



MORTALITY AND MORBIDITY FROM EXPOSURE TO EXCESSIVE NATURAL HEAT IN ARIZONA, 2009-2019



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MORTALITY AND MORBIDITY FROM EXPOSURE TO EXCESSIVE NATURAL HEAT IN ARIZONA, 2009-2019

by

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IN ARIZONA, 2009-2019**

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Purpose

The purpose of this report is to provide information on mortality trends in deaths from exposure to heat due to weather conditions occurring in Arizona, during the 2009-2019 period, and heat illness cases during 2019 data year. Exposure to natural heat poses a public health concern because it may lead to heat-related illness such as heat exhaustion or heat stroke, and heat-related death. Unlike our other reports, designed to monitor health status of the residents of Arizona, this publication focuses on mortality and morbidity occurring in the State to both residents and non-residents.

Methods and Sources

The *International Classification of Diseases* (ICD) permits the classification of environmental events and circumstances as the external cause of injury death. Beginning with the 2000 data year in Arizona (1999 nationally) the Tenth Revision of the International Classification of Diseases (ICD-10) has replaced the Ninth Revision (ICD-9), which was in effect since 1979. Exposure to excessive natural heat as the underlying (primary) cause of death is identified by a three-character category X30 in the Tenth Revision and corresponding to it code E900.0 in the Ninth Revision. In this report, the deaths from exposure to heat due to weather conditions are classified by ICD-9 for 1992-1999 and by ICD-10 beginning 2000. In addition to death certificates where exposure to excessive natural heat was indicated as the underlying cause of death, heatstroke or sunstroke may be reported on death certificates as contributing factors that had a bearing on the death, but were not its underlying cause. Those heat-related deaths are beyond the scope of this report.

In this report, heat illnesses are derived from the Hospital Discharge Data (HDD) of the state of Arizona. Hospitalizations (inpatient admissions) and emergency department (ED) visits for heat illness (hyperthermia) due to exposure to excessive natural heat are classified using ICD-10-CM codes (X30 and T67.0 - T67.9). Heat illness cases are derived from the principal diagnosis code, that is, the condition established after study to be chiefly responsible for occasioning the admission of the patient for care. Hospitalization dates were classified by time using admission date. Cases were counted once per hospitalization.

Limitations of the Data

In this report we distinguish three groups at risk of death from exposure to excessive natural heat: *Arizona residents, visitors to Arizona from other U.S. states, Canada or Europe, and migrants from Mexico, Central America, or South America*.

These groups differ not only in size but also with regard to sociodemographic characteristics, such as age composition, gender, occupation, or race/ethnicity. One of the primary objectives in the comparative analysis of mortality is to measure the likelihood (or risk) of death in the specified population during a particular time. Mortality rates express the likelihood of death – the frequency of a vital event (such as death) in the numerator occurring to individuals in the denominator – and they are generally expressed as units of population in the denominator (per 1,000, 10,000, 100,000, and so forth). It is important to note that the risk of death expressed as mortality rate can only be computed for the residents of Arizona. Neither the number of visitors to Arizona during a calendar year, nor the number of illegal border crossers can be estimated with any precision.

While comparisons are made among these groups, correlations between the increased number of deaths from exposure to excessive natural heat among migrants from Mexico, Central America, and South America and undocumented persons is beyond the scope of this report.

The value of comparing the absolute number of deaths, rather than group-specific relative frequencies, ought not to be overestimated. On the other hand, from an epidemiological or public health viewpoint, the number of deaths from a rare cause may be of great importance even if the statistically reliable mortality rate cannot be computed.

The total burden of illness from exposure to excessive natural heat may be larger than is indicated in this report. ADHS collects hospital discharge records for inpatient and emergency department visits from all Arizona licensed hospitals. Records do not capture illness cases that recover without medical intervention or were treated at an urgent care facility. The collection of data from hospitals is required by Arizona Revised Statute (A.R.S.) § 36-125-05 and Arizona Administrative Code Title 9, Chapter 11, Articles 4 and 5. All Arizona licensed hospitals (i.e. regulated by the Arizona Department of Health Services) are required to report.

Therefore, hospitals such as Veteran's Administration Department of Defense, and those located on tribal land, are not included in reporting.

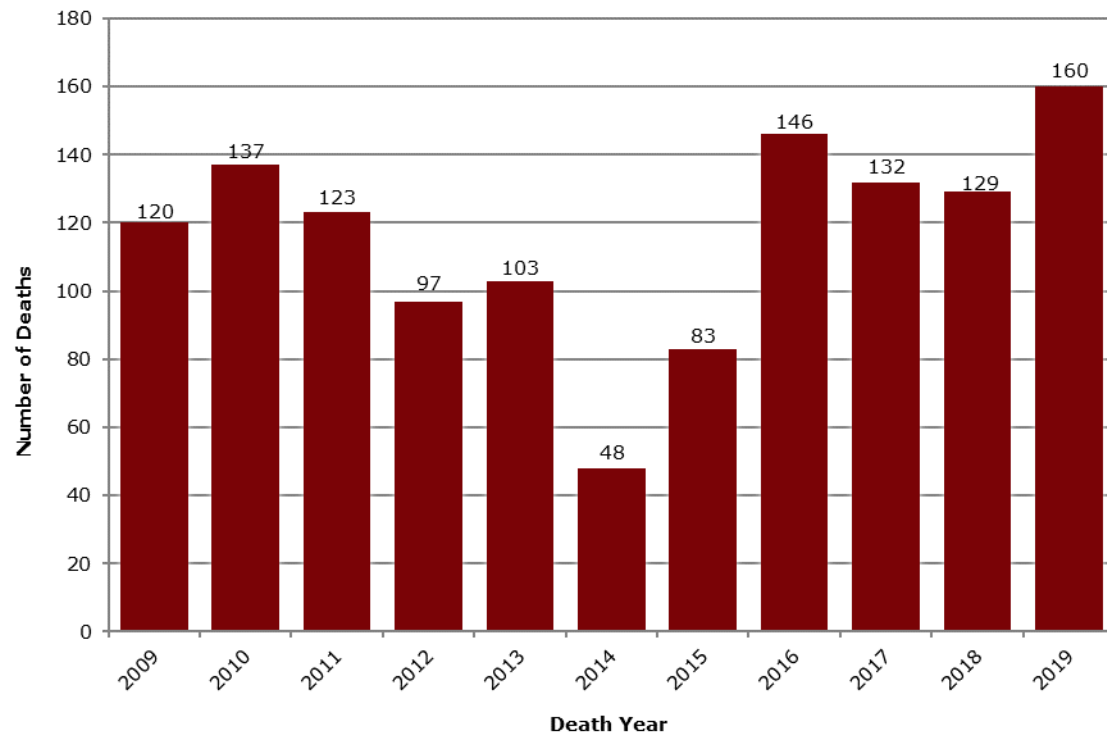
When examining heat morbidity in this report, we examined patients whose primary reason for hospitalization was caused by exposure to excessive natural heat. A case where a heat diagnosis is listed as one of the up to 24 secondary diagnoses is beyond the scope of this report.

