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## Epidemiology of melanoma in Puerto Rico, 1987-2002

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**Background:** The incidence of cutaneous malignant melanoma continues an increasing trend worldwide and has had the highest rise in incidence of all malignancies during the last decades. Mortality rates for melanoma have remained relatively stable in most countries despite the increase in incidence rates. The purpose of this study is to describe the epidemiological trends of malignant melanoma in Puerto Rico from 1987 to 2002 and to compare these findings with those previously reported for Puerto Rico as well as with those reported for other countries.

**Methods:** All cases of malignant melanoma reported to the Puerto Rico Cancer Registry from 1987 to 2002 were included. Age-adjusted incidence and mortality rates were calculated. Trends were compared by age, gender, anatomical location of the tumor and tumor thickness.

**Results:** There were 1,568 new melanoma cases reported between 1987 and 2002 in Puerto Rico, comprising a 50% overall increase in incidence during

this period. Male to female incidence ratio was 1:0.86. The most common anatomical location in women was the lower extremity followed by the head and neck region. In men, the most common anatomical location was the trunk, followed by the head and neck region. Most of the superficial tumors (<1mm) were located on the trunk followed by the lower limb. The most common specific histologic diagnosis reported was *melanoma in situ*. In 40.8% of the cases the tumor thickness value was not provided. The number of thinner melanomas (<1mm) reported increased during the study period. Mortality rates were slightly higher for men than for women, still mortality rates remained stable for both genders and all age groups analyzed.

**Conclusions:** Melanoma incidence rates continue to increase in Puerto Rico. This, in combination with an increase in the diagnosis of thin melanomas, suggests that the stable mortality rates may be due, in part, to earlier diagnosis and improved overall prognosis.

*Key words:* Melanoma, Incidence, Puerto Rico.

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**M**alignant melanoma (MM) is primarily a malignancy of white individuals. It is currently the seventh most common cancer in the United States and it is the most common cancer in women aged 25 to 29 years old (1). Although it accounts for only 4% of all skin cancers, it is responsible for more than 77% of all skin-cancer related deaths.

The incidence of melanoma continues an increasing trend worldwide, with the highest incidences being in Australia and New Zealand (2). Incidence rates in the United States have tripled in the white population during the last 20 years. Currently, the expected lifetime risk for

developing invasive melanoma is one case per sixty Americans, a 2000% increase since 1930 (1). The annual percent change (APC) based on rates age-adjusted to the 2000 US Standard population for the period from 1995 to 2004 for white males and females was 2.3 (3). The prevalence of MM in Hispanic persons is approximately one sixth of that of white persons. The incidence rate per 100,000 (age-adjusted to the 2000 US Standard population) for White Non-Hispanics was 25.1, 4.5 for Hispanics, and 1.0 for Blacks in the United States during 2000-2004 (3). The mortality rates per 100,000 (age-adjusted to the 2000 US Std population) for White Non-Hispanics was 3.2, and 0.7 for Hispanics while it was only 0.4 for Blacks during that same period (3).

Although the incidence of melanoma has risen at the fastest rate of all malignancies during the last decades (4), mortality rates have remained generally stable worldwide, particularly among younger age groups (5-7). An increase in the diagnosis of thin melanomas has also been observed recently in some countries (6-7), including Puerto Rico (8).

The purpose of this study is to describe the epidemiological trends of malignant melanoma in Puerto

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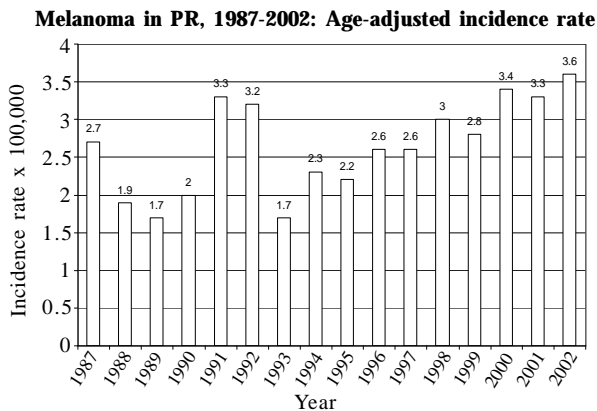
Rico from 1987 to 2002 and to compare these findings with those previously reported for Puerto Rico (9-10) and as well as with those reported for other countries.

