió la asociación más fuerte con la mortalidad por diabetes y el factor de riesgo socioeconómico que presentó una mayor asociación con la mortalidad fue un ingreso mensual inferior a US$ 100. Las puntuaciones más altas del índice de salud compuesto desde el punto de vista socioeconómico se obtuvieron en una provincia que es rural en su mayor parte y en zonas con poblaciones indígenas. Las puntuaciones más altas con los factores biológicos se observaron en las provincias urbanas y rurales y en las que contaban con el porcentaje más alto de personas ancianas.

Conclusiones. Las disparidades regionales de la asociación entre la mortalidad por diabetes sacarina y los factores de riesgo de padecer la enfermedad reafirman la composición heterogénea de la población de Panamá y la distribución desigual de los factores determinantes de riesgo biológicos y sociales en el país y ponen en evidencia la necesidad de diversificar las estrategias de manejo de esta importante causa de discapacidad y muerte, en función de las zonas geográficas en Panamá.

Palabras clave Enfermedad crónica, diabetes mellitus; medición de riesgo; causas de muerte; impactos en la salud; salud de la mujer; Panamá.