Summary of Findings

- ✓ From 2009 to 2019, there were 1,278 deaths from exposure to heat due to weather conditions occurred in Arizona.
- ✓ The annual number of deaths from exposure to excessive natural heat decreased from 120 deaths in 2009 to 97 in 2012, and 48 in 2014. In 2015 and 2016, the number of deaths due to this cause increased to 83 and 146, respectively, then declined to 132 in 2017, and 129 in 2018. In 2019 a new spike occurred with 160 deaths from exposure to excessive natural heat recorded in Arizona.
- ✓ There were 740 deaths from exposure to excessive natural heat among the residents of Arizona (57.9 percent of the total), or 67 deaths on average per year in 2009-2019.
- ✓ Visitors to Arizona from other U.S. states, Canada or Europe experienced around 91 deaths from exposure to heat due to weather conditions in 2009-2019.
- ✓ The state or country of residence of about 120 decedents in 2009-2019 remains unidentified.
- ✓ Approximately eight out of every ten deaths from exposure to excessive natural heat in 2009-2019 were males, and 38.2 percent were Hispanic or Latino.
- ✓ In 2009-2019, sixty-four percent of all deaths from exposure to heat due to weather conditions occurred during the five months from May through September.
- ✓ In 2009-2019, deaths from exposure to excessive natural heat among migrants to Arizona occurred at younger ages compared to deaths from natural heat among the state's residents. Young adults 20-44 years old accounted for 80.4 percent of deaths from exposure to excessive natural heat among the migrants from Mexico and other Central/South American countries.
- ✓ In contrast, older adults 65 years or older have been at the highest risk of heatstroke or sunstroke among the age groups of Arizona residents. Approximately 44.1 percent of fatalities due to exposure to heat among Arizona residents were this old, while there were no deaths from natural heat recorded among migrants aged 65 years and older.
- ✓ In 2009-2019, the four counties along the southern border of Arizona (Cochise, Pima, Santa Cruz, and Yuma) accounted for 39.4 percent of deaths from excessive heat. Individually, Pima county (31.9 percent) and Maricopa county (43.3 percent) accounted for most of the deaths due to exposure to natural heat.
- ✓ Residents from Mexico, Central or South America (58.6 percent) were largely represented in the total counts of death due to heat in Pima County, while in Maricopa the majority of deaths from heat were recorded among Arizona residents (85.4 percent).
- ✓ The median age at illness from exposure to excessive natural heat in 2019 was consistently higher among females for both inpatient (IP) admissions and emergency department (ED) visits. Gender differences with respect to age at illness tend to be larger for IP admissions compared to ED visits.

Section A: Heat-Related Mortality, 2009-2019

Figure 1A
Deaths from Exposure to Excessive Natural Heat*
occurring in Arizona by Year, 2009-2019



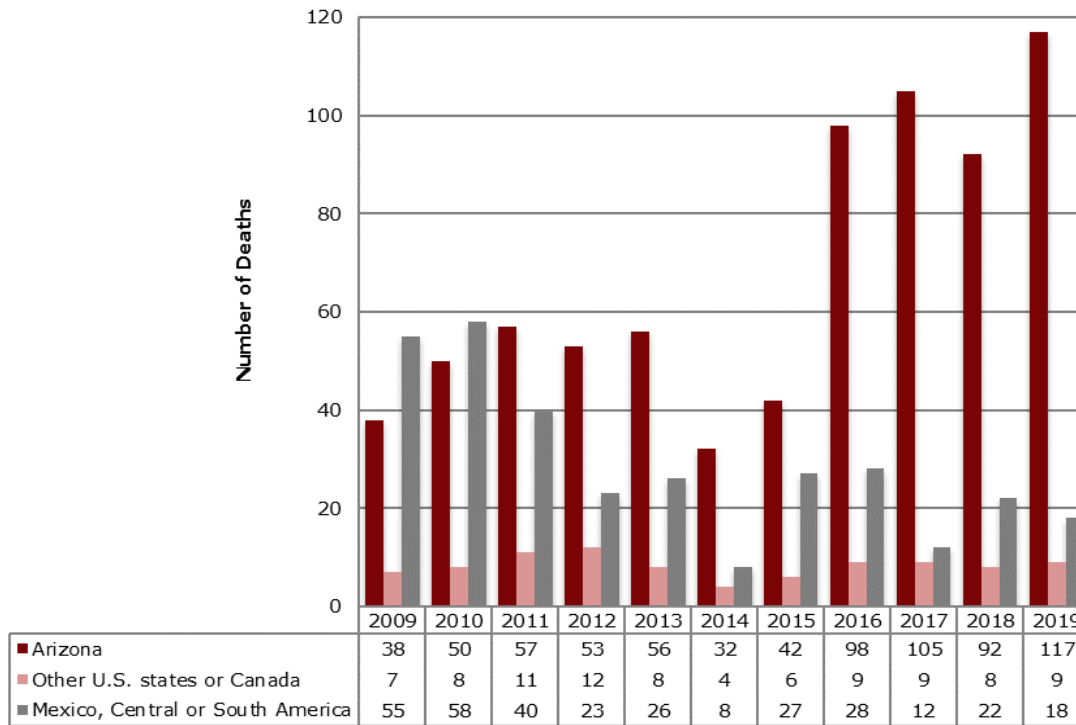
During the 2009-2019 period, 1,278 deaths related to exposure to excessive natural heat occurred in Arizona.