### Methods

All the cases of MM reported to the Puerto Rico Central Cancer Registry between 1987 and 2002 were reviewed. The data of each case included age and gender of the patients, year of diagnosis, anatomical location of the tumor, histologic subtype of the tumor and tumor thickness. The numbers of deaths from MM by age groups and gender for each year in the study period were also available for review. Age-adjusted incidence and mortality rates were calculated based on the Puerto Rico Census Bureau population estimates of the year 2000. Age-specific incidence and mortality rates were also calculated. The percent change in incidence over the study period was calculated by subtracting the average rates of the first two years from the average rates of the last two years. This difference was divided by the average of the rates in the first two years and then multiplied by 100 to obtain a percentage (11).

### Results

There were 1,568 new cases of melanoma reported to the Puerto Rico Cancer Registry between 1987 and 2002. The annual number of cases reported ranged from 52 to 164 with a mean of 98 new cases per year. There were 756 (48.2%) male cases and 812 (51.8%) female cases. Ages ranged from 5 to 110, with a mean age at diagnosis of 60 years old. Annual age-adjusted incidence rates per 100,000 habitants ranged from 1.9 to 3.6/100,000, with an overall increasing trend in incidence throughout the period studied (Figure 1). As can be observed in Figure 1, a



**Figure 1.** Annual age-adjusted incidence rates of malignant melanoma in Puerto Rico from 1987 to 2002.

dramatic increase in incidence during 1991 and 1992 was followed by a sharp decline. This trend can be partially explained by changes in the reporting procedures of the Puerto Rico Central Cancer Registry (PRCCR) during those years. Before 1993, the PRCCR followed an active protocol for the identification and documentation of cancer cases, which was then modified to a passive registry. In 1997 the PRCCR received a federal grant to update and collect missing cancer data; the corresponding effect can be observed in Figure 1 with the steady increase in incidence since 1997. (Personal communication with PRCCR’s director).

The majority of the cases reported in both sexes were between the ages of 61 to 80 years old. Age distribution varied somewhat between males and females.(Table 1) Among males, 82% of melanoma cancer cases were between the ages of 41 to 90 years old, with an average age of 61 years. In women 74% of the cases were between the ages of 41 to 90 years old with an average age of 60 years.

**Table 1.** Percent distribution of melanoma cancer cases in Puerto Rico from 1987 to 2002 by age and sex.

Age (yrs)	Males		Females		Total	
	Number	Percent	Number	Percent	Number	Percent
0-10	1	0.1	1	0.1	2	-
11-20	6	0.8	9	1.1	15	1
21-30	27	3.6	35	4.3	62	4
31-40	45	6.0	86	10.6	131	8
41-50	114	15.1	108	13.3	222	14
51-60	112	14.8	123	15.2	235	15
61-70	160	21.2	151	18.6	311	20
71-80	156	20.6	128	15.8	284	18
81-90	78	10.3	88	10.9	166	11
91-100	12	1.6	22	2.7	34	2
101-110	1	0.1	1	0.1	2	-
Unknown	44	5.8	60	7.3	103	7
<b>Total</b>	<b>756</b>	<b>100</b>	<b>812</b>	<b>100</b>	<b>1568</b>	<b>100</b>

Average (±SD) Age<sub>male</sub> = 61.2 ± 7.6 Age<sub>female</sub> = 59.5 ± 7.3

The most common anatomical location overall was the head and neck region (n=378), followed by the lower limb (n=362) and the trunk (n=360). Male cases were most frequently reported on the trunk (28%) followed by the head and neck (26%), while female cases were most commonly found in the lower limb (27%) followed by the head and neck region (22%). (Table 2) The percent distribution of anatomical sites by sex was statistically different (p<0.0001).

