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RESEARCH ARTICLE

Mortality Patterns of Melanoma in Mexico over the Last 2 Decades

Diego Armando Hernández-Domínguez[1], Fernando Aldaco-Sarvide[2], Guadalupe Cervantes-Sánchez[2], Laura Torrecillas-Torres[2], Analeticia Mendoza Balderas[3]

[1] Medical Oncology Service of the Hospital General León Secretary of Health, León Guanajuato, Mexico.
[2] Medical Oncology Service of the National Medical Center November 20, ISSSTE, Mexico City, Mexico.
[3] Department of Epidemiology, Secretary of Health of Guanajuato, Guanajuato Mexico.

Summary

Melanoma is the skin tumor with the highest morbidity and mortality with highly variable incidence rates that depend mainly on genetic-population, geographical and behavioral factors [1]. In our country we do not have a specialized, unified and vast oncology registry system that allows us to evaluate the historical behavior of neoplasms (incidence, prevalence and mortality) and our actions as health professionals. Previous information from different authors on melanoma mortality in Mexico coincides with an increase in mortality in the different historical contexts analyzed; this article updates the data from 2016, where a continuous increase in mortality was documented [2].

Objective: To know the evolution of melanoma mortality in the last 23 years in Mexico from 1998 to 2020.

Methods: The official information on melanoma mortality available in the dynamic cubes of the National System of Basic Information on Health (SINBA) and the National Institute of Statistics and Geography (INEGI) was reviewed. The population estimates and projections were obtained from the National Population Council (CONAPO); the number of patients affiliated with the main health systems was obtained directly from the official electronic pages available from each institution and from INEGI.

Findings: The general mortality rate due to melanoma in Mexico has increased by 71%, from $0.32*10^5$ inhabitants in 1998 to $0.54*10^5$ inhabitants in 2020, being the highest registered $0.61*10^5$ in 2018 and since then with a tendency to stabilize and decline. Currently, the state with the highest mortality rate is Zacatecas with $0.90*10^5$ and the lowest is reported in the state of Guerrero with $0.11*10^5$. In terms of age groups, the most affected by this neoplasm is that of 60 years and over with a rate of $3.42*10^5$ and the group of 0 to 29 years represents the lowest rate of $0.02*10^5$. Regarding sex, mortality is higher for men with a rate of $0.60*10^5$ and women $0.48*10^5$.

Interpretation: Melanoma mortality in Mexico has increased constantly for 21 consecutive years from 1998 to 2018, registering in this last year (2018) the historically highest mortality rate in our country. It should be noted that in the last two years of analysis in this study (2019 and 2020) the mortality rate has not increased, presenting a tendency to stabilize and decrease; this is something that had not occurred in the period of time studied and this fact is encouraging; In addition, this phenomenon may be influenced by the incorporation in the recent past of some innovative molecules in certain health systems and hospitals that were not previously available, and greater participation of our country in clinical trials.

keywords: Melanoma, mortality, Mexico

Introduction:

Melanoma is the skin tumor with the highest morbidity and mortality with highly variable incidence rates that depend mainly on genetic-population, geographical and behavioral factors [1]. GLOBOCAN 2020 data published by the International Agency for Research on Cancer report 324,635 new cases and 57,043 deaths in that year worldwide [3]. Australia and New Zealand have the highest incidence rate 35.8* 10^5 and mortality 2.7*10^5, the lowest rate corresponds to Central and South Asia with an incidence of 0.33 * 10^5 and mortality 0.19*10^5. [4]

In the US, The Surveillance, Epidemiology, and End Results (SEER) program estimates 99,780 new cases of melanoma and 7,650 deaths by 2022. Age-adjusted incidence rates have increased by an average of 1.2% each year between; in contrast, between 2010 and 2019, age-adjusted death rates have decreased by an average of 3.2% each year between 2010 and 2019. [5]

In Mexico, the information on the incidence and prevalence of this neoplasm is very limited, which would be really complex to analyze and interpret, falling outside the objective of this work; on the other hand, the mortality registry has more reliable data management.