The number of deaths from exposure to excessive natural heat has shown a wide variation from year to year (low = 48 deaths in 2014, high = 160 deaths in 2019). On average, 116 people died every year from a heatstroke or sunstroke between 2009-2019 (**Figure 1A, Table 1A**).

Approximately eight out of every ten deaths from exposure to excessive natural heat in 2009-2019 were males (980/1,278 or 76.7 percent, **Table 1A**), and 38.2 percent (488/1,278, **Table 1A**) were Hispanic or Latino.

* The underlying cause of death was classified as X30 by ICD-10. Included are deaths occurring in Arizona from excessive heat due to weather conditions as the cause of heatstroke or sunstroke among both residents of Arizona and non-residents. Excluded are deaths due to excessive heat of man-made origin.

Figure 2A
Deaths from Exposure to Excessive Natural Heat* occurring in Arizona
by State or Country of Residence and Year, 2009-2019



There were 740 deaths from exposure to excessive natural heat among the residents of Arizona (57.9 percent of the total), or 67 deaths on average per year in 2009-2019.

Migrants from Mexico, Central America or South America accounted for 24.8 percent of the total deaths from exposure to heat due to weather conditions during the 2009 to 2019 period.

Visitors to Arizona from other U.S. states or migrants from Canada experienced 91 deaths from exposure to excessive natural heat during the 2009-2019 period.

Arizona's Sonoran Desert is where the Greater Phoenix metropolitan area is located and where temperatures oftentimes reach triple digits during the summer months. The number of deaths from exposure to excessive natural heat was substantial for Arizona residents in each year from 2016 to 2019. During the same period, migrants from Mexico, Central American, and South American countries experienced a sustained reduction in mortality due to exposure to excessive natural heat.

* The underlying cause of death was classified as X30 by ICD-10. Included are deaths occurring in Arizona from excessive heat due to weather conditions as the cause of heatstroke or sunstroke among both residents of Arizona and non-residents. Excluded are deaths due to excessive heat of man-made origin. Deaths from other or unknown county of residents are not represented in the graph.

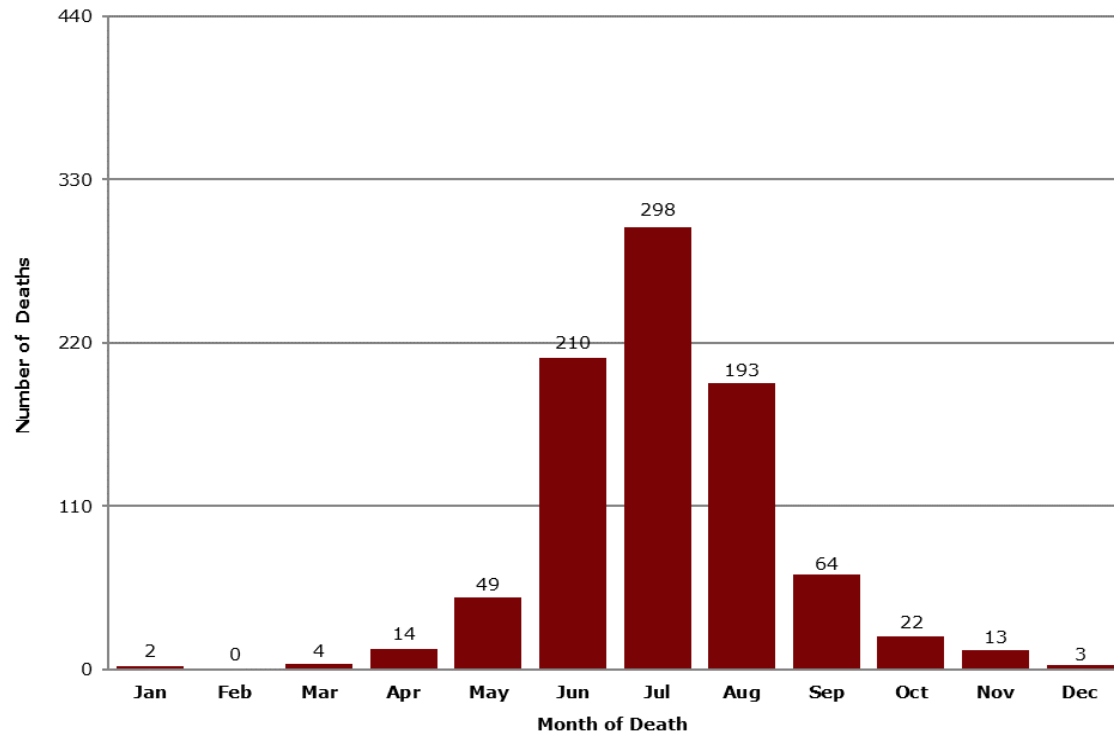
¹ http://phoenix.about.com/cs/weather/a/weathertrivia_2.htm

Figure 3A
Deaths from Exposure to Excessive Natural Heat* occurring in Arizona
by Month, 2009-2019

In Phoenix, Arizona, normal daily maximum temperature reaches $\geq 100^{\circ}$ F in early June and can remain at that level until mid-September. The historical data collected by the Western Regional Climate Center demonstrate that the temperature of 100° can be reached as early as March and continue through October.² Temperatures exceeding 125° F have been observed in the desert area.