There were some variations in the anatomical location of melanoma when examined by age groups as illustrated in Tables 3 and 4. In male patients less than 60 years of age, tumors were most commonly found in the trunk. In

**Table 2.** Anatomical sites of melanoma cancer cases in Puerto Rico from 1987 to 2002 by sex. Melanoma cancer cases were classified into five categorical locations. There is a statistically significant ( $p < 0.0001$ ) difference of anatomical location by sex.

Anatomical Site	Males		Females		Total	
	Number	Percent	Number	Percent	Number	Percent
Head & Neck	196	26	182	22	378	24
Trunk	207	28	153	19	360	23
Upper limb	104	14	152	19	256	16
Lower limb	147	19	215	27	362	23
Genitalia	0	0	19	2	19	1
Not specified	102	13	91	11	193	13
<b>Total</b>	<b>756</b>	<b>100</b>	<b>812</b>	<b>100</b>	<b>1568</b>	<b>100</b>

$\chi^2=28.73$ , 3 d.f.;  $p < 0.0001$  ( $\chi^2$  calculated excluding genitalia and not specified sites)

**Table 3.** Anatomical sites of melanoma cancer cases in males in Puerto Rico from 1987 to 2002 by age groups.

Male Anatomical Site	≤ 40 years		40-60 years		>60 years		Unknown	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Head & neck	8	10	46	21	128	31	14	32
Trunk	38	48	72	32	90	22	7	16
Upper limb	10	13	41	18	46	12	7	16
Lower limb	9	11	34	15	99	24	5	11
Genitalia	0	-	0	-	0	-	0	-
Not specified	14	18	32	14	45	11	11	25
<b>Total</b>	<b>79</b>	<b>100</b>	<b>225</b>	<b>100</b>	<b>408</b>	<b>100</b>	<b>44</b>	<b>100</b>

$\chi^2=22.86$ , 3 d.f.;  $p < 0.0001$  comparing the anatomical sites distribution among males, 40-60 years of age and those older than 60 years of age. ( $\chi^2$  calculated excluding genitalia, not specified sites and unknown age)

**Table 4.** Anatomical sites of melanoma cancer cases in females in Puerto Rico

Female anatomical site	≤ 40 years		40-60 years		>60 years		Unknown	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Head & neck	13	10	40	17	111	28	18	31
Trunk	45	34	48	21	47	12	13	22
Upper limb	21	16	63	27	60	15	8	14
Lower limb	38	29	59	26	111	28	7	11
Genitalia	2	2	2	1	15	5	0	-
Not specified	12	9	19	8	47	12	13	22
<b>Total</b>	<b>131</b>	<b>100</b>	<b>231</b>	<b>100</b>	<b>391</b>	<b>100</b>	<b>59</b>	<b>100</b>

$\chi^2=24.28$ , 3 d.f.;  $p < 0.0001$  comparing the anatomical sites distribution among females, 40-60 years of age and those older than 60 years of age. ( $\chi^2$  calculated excluding genitalia, not specified sites and unknown age)

male patients 60 years or older most of the tumors were located on the head and neck region (31%) followed by the lower limb (24%). (Table 3) As can be observed in Table 4, the trunk was the most common anatomical site for females cases under 40 years of age at diagnosis. The limbs were frequent anatomical sites for females 40 to 60

years of ages: upper limb (27%) and lower limb (26%). The head and neck (28%) as well as the lower limb (28%) were preferred anatomical sites among females over 60 years of age. There were 19 melanoma cases reported occurring on the genitalia and they were all on females. Of these, 15 occurred in women older than 60 years of age.