Methods

A descriptive and retrospective analysis was performed. The dynamic mortality cubes of the National System of Basic Information on Health (SINBA) and the National Institute of Statistics and Geography (INEGI) [6] were consulted between the years 1998 and 2020 on mortality due to melanoma according to the Classification International Diseases (CIE)-10ES -C43, [7] due to the fact that the information available in this period of time corresponds to the same classification of mortality, while in the period prior to 1998 corresponds to a different reporting system, which would make it difficult to manage the data.

The variables used were: mortality, tumors, melanoma, year of registration, entity of usual residence, age, sex and affiliation to health systems. Six mortality data were excluded for the entire period of time analyzed, two in the gender variable and four in the information by age groups when recorded as unspecified (without statistical repercussion). In the analysis of the mortality rates by entity of habitual residence in Mexico, 49 records were excluded from the calculation of the same, which had a place of habitual residence outside of the Mexican Republic, 39 in the US, 3 in Latin American countries and 7 in other countries. [6]

The mortality rate per 100,000 inhabitants was calculated according to the population estimates and projections of the National Population Council (CONAPO) between 1998-2020 (INEGI, [6]?.

To calculate mortality at the Instituto de Seguridad y Servicios Sociales de los Trabajadores del Estado (which is the mediclal servise for workers of the state (ISSSTE) [8], The Instituto Mexicano del Seguro Social (IMSS) (public medical service for workers of prívate companies) [9], Seguro Popular (public medical service for non workers) [10], Petroleros Mexicanos)(Medical service for national petrol workers) (PEMEX) [11], Secretaria de la Defensa Nacional the Secretary of National Defense) (SEDENA) and the Secretaria de Marina(the Secretary of the Navy) (SEMAR), the database of the eligible population available on the official website of each was reviewed and that of INEGI [6]. The Seguro Popular data is recorded from 2005 to 2015, since it was only in operation from 2004 to 2019. By 2020, the Instituto de Salud para el Bienestar (Institute of Health for Well-being) (INSABI) was established in its place.

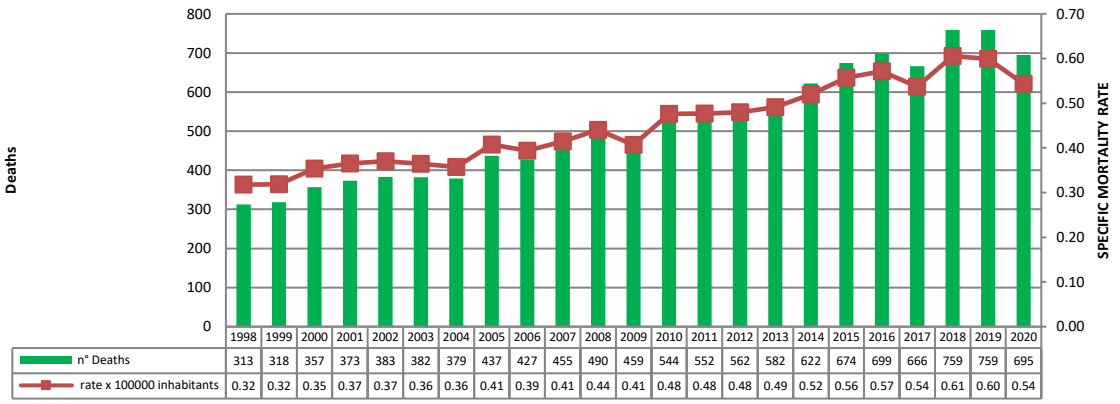
Regarding the age variable, it was decided to make three population subgroups: from 0 to 29 years old, from 30 to 59 years old and from 60 years old and over.

