Evaluating Mexico's low cancer mortality using two national death registries

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Abstract

Purpose: Mexico has low cancer mortality relative to high income and other Latin American countries. We hypothesized that the low cancer mortality could be partly explained by pitfalls in death certificate processing. We undertook this work to compare cancer mortality rates from two national death registries that independently code and attribute cause of death.

Methods: We compared 5-year age-standardized total cancer and site-specific cancer mortality rates (2010–2014) from Mexico's official death registry with a death registry from a disease surveillance system. We obtained age-adjusted mortality rates and 95% confidence intervals using the direct method and World Population Prospects 2010 as a standard.

Results: Cancer mortality estimates for Mexico were minimally affected by the use of two distinct death certificate-coding procedures. Cancer mortality was 73.3 for INEGI and 72.7 for SEED per 100,000 women. The corresponding estimates for men were 68.3 and 67.8.

Conclusion: Mexico's low cancer mortality is unlikely to be explained by death certificate processing. Further investigations into the process of death certification and cancer registration should be conducted in Mexico.

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RESUMEN

México tiene una de las más bajas tasas de mortalidad por cáncer en Latinoamérica. Se ha propuesto que esta incongruencia es debido a fallas en el procesamiento de los certificados de defunción. El objetivo de este artículo es comparar la mortalidad por cáncer utilizando dos registros de mortalidad nacionales.

Comparamos la tasa de mortalidad estandarizada por edad para cáncer total y por sitio específico (2010–2014) utilizando dos fuentes con diferentes métodos de procesamiento de información. Obtuvimos tasas estandarizadas e intervalos de confianza 95% utilizando el método directo y como población estándar el World Population Prospects 2010.

Las tasas de mortalidad no se vieron afectada por métodos distintos para procesar información. La mortalidad por cáncer en mujeres fue de 73.3 por cada 100,000 en INEGI y 72.7 en SEED. Las estimaciones para hombres fueron 68.3 y 67.8.

Es poco probable que la baja mortalidad por cáncer en México sea explicada por el procesamiento de la información. Son necesarios estudios enfocados en el proceso de certificación y registro de muerte por cáncer.

Keywords

Cancer mortality; Mexico; Mortality registries

Palabras clave

Cáncer/mortalidad; México; Registros de mortalidad

INTRODUCTION

GLOBOCAN and the Global Burden of Disease (GBD) estimates place Mexico's cancer mortality among the lowest in the Americas. GBD's 2017 age-standardized cancer mortality rate for Mexico was 86.3 per 100,000, the lowest in Latin America only after Nicaragua (71.3 per 100,000).[1,2] Mexico's low cancer mortality is paradoxical, given the ageing of the population, the epidemiologic transition, and the high frequency of cancers detected in late stages.[3–5]

Understanding this paradoxical observation is important to strengthen health information systems, accurately characterize the burden of disease, and guide etiologic research. We hypothesized that Mexico's low cancer mortality could be attributable to pitfalls in death certificate coding and attribution of underlying cause of death in national mortality registry used for mortality statistics.[6] We aim to explore death registration inaccuracy by comparing cancer mortality rates from Mexico's official death registry with a death registry from a disease surveillance system that independently processes death certificates.

MATERIALS AND METHODS

Data sources

In Mexico, death certificates completed by treating physician include six causes of death: immediate cause of death, three potentially contributing causes, and two medical diagnoses present at the time of death that were not immediately related to the diseases or condition that caused the death. Copies of death certificates are then forwarded to different institutions for data management and processing.

The National Institute of Geography and Statistics (INEGI) generates Mexico's official mortality statistics based on death certificates from Civil Registrars' death registries compiled by regional offices. International agencies such as the International Agency for Research on Cancer consider this INEGI's registry the gold standard for Mexico's death statistics and use this data to estimate cancer incidence and mortality. In INEGI's registry, all causes of mortality from death certificates are coded using the International Classification of Diseases, 10th Revision's (ICD-10) codes.[7] Entry, classification, and retrieval of information is conducted using an automated system based on the National Center for Health Statistics' Mortality Medical Data System (MMDS) that was adapted to Mexico.[8] Regional mortality databases are forwarded to INEGI's Central office for correction, validation, and integration.

For comparison, we used the System for Epidemiologic Death Statistics (Subsistema Epidemiológico y Estadístico de Defunciones or SEED), a mortality registry designed for disease surveillance and maintained by the Ministry of Health. Until 2014, standardized coders in all health districts manually coded the causes of death from death certificates using ICD-10 codes and attributed the underlying cause of death based on the ICD-10 criteria. After correction, validation, and integration, health districts send the information to the Ministry of Health. Child and maternal deaths, as well as deaths attributed to selected diseases under epidemiological surveillance (e.g., HIV), are verified through a direct comparison between INEGI and the Ministry of Health, otherwise, SEED and INEGI process death certificates independently.