The authors of "Impact of Excess Heat Events in Maricopa County, Arizona, 2000-2005"³ rightly point out that in a desert environment such as Maricopa County where summer temperatures average 98° F – 107° F, a heat wave⁴ is a summer-long experience.

Not surprisingly, most deaths from excessive natural heat occurred during summer and late spring (**Figure 3A, Table 2A, Table 3A**), with the highest number of deaths occurring during the month of July (298) in 2009-2019, followed by June (210), then August (193) September (64), and May (49). In 2009-2019, approximately sixty-four percent of all deaths from exposure to heat due to weather conditions occurred during the months of May through September.



² <http://www.wrcc.dri.edu/cqi-bin/clilcd.pl?az23183>

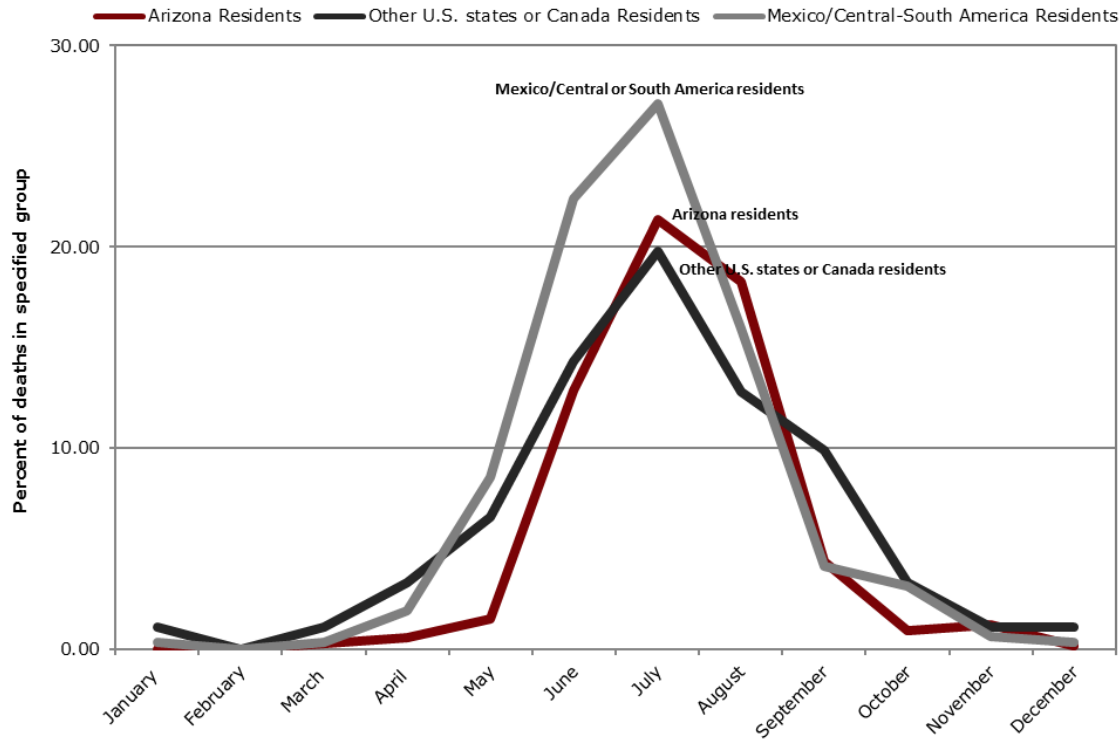
³ Fuyuen Yip, W.D Flanders, A. Wolkin, D. Engelthaler, W. Humble, A. Neri, L. Lewis, L. Backer, C. Rubin. CDC: National Center for Environmental Health, Health Studies Branch, 2006

⁴ Defined by the National Weather Service as three or more consecutive days of maximum temperatures $>90^{\circ}$ F

* The underlying cause of death was classified as X30 by ICD-10. Included are deaths occurring in Arizona from excessive heat due to weather conditions as the cause of heatstroke or sunstroke among both residents of Arizona and non-residents.

Excluded are deaths due to excessive heat of man-made origin.

Figure 4A
Percent Distribution of Deaths from Exposure to Excessive Natural Heat*
occurring in Arizona by Month and Residence Status, 2009-2019



Regardless of the residence status, most deaths from excessive natural heat occurred during the month of July (**Figure 4A, Table 2A**). Compared to the residents of Arizona there were substantially more deaths among residents of Mexico, Central America, and South America from March–June during the 2009-2019 period. In contrast, the number of deaths from excessive natural heat among Arizona residents exceeded the number of deaths from either the two remaining groups in both July and August.