Findings:

General mortality in the country and by state

The melanoma mortality in Mexico has increased, in 2020 there were 695 deaths, which corresponds to a rate of 0.54*10^5, while in 1998 there were 313 deaths from melanoma and a mortality rate of 0.32*10^5, 2018 being the year with the highest rate reached in our country of 0.61*10^5, and from then on it decreases annually. This phenomenon had not been observed in any other period of time. Graph 1

Graph 1. Schedule of Mortality due to Melanoma 1998-2020 in Mexico

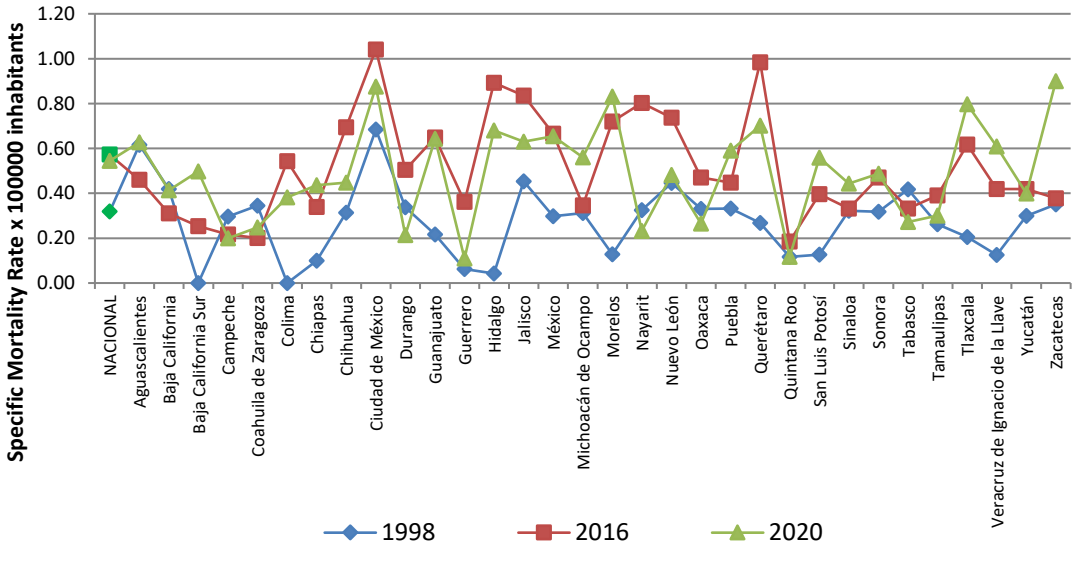


	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
n° Deaths	313	318	357	373	383	382	379	437	427	455	490	459	544	552	562	582	622	674	699	666	759	759	695
rate x 100000 inhabitants	0.32	0.32	0.35	0.37	0.37	0.36	0.36	0.41	0.39	0.41	0.44	0.41	0.48	0.48	0.48	0.49	0.52	0.56	0.57	0.54	0.61	0.60	0.54

Regarding the 5 states of the republic with the highest mortality rates in 2020 are: Zacatecas ($0.90*10^5$), Mexico City ($0.88*10^5$), Morelos ($0.83*10^5$), Tlaxcala ($0.80*10^5$) and Querétaro ($0.70*10^5$), all are above the national average. As for the 5 with the highest number of deaths, they are located: State of Mexico with 114 deaths, Mexico City with 79 deaths, Jalisco with 53 deaths, Veracruz with 52 deaths and Guanajuato with 40 deaths. Graph 2-3 and Table 1

The 5 states with the lowest mortality rates in 2020 are: Guerrero ($0.11*10^5$), Quintana Roo ($0.12*10^5$), Campeche ($0.20*10^5$), Durango ($0.21*10^5$) and Nayarit ($0.23*10^5$) , the 5 states with the lowest number of deaths are: Campeche (2 deaths), Quintana Roo (2 deaths), Colima (3 deaths), Nayarit (3 deaths), Baja California Sur (4 deaths), Durango (4 deaths) and Guerrero (4 deaths). Graph 2-3 and Table 1