Most of the melanomas whose tumor thickness was reported measured  $< 1$ mm. When comparing tumor thickness with anatomical location, most of the melanomas *in situ* were located on the trunk followed by the head and neck region. Melanomas that measured  $< 1$ mm were mostly located of the lower limb followed by the trunk. (Table 5) In 40.8% of the cases the tumor thickness was not reported. It is also important to mention

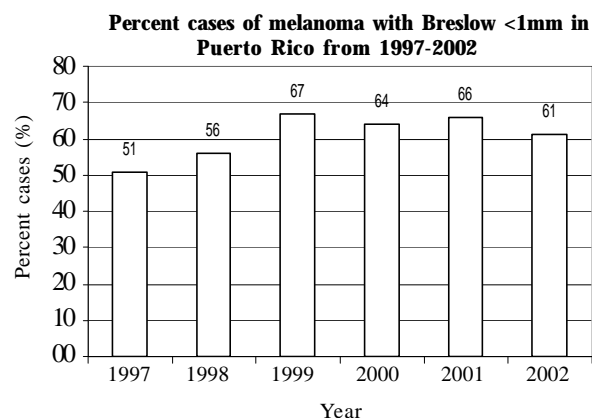
that the number of diagnosis of thin tumors, or less than 1mm thickness, increased during the period studied, ranging from 14 to 100 cases per year and reaching 100 cases in 2002. When analyzing the percent of melanoma cases that measured  $< 1$ mm from 1997 to 2002, there was a 19% increase when comparing the periods from 1997-1998 and 2001-2002 (Figure 2).

The most common specific histologic diagnosis reported was melanoma *in situ* (22.3%) followed by lentigo maligna (9.3%), nodular melanoma (5.6%), superficial spreading melanoma (5.3%), lentigo maligna melanoma (4.7%), and acral lentiginous melanoma (4.6%). In 44.1% of the cases no specific histologic subtype was reported.

There were a total of 242 deaths reported secondary to melanoma during the period studied. Of these, 133 were in males and 109 were in females with a mean of 8 deaths per year for males and 7 deaths per year for females. Even though age-adjusted incidence rates increased during the period studied, overall

age-adjusted mortality rates remained stable ranging from 0.3 to 0.7 per 100,000 habitants per year. (Figure 3)

Although mortality rates remained stable during the 16 years included in the study, mortality cases increased with advancing age groups. (Figure 4) Approximately 74% of the deaths reported occurred in patients older than 60