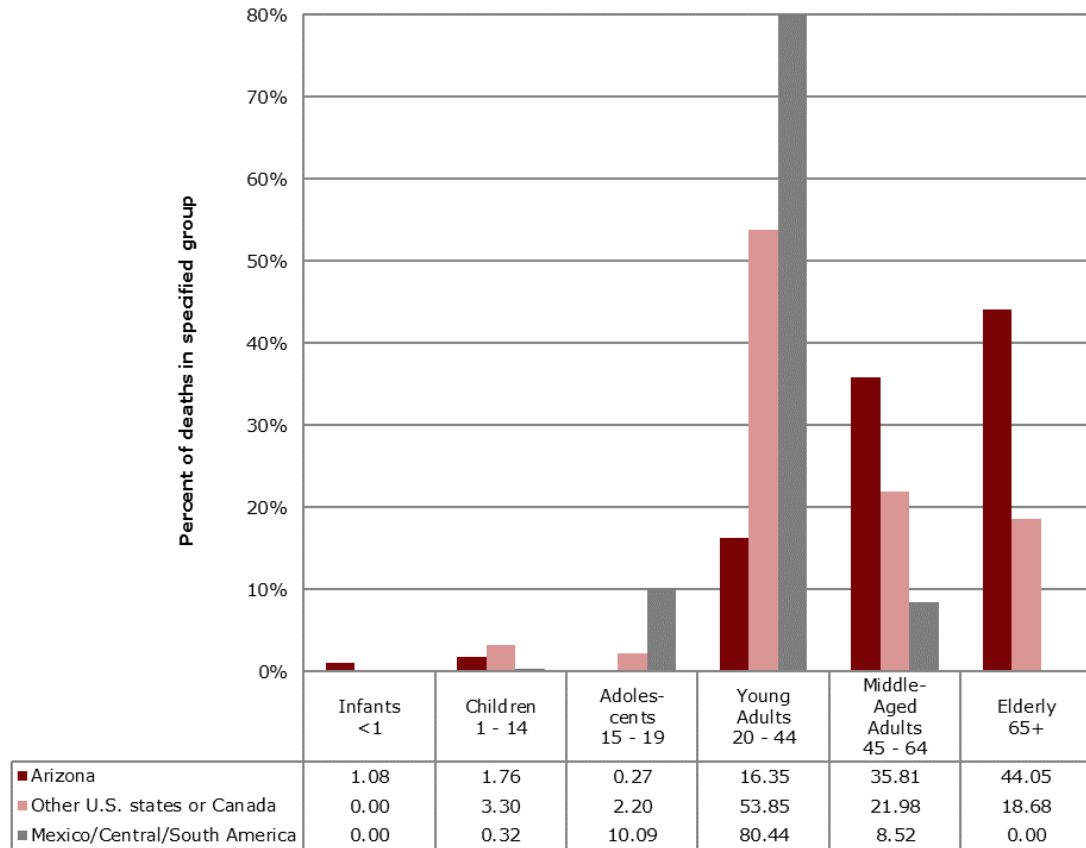
The difference in the seasonal pattern of mortality may mean that fewer migrants entered Arizona in July and August, the two summer months with the highest temperatures (**Table 2A**).

* The underlying cause of death was classified as X30 by ICD-10.
 Deaths from other or unknown county of residents are not represented in the graph.

Figure 5A
Percent Distribution of Deaths from Exposure to Excessive Natural Heat*
occurring in Arizona by Age Group and Residence Status, 2009-2019

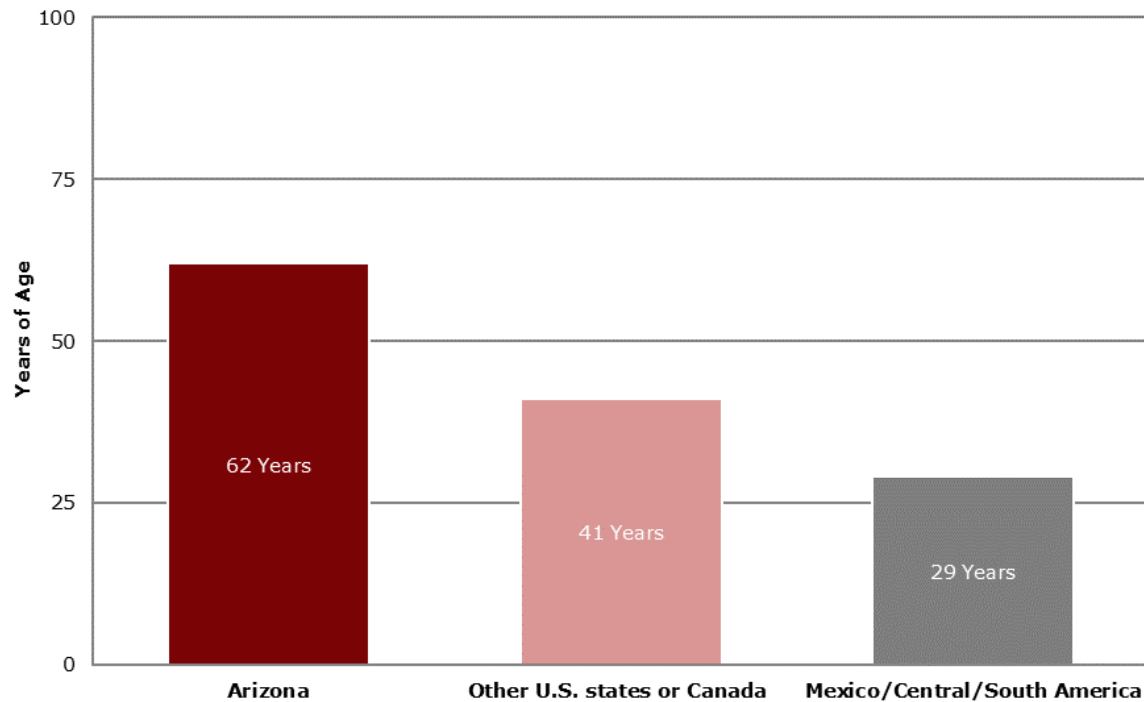
In 2009-2019, deaths from exposure to excessive natural heat among migrants to Arizona occurred at younger ages compared to deaths from natural heat among the State's residents (**Figure 5A**). In fact, young adults 20-44 years old during 2009-2019 accounted for 80.4 percent of deaths from exposure to excessive natural heat among the migrants from Mexico and other Central/South American countries.