Graph 2. Comparative Mortality due to Melanoma 1998-2016-2020 by Federal Entity



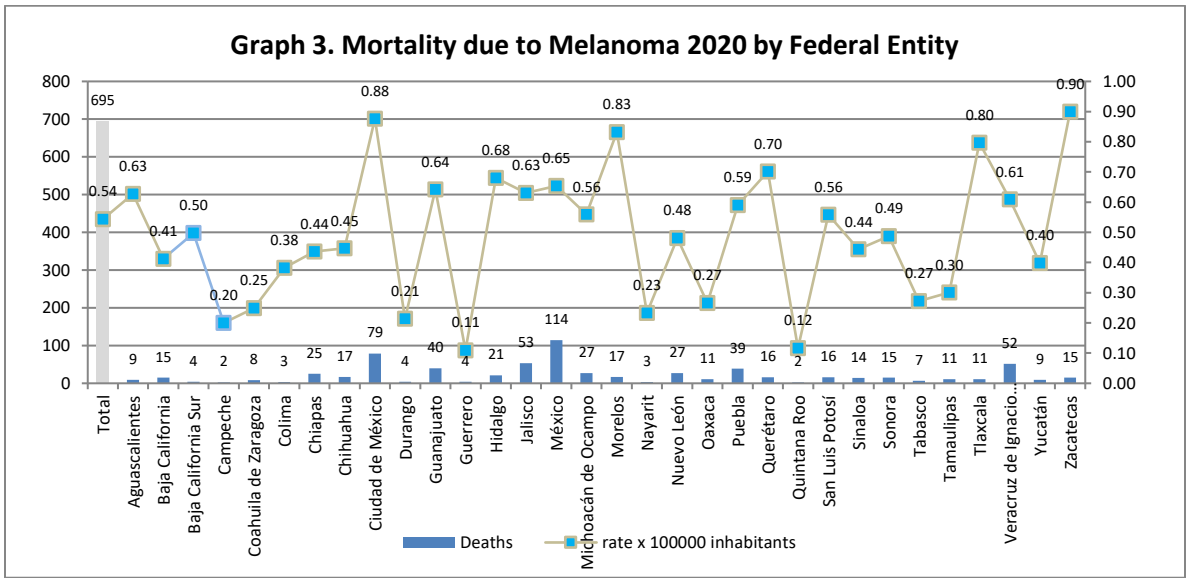


Table 1. Chronogram of Mortality due to Melanoma 1998-2016 by Federal Entity (rate per 100,000 inhabitants)