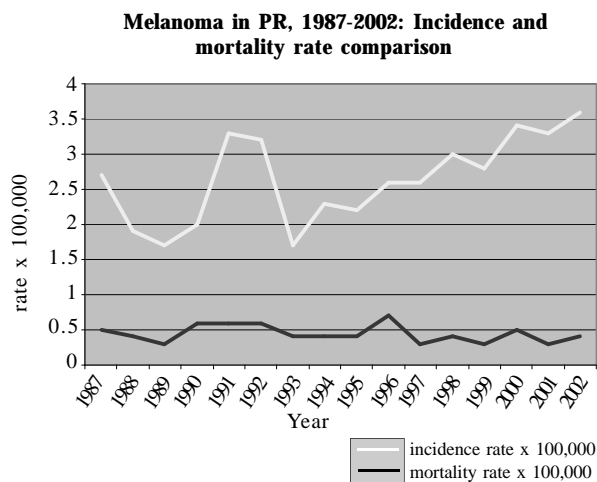


**Figure 2.** Percent of cases of melanoma with Breslow <1mm diagnosed in Puerto Rico from 1997 to 2002.

**Tabla 5.** Tumor thickness of cases of malignant melanoma in Puerto Rico from 1987 to 2002 by sex

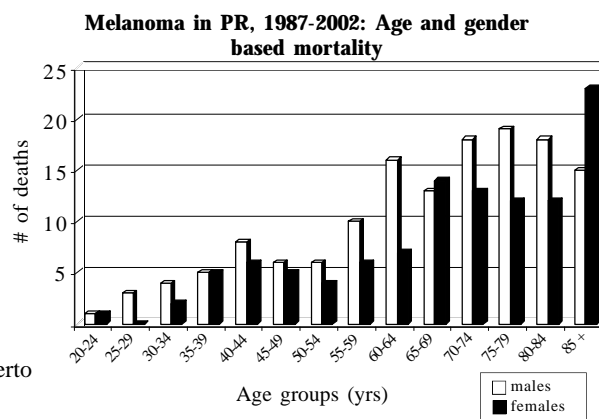
Tumor thickness (mm)	Anatomical site						Total
	Head & neck	Trunk	Upper limb	Lower limb	Genitalia	Not specified	
In situ	93	107	75	36	1	37	349/ 22.3%
<1	99	125	93	172	5	29	523/ 33.3%
1-1.99	6	6	5	8	1	0	26/ 1.7%
2-3.99	3	1	4	5	1	2	16/ 1.0%
e"4	5	2	1	6	0	0	14/ 0.9%
Unknown	640/ 40.8%						

2002 by anatomical site.



**Figure 3.** Comparison of age-adjusted incidence and mortality rates of cases reported of malignant melanoma in Puerto Rico from 1987 to 2002.

years of age. It is also important to note that in all age groups mortality cases were equal or slightly higher for men than for women except in patients older than 85 years, where female cases outweighed those reported for males.



**Figure 4.** Mortality cases of malignant melanoma in Puerto Rico from 1987 to 2002 by age and gender.

## Discussion

There was a total of 1,568 new melanoma cases in Puerto Rico from 1987 to 2002, with an average of 98 new cases per year. This value nearly doubled the average number of new cases of melanoma reported during 1977 to 1987, when there was an average of 45 new cases diagnosed per year (9-10). During the sixteen years included in the study period there was a 50% overall increase in melanoma incidence in Puerto Rico. This increase in incidence was due mostly to an increased incidence in patients between 40 and 60 years old (3.5 per 100,000 habitants in 1987 to 5.5 per 100,000 habitants in 2002). In patients younger than 40 years old and older than 60 years old, age-specific incidence rates remained stable during the study period.

When comparing incidence rates in Puerto Rico for the year 2002 with those of the United States and Australia, it is evident that in the latter, the incidence rates are much higher than those encountered in our island. Australia has the highest melanoma incidence in the world (11). Age adjusted incidence rate for melanoma in that country for 2002 was 38.5 per 100,000 habitants for men and 29.5 per 100,000 for women (11). The overall incidence rates in the United States have increased nearly 138% from 1975 to 2002 (7.9 per 100,000 to 18.6 per 100,000) with a disproportionate increase in persons over the age of 55 years (3). The annual percent change in the United States was +2.3 for the period of 1995-2004, which was statistically significant ( $p < 0.05$ ) (3). Incidence rate during

2002-2004 for white males was 31.4 per 100,000 and 4.5 per 100,000 for Hispanic males living in the United States (3). In Puerto Rico, the overall age adjusted (2000 Standard Puerto Rico Population) incidence increased from 2.3 to 3.5 per 100,000 when 1987-1988 rates are compared to 2001-2002 rates and the overall annual percent change was +3.1. Even though we cannot directly compare rates from Puerto Rico to the rates previously presented for the US population (SEER data) because they are not adjusted to the same standard population, the annual percent change can be compared. The annual percent change was +2.3 in the US (1995-2004) while it was +3.1 in Puerto Rico (1987-2002).

Mortality rates in our study remained stable throughout the years for both genders and all age groups, despite an overall increase in incidence. This is comparable with other countries where a stable mortality rate trend has been observed particularly in younger age groups, while mortality continues to rise in older patients. In the United States, an increase in mortality rates has been observed in men and women 65 years of age and older, with an increase of 130% and 73 % for men and women, respectively, from 1973 to 2002 (3). In Australia increased mortality has also been noted in patients, of both genders, older than 80 years of age (11). Still, in our results, mortality rates increased with advancing age groups and were slightly higher for men than for women a finding also encountered in other countries such as Australia, New Zealand, United States, and the United Kingdom (11).