In contrast, middle-aged adults and adults 65 years or older have been at the highest risk of heatstroke or sunstroke among the age groups of Arizona residents. Forty-four percent of fatalities due to exposure to heat occurred among Arizona residents aged 65 years or older. While there were no deaths recorded among migrants from Mexico and other Central/South American countries of that age group.



* The underlying cause of death was classified as X30 by ICD-10.
 Deaths from other or unknown county of residents are not represented in the graph.

Figure 6A
Median Age at Death from Exposure to Excessive Natural Heat*
by Residence Status, 2009-2019

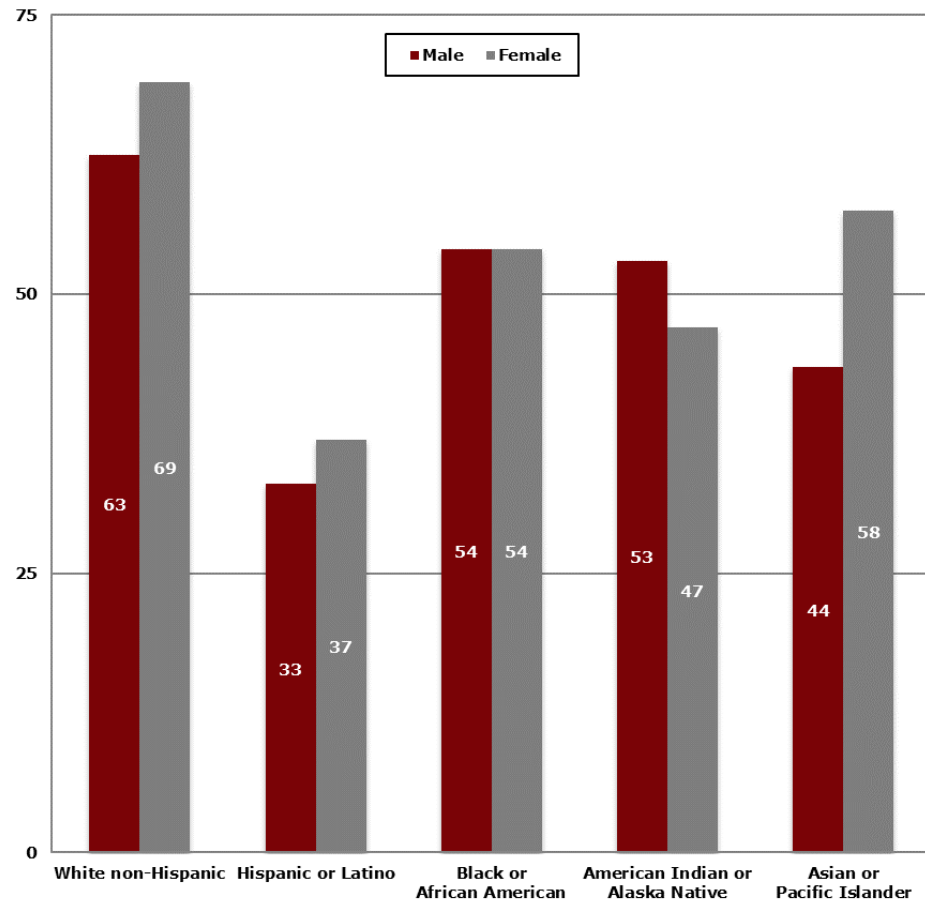


One out of two Arizonans who died from exposure to excessive natural heat in 2009-2019 was older than 62 years of age (**Figure 6A, Table 5A**).

In 2009-2019, on average visitors from other states were 21 years younger than the residents of Arizona at the time of death. The median age of residents from Mexico, Central American or South American countries who died from exposure to excessive natural heat was 29 years of age, which was 33 years younger than the median age of deaths of Arizonans.

* The underlying cause of death was classified as X30 by ICD-10.
Deaths from other or unknown county of residents are not represented in the graph.

Figure 7A
Median Age at Death from Exposure to Excessive Natural Heat*
by Gender and Race/Ethnic Group, 2009-2019



In 2009-2019, White non-Hispanic females ranked highest with median age at death from exposure to excessive natural heat at 69 years, exceeding by 32.0 years the median age at death for Hispanic or Latino females (**Figure 7A, Table 6A**). White non-Hispanic males had the highest (63 years), and Hispanic males had the lowest (33 years), median age at death from exposure to excessive natural heat, respectively.

* The underlying cause of death was classified as X30 by ICD-10.

Table 1A
Characteristics of Deaths from Exposure to Excessive Natural Heat Occurring in Arizona by Year, 2009-2019