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
NATIONAL	0.32	0.32	0.35	0.37	0.37	0.36	0.36	0.41	0.39	0.41	0.44	0.41	0.48	0.48	0.48	0.49	0.52	0.56	0.57	0.54	0.61	0.60	0.54
Aguascalientes	0.62	0.20	0.40	0.20	0.38	0.09	0.28	0.55	0.90	0.18	0.35	0.60	0.59	0.33	0.65	0.40	0.31	0.78	0.46	1.02	0.43	0.77	0.63
Baja California	0.42	0.24	0.31	0.24	0.26	0.07	0.11	0.31	0.17	0.20	0.16	0.35	0.16	0.40	0.21	0.59	0.47	0.34	0.31	0.32	0.57	0.44	0.41
Baja California Sur	0.00	0.22	0.00	0.22	0.40	0.59	0.38	0.91	0.18	0.00	0.66	0.48	0.31	0.30	0.43	0.42	0.54	0.13	0.25	0.27	0.39	0.62	0.50
Campeche	0.30	0.29	0.43	0.29	0.14	0.54	0.40	0.52	0.26	0.13	0.12	0.61	0.48	0.59	0.23	0.45	0.56	0.00	0.22	0.53	0.31	0.60	0.20
Coahuila de Zaragoza	0.35	0.17	0.46	0.17	0.16	0.24	0.27	0.39	0.30	0.19	0.44	0.15	0.43	0.53	0.32	0.28	0.27	0.47	0.20	0.16	0.38	0.25	0.25
Colima	0.00	0.55	0.18	0.55	0.18	0.35	0.51	0.51	0.33	0.16	0.32	0.93	0.46	0.74	1.17	0.43	0.00	0.00	0.54	0.40	0.26	1.15	0.38
Chiapas	0.10	0.15	0.17	0.15	0.23	0.20	0.09	0.09	0.17	0.13	0.19	0.23	0.24	0.18	0.20	0.31	0.27	0.21	0.34	0.31	0.29	0.35	0.44
Chihuahua	0.31	0.17	0.40	0.17	0.39	0.22	0.47	0.37	0.39	0.41	0.50	0.34	0.54	0.37	0.61	0.44	0.54	0.51	0.69	0.60	0.80	0.55	0.45
Ciudad de México	0.68	0.49	0.55	0.49	0.62	0.58	0.67	0.56	0.61	0.60	0.76	0.64	0.87	0.75	0.79	0.78	0.86	0.98	1.04	0.95	0.79	1.05	0.88
Durango	0.34	0.40	0.27	0.40	0.85	0.19	0.32	0.26	0.38	0.37	0.43	0.42	0.36	0.53	0.41	0.29	0.69	0.40	0.50	0.44	0.60	0.32	0.21
Guanajuato	0.22	0.39	0.29	0.39	0.35	0.36	0.47	0.60	0.47	0.46	0.51	0.25	0.74	0.53	0.53	0.47	0.57	0.58	0.65	0.45	0.51	0.47	0.64
Guerrero	0.06	0.12	0.22	0.12	0.34	0.21	0.06	0.30	0.36	0.12	0.21	0.20	0.20	0.20	0.11	0.23	0.17	0.31	0.36	0.30	0.47	0.36	0.11
Hidalgo	0.04	0.51	0.38	0.51	0.25	0.28	0.36	0.40	0.28	0.35	0.65	0.34	0.45	0.73	0.65	0.43	0.53	0.73	0.89	0.87	0.83	0.55	0.68
Jalisco	0.45	0.43	0.61	0.43	0.55	0.68	0.62	0.77	0.77	0.58	0.42	0.59	0.58	0.41	0.56	0.70	0.55	0.73	0.84	0.75	0.73	0.64	0.63
México	0.30	0.27	0.41	0.27	0.36	0.36	0.39	0.43	0.39	0.49	0.40	0.47	0.51	0.55	0.54	0.58	0.50	0.59	0.67	0.59	0.73	0.67	0.65
Michoacán de Ocampo	0.31	0.31	0.29	0.31	0.33	0.36	0.40	0.21	0.52	0.51	0.53	0.30	0.34	0.54	0.33	0.60	0.50	0.57	0.35	0.36	0.63	0.44	0.56
Morelos	0.13	0.44	0.38	0.44	0.61	0.24	0.42	0.48	0.59	0.58	0.46	0.51	0.78	0.33	0.43	0.59	0.58	0.42	0.72	0.76	0.80	0.44	0.83
Nayarit	0.32	0.22	0.43	0.22	0.21	0.41	0.10	0.60	0.20	0.39	0.09	0.46	0.72	0.53	0.52	0.68	0.58	0.25	0.80	0.65	0.64	1.40	0.23
Nuevo León	0.45	0.62	0.30	0.62	0.34	0.50	0.38	0.44	0.34	0.33	0.57	0.34	0.59	0.50	0.49	0.36	0.68	0.65	0.74	0.45	0.62	0.64	0.48
Oaxaca	0.33	0.22	0.30	0.22	0.43	0.54	0.37	0.24	0.13	0.40	0.34	0.39	0.31	0.59	0.59	0.35	0.58	0.67	0.47	0.66	0.46	0.41	0.27
Puebla	0.33	0.44	0.34	0.44	0.47	0.37	0.40	0.32	0.29	0.41	0.45	0.40	0.53	0.29	0.47	0.40	0.51	0.53	0.45	0.61	0.62	0.55	0.59
Querétaro	0.27	0.20	0.32	0.20	0.37	0.31	0.24	0.41	0.29	0.63	0.56	0.77	0.54	0.48	0.52	0.51	0.25	0.90	0.98	0.56	0.86	0.66	0.70
Quintana Roo	0.12	0.33	0.00	0.33	0.10	0.19	0.27	0.35	0.09	0.16	0.16	0.23	0.22	0.29	0.21	0.13	0.46	0.19	0.19	0.37	0.30	0.12	0.12
San Luis Potosí	0.13	0.25	0.33	0.25	0.21	0.37	0.24	0.28	0.40	0.44	0.51	0.31	0.31	0.53	0.34	0.56	0.51	0.54	0.40	0.57	0.92	0.84	0.56
Sinaloa	0.32	0.28	0.20	0.28	0.23	0.57	0.26	0.30	0.48	0.51	0.39	0.39	0.49	0.42	0.65	0.24	0.57	0.54	0.33	0.71	0.52	0.48	0.44
Sonora	0.32	0.18	0.09	0.18	0.34	0.17	0.16	0.08	0.28	0.31	0.38	0.41	0.29	0.36	0.36	0.21	0.55	0.44	0.47	0.34	0.37	0.72	0.49
Tabasco	0.42	0.21	0.15	0.21	0.10	0.10	0.14	0.38	0.14	0.41	0.36	0.22	0.36	0.61	0.26	0.39	0.42	0.46	0.33	0.24	0.40	0.47	0.27
Tamaulipas	0.26	0.18	0.29	0.18	0.17	0.20	0.17	0.36	0.16	0.35	0.15	0.30	0.27	0.39	0.35	0.64	0.34	0.17	0.39	0.31	0.33	0.44	0.30
Tlaxcala	0.21	0.40	0.30	0.40	0.38	0.09	0.18	0.46	0.18	0.44	0.43	0.17	0.42	0.58	0.41	0.40	0.95	1.25	0.62	0.53	0.45	1.01	0.80
Veracruz de Ignacio de la Llave	0.13	0.11	0.28	0.11	0.33	0.33	0.20	0.32	0.34	0.44	0.41	0.39	0.36	0.42	0.46	0.44	0.49	0.52	0.42	0.29	0.56	0.62	0.61
Yucatán	0.30	0.41	0.58	0.41	0.17	0.22	0.22	0.54	0.43	0.37	0.52	0.51	0.15	0.25	0.20	0.63	0.24	0.38	0.42	0.46	0.36	0.44	0.40
Zacatecas	0.35	0.49	0.35	0.49	0.42	0.56	0.70	0.42	0.69	0.41	0.95	0.33	0.53	0.85	0.98	0.39	0.96	0.76	0.38	0.80	1.04	0.60	0.90