Another trend observed in our study was that of an increase in the number of thin (<1mm Breslow) melanomas throughout the years in the study period, while melanomas thicker than 1mm remained stable. This increase in thin melanomas has also been reported in other countries. In Italy, the number of melanomas reported that were <1mm in thickness increased significantly for both genders between 1987 and 2003 (12). In Australia, the percentage of melanomas *in situ* increased one third between 1991 and 2002 (5), while in the United States, there has been an increase in thin melanomas (<1mm) in groups of patients younger than 65 years of age, but a continued increase in thick tumor in those older than 65 years of age (11).

An important finding in this study was that in 40.8% of the melanoma cases reported from 1987 to 2002, the Breslow value was not provided. Even though this is an improvement from the 89% of cases in which this value was not provided during 1977 to 1987 (9-10), it is a significant finding because tumor thickness represents the most important prognostic factor for melanoma.

A previous population based study (13) regarding epidemiological trends for melanoma in Puerto Rico, also obtained the data from the Puerto Rico Central Cancer

Registry and included the incidence rates of melanoma from 1987 to 1991, a time period also included in our analysis. This study adjusted the incidence rates to the age distribution of the 1950 Puerto Rican standard population while our study adjusted the incidence rates to the age distribution of the 2000 Puerto Rican standard population, rates that are not directly comparable. The difference in both studies could be explained in part by the fact that the PRCCR was undergoing important changes during the time periods in which these two studies overlap.

In conclusion, although melanoma incidence rates continue to increase in Puerto Rico, the risk is less than in other regions such as Australia and the United States. Still, this increase in the incidence of melanoma in combination with an increase in the diagnosis of thin melanomas, suggest that the stable mortality rates may be due, in part, to earlier diagnosis and improved prognosis.

## Resumen

La incidencia de melanoma cutáneo continúa una tendencia de aumento a través del mundo reflejando el mayor aumento de todas las malignidades en las últimas décadas. Las tasas de mortalidad para melanoma se han mantenido relativamente estables en la mayoría de los países a pesar del aumento en las tasas de incidencia.

El propósito de este estudio es describir las tendencias epidemiológicas de melanoma en Puerto Rico entre el año 1987 y el 2002 y comparar los hallazgos con aquellos datos previamente reportados para Puerto Rico como para otros países.

Todos los casos de melanoma reportados al Registro de Cáncer de Puerto Rico entre el 1987 y el 2002 se incluyeron en el análisis. Se calcularon las tasas de incidencia y mortalidad ajustadas por edad. Las tendencias se compararon por edad, género, localización anatómica del tumor y grosor del tumor.

Se reportaron un total de 1,568 casos nuevos de melanoma entre el 1987 y el 2002, lo que constituye un 50% de aumento en incidencia durante este período. La razón de hombres a mujeres fue de 1:1. La localización anatómica más común en mujeres fue la extremidad inferior seguido del área de la cabeza y cuello. En los hombres, la localización anatómica más común fue el tronco seguido de la cabeza y cuello. La mayoría de los tumores superficiales (<1mm) se encontraban en el tronco seguido de la extremidad inferior. El diagnóstico histológico específico más comúnmente reportado fue "*melanoma in situ*." En 40.82% de los casos el grosor del tumor no fue reportado. El número de melanomas finos (<1mm) reportados aumentaron anualmente durante el período de

estudio. Las tasas de mortalidad fueron levemente mayores en los hombres que en las mujeres, sin embargo, las mismas se mantuvieron estables para ambos géneros y grupos de edades analizados.

En conclusión, las tasas de incidencia de melanoma continúan aumentando en Puerto Rico. Esto, en combinación con un aumento en el diagnóstico de melanomas superficiales, sugiere que la estabilización en las tasas de incidencia se debe en gran parte, a un diagnóstico más temprano y por consiguiente un mejor pronóstico.

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