		Total	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Total		1,278	120	137	123	97	103	48	83	146	132	129	160
State or Country of Residence	Arizona	740	38	50	57	53	56	32	42	98	105	92	117
	Other U.S. states or Canada	90†	7	8	11	12	8	*	6	9	9	8	9
	Mexico, Central or South America	317	55	58	40	23	26	8	27	28	12	22	18
	Other	10†	0	*	*	*	*	0	*	*	0	0	0
	Unknown	120†	20	19	14	8	12	*	6	8	6	7	16
Geographic Region of Occurrence^a	Central	639	51	48	61	55	45	27	39	69	67	76	101
	Eastern	0	0	0	0	0	0	0	0	0	0	0	0
	Northern	120†	*	6	7	0	13	*	*	12	33	19	23
	Southern	503	64	81	55	41	45	18	39	60	32	34	34
	Western	10†	*	*	0	*	0	0	*	*	0	0	*
County of Occurrence	Apache	0†	0	0	*	0	*	0	0	0	0	*	0
	Cochise	10†	*	*	0	0	*	0	*	*	*	*	*
	Coconino	30†	*	*	*	0	*	*	*	0	8	*	*
	Gila	10†	0	0	*	0	*	0	0	*	*	*	*
	Graham	0†	0	0	0	*	0	0	0	0	0	0	0
	Greenlee	0	0	0	0	0	0	0	0	0	0	0	0
	La Paz	10†	*	*	0	*	0	0	*	*	0	0	*
	Maricopa	554	43	40	54	50	35	21	32	64	59	68	88
	Mohave	90†	0	*	*	0	7	*	*	11	25	15	21
	Navajo	0†	0	0	0	0	0	0	0	*	0	0	0
	Pima	408	50	74	49	35	38	13	28	45	26	25	25
	Pinal	60†	6	6	6	*	*	*	*	*	*	*	12
	Santa Cruz	20†	9	*	*	0	*	*	*	*	0	*	0
	Yavapai	20†	*	*	0	*	*	*	*	*	*	*	0
	Yuma	60†	*	*	*	6	*	*	7	12	*	*	8
Age Group	0 - 4	20†	0	*	0	*	*	*	*	*	*	0	*
	5 - 9	1	0	0	0	0	0	0	0	0	0	0	*
	10 - 14	10†	*	*	0	0	0	0	*	*	0	*	*
	15 - 19	40†	7	7	*	*	*	*	*	*	*	*	*
	20 - 24	80†	10	15	8	*	13	*	7	8	*	*	7
	25 - 29	100†	14	14	12	7	*	6	8	11	9	7	8
	30 - 34	90†	11	8	14	7	*	0	*	11	10	12	9
	35 - 39	100†	13	13	12	10	7	*	10	11	7	10	6
	40 - 44	70†	8	10	10	8	*	*	*	7	*	6	10
	45 - 49	80†	8	10	9	12	11	0	6	*	7	7	9
	50 - 54	90†	10	11	8	*	8	*	*	10	13	9	8
	55 - 59	100†	*	*	6	7	6	*	9	18	11	7	17
	60 - 64	80†	*	*	10	7	*	*	*	13	8	12	11
	65 - 69	80†	6	*	*	*	*	*	7	7	12	15	11
	70 - 74	80†	0	*	*	7	*	*	7	9	12	17	14
	75 - 79	80†	6	6	6	7	*	*	*	11	13	10	13
	80 - 84	50†	*	*	*	*	6	*	*	*	10	6	11
	85+	70†	*	*	10	*	6	*	*	12	7	*	14
Unknown	80†	14	19	7	*	12	*	*	*	*	0	*	

Table 1A (continued)
Characteristics of Deaths from Exposure to Excessive Natural Heat Occurring in Arizona by Year, 2009-2019

		Total	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Gender	Male	980	97	111	97	74	83	32	65	103	91	104	123
	Female	297	22	26	26	23	20	16	18	43	41	25	37
	Unknown	0†	*	0	0	0	0	0	0	0	0	0	0
Race/Ethnicity	White non-Hispanic	623	43	59	53	46	48	28	44	81	77	70	74
	Hispanic or Latino	488	69	70	59	43	43	16	32	52	28	35	41
	Black or African American	50†	*	6	6	*	6	*	*	*	*	7	9
	American Indian or Alaska Native	60†	*	*	*	*	6	*	*	10	11	6	6
	Asian or Pacific Islander	10†	*	0	0	*	0	0	*	*	*	*	*
	Unknown	48	0	0	0	0	0	0	0	0	12	10	26
Month of Death	January	0†	0	0	*	0	0	0	0	0	0	0	0
	February	0	0	0	0	0	0	0	0	0	0	0	0
	March	0†	*	0	*	0	*	0	0	*	0	0	0
	April	10†	*	*	*	*	*	*	*	*	0	0	0
	May	50†	12	8	*	9	9	*	*	*	0	0	0
	June	210	10	23	27	24	30	12	32	52	0	0	0
	July	298	53	71	30	28	39	17	9	51	0	0	0
	August	193	29	18	39	26	14	7	34	26	0	0	0
	September	60†	9	12	15	6	6	*	*	8	0	0	0
	October	20†	*	*	*	*	*	*	*	*	*	*	*
	November	10†	0	*	*	*	*	*	*	*	*	*	0
	December	0†	*	0	0	0	0	0	0	0	*	0	0
	Unknown	406	0	0	0	0	0	0	0	0	124	126	156
Autopsy Performed	No	374	24	19	36	34	27	12	18	37	63	42	62
	Yes	904	96	118	87	63	76	36	65	109	69	87	98
	Unknown	0	0	0	0	0	0	0	0	0	0	0	0

Notes: * Cell suppressed due to non-zero count less than 6; † Sum rounded to nearest tens unit due to non-zero addend less than 6; ^a Classification of geographic regions: Central = Gila, Graham, Maricopa, Pinal, and Yavapai; Eastern = Greenlee; Northern = Apache, Coconino, Mohave, and Navajo; Southern = Cochise, Pima, Santa Cruz, and Yuma; Western = La Paz.