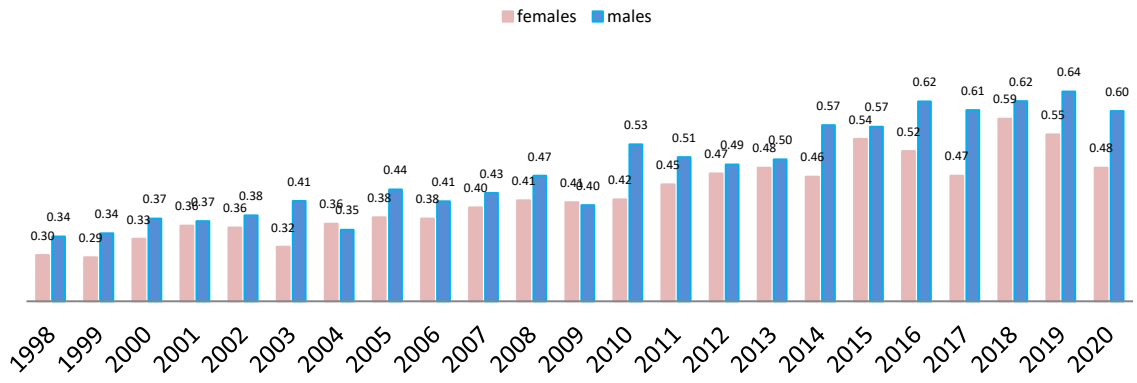
Mortality by sex

Regarding the mortality analyzed in men and women, an increase is documented in both groups; however, this increase has not been constant, registering fluctuations. The male sex is the most affected group, with a mortality rate in 2020 of $0.60*10^5$, equivalent to 393 deaths; while in 1998 the rate was $0.34*10^5$ and 168 deaths. Regarding the female sex, in 1998 the rate was $0.30*10^5$, with 145 deaths, for the year 2020 the rate increased to $0.48*10^5$ and 302 deaths. Only on two occasions was the mortality rate in women higher than that of men, corresponding to the years 2004 and 2009. Graph 4