Mortality rate calculation

We obtained all recorded deaths between 2010 and 2014 from both death registries. We calculated the 5-year age-standardized mortality rates and 95% confidence intervals (95% CI) by sex using the direct method with the World Population Prospects 2010 as the standard population using STATA (Release 14. College Station, TX: StataCorp LP).[9] We estimated cancer mortality using the underlying cause of death for all sites excluding non-skin melanoma (ICD-10 codes C00–97, except C44). We also estimated site-specific cancer mortality rates in adults for esophageal (C15), stomach (C16), colon and rectum (including anus C18–21), liver (C22), pancreas (C25), lung (including trachea, C33–34), female breast (C50), cervix uteri (C53), ovary (C56), prostate (C61), kidney (C64), central nervous system (or CNS; C71), bladder (C67), non-Hodgkin lymphoma (or NH lymphoma; C82–83,C85), and leukemia (C91–95). For comparison, we estimated mortality rates for stroke (I60–69), diabetes (E08-E13), myocardial infarction (or MI; I2), and chronic kidney disease (or CKD; N18). Codes for underlying cause of death that are not biological causes of death are

commonly used to assess the quality of mortality data. These "garbage codes" were identified in both registries as a quality measure using GBD's definition.[10] We calculated the percentage of cancer deaths coded to unspecified sites (C76, C80, and C97), cardiovascular deaths lacking diagnostic meaning (I47.2, I49.0, I46, I50, I51.4, I51.5, I51.6, I51.9, and I70.9), and deaths due to symptoms, signs, and abnormal clinical and laboratory findings (R00-R99). Finally, we evaluated the impact of including cancer cases that were reported in the death certificate, but were not attributed to being the underlying cause of death for 2010.

RESULTS

Between 2010 and 2014, there were 366,958 cancer deaths from all sites according to INEGI and 364,618 according to SEED (<1% difference). We observed minimal differences in age-standardized mortality rates for cancer and site-specific cancer mortality for either sex (Table 1). Cancer mortality from all sites in women per 100,000 was 73.3 (95%CI 73.0, 73.6) for INEGI and 72.7 (95%CI 72.4, 73.0) for SEED. The corresponding estimates for men were 68.3 (95%CI 67.9, 68.6) and 67.8 (95%CI 67.5, 68.2). Rates were similar even for site-specific neoplasms. For breast cancer, the mortality rate per 100,000 women was 10.4 (95%CI 10.3, 10.5) for INEGI while SEED reported 10.5 (95%CI 10.3, 10.6). INEGI reported 10.6 (95%CI 10.4, 10.7) per 100,000 men for prostate cancer, while 10.5 (95%CI 10.4, 10.6) was recorded by SEED. We found considerable differences in mortality estimates for stroke, MI, and CKD when comparing INEGI to SEED. Differences were particularly striking for CKD (females: 8.5 vs. 6.8 per 100,000 for women, and males: 10.2 vs. 8.3 per 100,000 for men).

Garbage codes for cancer deaths were practically the same for both registries (Table 2). SEED had slightly more garbage codes compared to INEGI for deaths from cardiovascular disease. When we explored the impact of including as cancer deaths those with a cancer diagnosis in the contributing causes of death, the number of deaths increased by 2,431 for INEGI and 1,474 for SEED but cancer mortality rates were minimally modified. For INEGI, cancer mortality per 100,000 in women increased from 74.8 to 77.4 and from 69.0 to 71.3 in men after inclusion of these potential cancer deaths. The corresponding increases in mortality rates for SEED were 74.1 to 75.5 per 100,000 in women and 68.4 to 70.0 per 100,000 in men.

DISCUSSION

Cancer mortality estimates were essentially equal based on two independently processed mortality registries. The percentage of garbage codes for cancer were very similar and cancer mortality estimates were not affected after inclusion of cancer diagnoses that were not considered the underlying cause of death.

Our results suggest that Mexico's low cancer mortality is unlikely to be explained by death certificate processing. In Mexico, agreement between death certificates and medical records appears to be moderately high for neoplasia (85% agreement), but not for hypertensive diseases, diabetes, and infections.[6]. The 25% difference in mortality estimates for CKD underscores the challenges of assigning causes of death and warrants a more detailed

investigation of the potential source of this difference given the increasing importance of the burden of CKD in Mexico.[11,12] This finding also sheds light on the fact that although Mexico's official death registration has been rated with the highest quality based on completeness and coding characteristics, inaccuracy in data processing may be present for certain diseases.[13] More research is needed to evaluate the potential inaccuracy of death certification according to geographic area, type of health facility where the death occurred, and personnel who completed the death certificate. While INEGI's database remains the gold standard for national statistics, researchers must be cautious when choosing which data source to use for research.

The most straightforward explanation for Mexico's low cancer mortality would be low cancer incidence. However, more likely possibilities include cancer under diagnosis (as a result of low cancer screening coverage or lack of availability of diagnostic tools), limitations access to cancer care, competing causes of mortality due to increasing incidence of diabetes, and infrequent necropsies.[14–16] Future studies are needed to evaluate the quality of medical diagnosis at death using necropsies, especially in rural and public/at home deaths. Mexico has only recently established population-based cancer registries. These registries will provide insights on cancer mortality estimates and critical information on cancer prevalence, incidence, and survival.