Mortality by age groups

The group from 0 to 29 years has the lowest mortality rates, $0.01*10^5$ in 1998 (7 deaths) and $0.02*10^5$ in 2020 (16 deaths); however, the rate figures tend to remain stable without major changes throughout the study period. The group of 30 to 59 years is the second most affected, documenting in 1998 a rate of $0.39*10^5$ (114 deaths) and in 2020 a rate of $0.39*10^5$ (185 deaths) that seems to remain stable without being real, since in the previous 5 years (2015, 2016, 2017, 2018 and 2019) the rate tended to remain stable around $0.5*10^5$ and previously it was maintained with significant variations; only for 2020 do we see a significant reduction in the same. The most affected group is that 60 years or older, as expected due to the very nature of the disease, registering a rate of $2.73*10^5$ (192 deaths) in 1998 and a rate of $3.42*10^5$ in 2020 (493 deaths) presenting fluctuations during the 23 years of this work. Graph 5

Graph 4. Schedule of Mortality due to Melanoma 1998-2020 by Gender (rates per 100000 inhabitants)



Graph 5. Chronogram of Mortality due to Melanoma 1998-2020 by Age Groups

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Total	0.32	0.32	0.35	0.37	0.37	0.36	0.36	0.41	0.39	0.41	0.44	0.41	0.48	0.48	0.48	0.49	0.52	0.56	0.57	0.54	0.61	0.60	0.54
0 a 29 years	0.01	0.02	0.03	0.03	0.02	0.03	0.03	0.02	0.02	0.03	0.02	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.04	0.03	0.03	0.02	0.02
30 a 59 years	0.40	0.38	0.35	0.43	0.45	0.37	0.42	0.40	0.43	0.41	0.49	0.41	0.45	0.50	0.45	0.44	0.43	0.49	0.48	0.46	0.51	0.50	0.39
60 and more years	2.70	2.60	3.09	2.84	2.84	2.95	2.57	3.25	2.89	3.08	3.05	2.98	3.47	3.23	3.36	3.39	3.61	3.67	3.68	3.39	3.75	3.68	3.42

Mortality due to affiliation services

The information in this area is the most difficult to interpret, since in addition to the little information from some institutions, they serve populations with diverse characteristics, different pathologies and the arsenal of medications is also different, due to all of the above, the data is only for self-analyze their evolution and look for areas of opportunity, without being able to make a direct comparison between the various health systems. Figures were analyzed for five years from the year 2000 (2000, 2005, 2010, 2015 and 2020), except for the information on the Seguro Popular health system, which operated from 2004 to 2019, creating in 2020 a new care model.

IMSS (The Mexican Institute of Social Security) shows a slight and constant increase in the mortality rate with a tendency to remain stable in all years except 2020, where there is a decrease for the first time. ISSSTE (The State Workers Social Security and Services Institute) is the one that registers the greatest fluctuations with rises and falls in the different years without a constant. PEMEX (Mexican Petrol) reports a small but constant decrease in mortality. Seguro Popular shows a progressive increase in the mortality rate. SEDENA (The Secretary of National Defense) only shares information from two years of study (2000 and 2010) and a reduction in the rate can be seen. SEMAR (Secretary of the Navy) with data only from 2010. Table 2

Table 2. Death rates by affiliation services in Mexico

	2000			2005			2010			2015			2020		
	Deaths	**affiliates**	**rate**	**Deaths**	**affiliates**	**rate**	**Deaths**	**affiliates**	**rate**	**Deaths**	**affiliates**	**rate**	**Deaths**	**affiliates**	**rate**
Total	**352**			**435**			**538**			**673**			**693**		
IMSS	172	45053710	0.38	198	44531666	0.44	237	52310086	0.45	289	61864971	0.47	288	68659149	0.42
ISSSTE	31	10065861	0.31	48	10608209	0.45	49	11993354	0.41	59	12973731	0.45	80	13515575	0.59
PEMEX	4	647000	0.62	4	708000	0.56	4	743000	0.54	10			4	750000	0.53
SEDENA	4	489000	0.82	1	ND		5	1048000	0.48	7			4		
SEMAR	0	187000	0.00		201000	0.00	1	240000	0.42	3			3		
Seguro Popular				9	11405000	0.08	63	43519000	0.14	163	57100000	0.29	62	53530359	0.12

Interpretation:

Melanoma mortality in Mexico has increased constantly for 21 consecutive years from 1998 to 2018, registering in this last year (2018) the historically highest mortality rate in our country. It should be noted that in the last two years of analysis in this study (2019 and 2020) the mortality rate has not increased, presenting a tendency to stabilize and decrease; this is something that had not occurred in the period of time studied and this fact is encouraging; In addition, this phenomenon may be influenced by the incorporation in the recent past of some innovative molecules in certain health systems and hospitals that were not previously available, and greater participation of our country in clinical trials.

Discussion

The data obtained document a progressive increase in the mortality rate due to melanoma in Mexico from 1998 to 2018; this growth is attributed to the following: greater exposure to ultraviolet (UV) rays and intentional tanning without the medically recommended protection, lack of disclosure about this neoplasm to the general population that allows them to reduce risk factors and detect lesions early, scarcity of culture to attend some assessment before initial signs and symptoms, and the demographic transition due to greater life expectancy.

Although in the last two years mortality has not increased, we are still very far from what happens in developed countries such as the US, where the mortality rate has steadily decreased by 3% per year for 10 consecutive years (from 2010 to 2019); the same situation has been achieved by Switzerland and Spain where the lethality is declining. [5,4]

Malignant melanoma is a highly curable neoplasm when diagnosed and treated in early stages, so it is mandatory to implement and strengthen primary and secondary prevention programs to eliminate modifiable risk factors, implement screening programs, raise awareness, and inform the population and first-level doctors of care for this pathology; This factor allows suspecting, detecting, and referring the patient to specialized centers in a timely manner, seeking strategies for rapid care by the oncologist or dermatologist despite the oversaturation of our hospitals and thus achieving diagnoses in localized stages with high chances of cure, being this the most cost-effective way of acting. Immunotherapy and targeted therapy have changed the natural history of this disease from the last 10 years, showing surprising benefits; however, the main barriers to access in our country are the high cost and the approval time for its use. Government authorities, the pharmaceutical

industry, and health professionals must continue to work hard jointly and rationally, so that this type of therapy is provided in our different public health systems for the benefit of the patient; since there is little progress in this sense, much remains to be done.

Within the limitations of this study we find the system of registration and collection of information. Despite being official data of the organizations that our country has to obtain accurate statistics, in some territorial areas no declaration is made, or the information is incomplete, leaving this condition totally unrelated to their work; in addition, the electronic pages of some health institutions are not properly updated.

In Mexico, there is no a reliable, easily accessible and vastunified and specialized national oncology registry system to control cancer incidence, prevalence, and mortality; this constitutes a great challenge and an area of opportunity. Due to the above, there may be an underreporting of the information, because some death certificates could have been filled by people unrelated to the diagnosis and treatment of this pathology; it is also important to consider the high cost of the pandemic and the lethality, especially in elderly where it would cause certain bias in the results due to underreporting and modification of the 2020 rate. However, the data are conclusive on the increase in mortality in our country, previous studies show the same situation. The publication by Dr. Fernando Aldaco [12] shows how mortality from skin cancer increased in Mexico (melanoma and non-melanoma); the rates differ slightly because this work only records mortality from melanoma, excluding any other diagnosis. In a 2011 article on melanoma in Latin America with the participation of Mexico [13], Dr. Héctor Martínez provides very similar information on mortality rates to the current study.

This work refers us to the current panorama of this neoplasm in order to continue evaluating the actions that are implemented in the short, medium, and long term, with the aim of reducing mortality from melanoma in Mexico; provided these actions are not fulfilled, and coupled with the population epidemiological transition, together they will represent an important health care and economic problem that will be more difficult to sustain.

Conflict of interest

The authors declare no conflict of interest

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