This study is not without limitations. First, in order to fully understand the nature of the discrepancies, a one-on-one record comparison would be necessary to discern error derived from inaccuracies in coding deaths from errors in adjudication of the underlying cause of death. However, current data protection policies preclude this possibility. Second, we are unable to assess whether low cancer mortality was due to errors in death certificate recording by clinicians rather than death certificate processing. Finally, most of the deaths reported in both databases occurred in the adult population, it would be interesting to evaluate if the discrepancies shown in this study translates to the pediatric population when evaluated separately.

CONCLUSION

To the best of our knowledge, this is the first study that compares mortality rates across death registries regularly used for research in Mexico. For cancer, mortality estimates from an epidemiologic surveillance system that independently processes death certificates did not differ from those based on the database used for national mortality statics. The reasons for the apparent paradoxical low cancer mortality in Mexico remain unknown.

Acknowledgements

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Table I.

Age-adjusted mortality rates (95% CI) per 100,000 for cancer and non-cancer deaths according to INEGI and SEED death registries, Mexico 2010–2014

| | Women | | | | Men | | | |
| | INEGI | | SEED | | INEGI | | SEED | |
	Rate	95% CI	Rate	95% CI	Rate	95% CI	Rate	95% CI
Total Cancer	73.3	(73.0,73.6)	72.7	(72.4,73.0)	68.3	(67.9,68.6)	67.8	(67.5,68.2)
Site-specific								
Esophagus	0.5	(0.4,0.5)	0.4	(0.4,0.5)	1.4	(1.3,1.4)	1.4	(1.3,1.4)
Stomach	5.2	(5.1,5.3)	5.1	(5.0,5.2)	5.7	(5.6,5.8)	5.6	(5.5,5.7)
Colon/rectum	4.4	(4.3,4.5)	4.5	(4.4,4.6)	4.8	(4.7,4.9)	4.9	(4.8,5.0)
Liver	6.0	(5.9,6.1)	6.3	(6.2,6.4)	5.3	(5.2,5.3)	5.6	(5.5,5.7)
Pancreas	4.1	(4.0,4.2)	4.1	(4.0,4.2)	3.4	(3.3,3.5)	3.5	(3.4,3.5)
Lung	4.9	(4.8,4.9)	4.9	(4.8,5.0)	8.3	(8.1,8.4)	8.2	(8.1,8.3)
Breast	10.4	(10.3,10.5)	10.5	(10.3,10.6)	-	-	-	-
Cervix uteri	7.5	(7.4,7.6)	7.5	(7.4, 7.6)	-	-	-	-
Ovary	3.9	(3.8,4.0)	3.9	(3.9,4.0)	-	-	-	-
Prostate	-	-	-	-	10.6	(10.4,10.7)	10.5	(10.4,10.6)
Kidney	1.5	(1.4,1.5)	1.5	(1.4,1.5)	2.4	(2.3,2.4)	2.4	(2.3,2.4)
Bladder	0.6	(0.6,0.7)	0.6	(0.5,0.6)	1.2	(1.2,1.2)	1.2	(1.1,1.2)
CNS	1.6	(1.6,1.7)	1.9	(1.8,1.9)	2.1	(2.0,2.1)	2.3	(2.2,2.4)
NH lymphoma	2.0	(1.9,2.0)	2.0	(1.9,2.0)	2.4	(2.3,2.4)	2.4	(2.3,2.4)
Leukemia	3.4	(3.3,3.5)	3.4	(3.3,3.4)	4.0	(3.9,4.1)	3.9	(3.9,4.0)
Non-cancer								
Stroke	33.7	(33.5,33.9)	30.1	(29.8,30.3)	28.1	(27.9,28.3)	25.0	(24.8,25.1)
Diabetes	61.0	(60.7,61.3)	61.8	(61.4,62.1)	54.1	(53.8,54.4)	54.6	(54.3,54.9)
MI	65.5	(65.2,65.9)	60.0	(59.7,60.3)	75.9	(75.5,76.2)	70.0	(69.7,70.3)
CKD	6.8	(6.7,6.9)	8.5	(8.4,8.6)	8.3	(8.1,8.4)	10.2	(10.1,10.3)

INEGI: National Institute of Geography and Statistics; SEED: Epidemiology System for Death Statistics; CNS: Central nervous system; NH: non-Hodgkin; MI: Myocardial infarction; CKD: Chronic kidney disease.

Table II.

Percentage of garbage codes in underlying deaths according to INEGI and SEED death registries, Mexico 2010–2014

	Women		Men	
	INEGI	**SEED**	**INEGI**	**SEED**
Total	4.4	4.6	3.3	3.4
Cancer	0.7	0.6	0.5	0.4
Cardiovascular	1.7	2.0	1.1	1.4
Symptoms	2.0	2.0	1.6	1.5

INEGI: National Institute of Geography and Statistics; SEED: Epidemiology System for Death Statistics