Table 2A
Characteristics of Arizona Deaths from Exposure to Excessive Natural Heat by Residence Status, 2009-2019

		Total	State or Country of Residence				
			Arizona	Other U.S. states or Canada	Mexico, Central or South America	Other	Unknown
Total		1,278	740	90†	317	10†	120†
Year	2009	120	38	7	55	0	20
	2010	140†	50	8	58	*	19
	2011	120†	57	11	40	*	14
	2012	100†	53	12	23	*	8
	2013	100†	56	8	26	*	12
	2014	50†	32	*	8	0	*
	2015	80†	42	6	27	*	6
	2016	150†	98	9	28	*	8
	2017	132	105	9	12	0	6
	2018	129	92	8	22	0	7
	2019	160	117	9	18	0	16
Geographic Region of Occurrence^a	Central	640†	527	30	36	*	42
	Eastern	0	0	0	0	0	0
	Northern	120†	100	22	0	*	0
	Southern	500†	104	36	281	*	78
	Western	10†	9	*	0	0	0
Age Group	0 - 4	15	15	0	0	0	0
	5 - 9	0†	0	*	0	0	0
	10 - 14	10†	6	*	*	0	0
	15 - 19	40†	*	*	32	0	*
	20 - 24	80†	13	*	61	0	*
	25 - 29	100†	23	*	66	*	*
	30 - 34	90†	21	14	49	*	*
	35 - 39	100†	38	13	49	*	*
	40 - 44	72	26	13	30	0	*
	45 - 49	80†	55	*	14	*	9
	50 - 54	90†	68	*	8	*	9
	55 - 59	100†	76	7	*	*	7
	60 - 64	80†	66	6	*	0	*
	65 - 69	76	66	8	0	0	*
	70 - 74	80†	73	*	0	0	*
	75 - 79	80†	76	*	0	0	*
	80 - 84	50†	44	*	0	*	*
	85+	67	67	0	0	0	0
	Unknown	80†	*	0	*	0	68

Table 2A (continued)
Characteristics of Arizona Deaths from Exposure to Excessive Natural Heat by Residence Status, 2009-2019

		Total	State or Country of Residence				
			Arizona	Other U.S. states or Canada	Mexico, Central or South America	Other	Unknown
Gender	Male	980	522	69	274	8	107
	Female	300†	218	22	43	*	12
	Unknown	1	0	0	0	0	*
Race/Ethnicity	White non-Hispanic	620†	483	54	*	6	79
	Hispanic or Latino	490†	127	30	315	*	14
	Black or African American	50†	40	*	*	0	*
	American Indian or Alaska Native	60†	61	*	0	0	0
	Asian or Pacific Islander	10†	8	*	0	*	0
	Unknown	50†	21	*	0	0	25
Month of Death	January	0†	0	*	*	0	0
	February	0	0	0	0	0	0
	March	0†	*	*	*	0	0
	April	10†	*	*	6	0	*
	May	50†	11	6	27	*	*
	June	210†	95	13	71	*	27
	July	300†	158	18	86	*	33
	August	193	114	11	52	0	16
	September	60†	32	9	13	*	8
	October	20†	7	*	10	0	*
	November	10†	9	*	*	0	*
	December	0†	*	*	*	0	0
	Unknown	406	307	24	47	0	28
Autopsy Performed	No	370†	322	24	14	*	13
	Yes	904	418	67	303	9	107
	Unknown	0	0	0	0	0	0

Notes: * Cell suppressed due to non-zero count less than 6; † Sum rounded to nearest tens unit due to non-zero addend less than 6; ^a Classification of geographic regions: Central = Gila, Graham, Maricopa, Pinal, and Yavapai; Eastern = Greenlee; Northern = Apache, Coconino, Mohave, and Navajo; Southern = Cochise, Pima, Santa Cruz, and Yuma; Western = La Paz.

Table 3A
Characteristics of Arizona Deaths from Exposure to Excessive Natural Heat by Region, 2009-2019

		Total	Geographic Region of Occurrence ^a			
			Central	Northern	Southern	Western
Total		1,278	639	120†	503	10†
Year	2009	120†	51	*	64	*
	2010	140†	48	6	81	*
	2011	123	61	7	55	0
	2012	100†	55	0	41	*
	2013	103	45	13	45	0
	2014	50†	27	*	18	0
	2015	80†	39	*	39	*
	2016	150†	69	12	60	*
	2017	132	67	33	32	0
	2018	129	76	19	34	0
	2019	160†	101	23	34	*
State or Country of Residence	Arizona	740	527	100	104	9
	Other U.S. states or Canada	90†	30	22	36	*
	Mexico, Central or South America	317	36	0	281	0
	Other	10†	*	*	*	0
	Unknown	120	42	0	78	0
County of Occurrence	Apache	0†	0	*	0	0
	Cochise	14	0	0	14	0
	Coconino	28	0	28	0	0
	Gila	7	7	0	0	0
	Graham	0†	*	0	0	0
	Greenlee	0	0	0	0	0
	La Paz	12	0	0	0	12
	Maricopa	554	554	0	0	0
	Mohave	91	0	91	0	0
	Navajo	0†	0	*	0	0
	Pima	408	0	0	408	0
	Pinal	57	57	0	0	0
	Santa Cruz	24	0	0	24	0
	Yavapai	20	20	0	0	0
	Yuma	57	0	0	57	0
Age Group	0 - 4	20†	11	*	*	0
	5 - 9	0†	0	0	*	0
	10 -14	10†	6	0	*	0
	15 - 19	40†	7	*	30	0
	20 - 24	80†	16	*	60	0
	25 - 29	100†	30	*	66	*
	30 - 34	90†	28	*	56	0
	35 - 39	104	36	6	62	0
	40 - 44	70†	31	*	34	*
	45 - 49	80†	56	*	24	0
	50 - 54	90†	67	6	15	*
	55 - 59	100†	58	17	18	*
	60 - 64	80†	57	10	10	*
	65 - 69	80†	50	13	12	*
	70 - 74	80†	50	18	10	*
	75 - 79	80†	49	15	15	*
	80 - 84	48	28	11	9	0
	85+	70†	50	6	10	*
	Unknown	75	9	0	66	0

Table 3A (continued)
Characteristics of Arizona Deaths from Exposure to Excessive Natural Heat by Region, 2009-2019

		Total	Geographic Region of Occurrence			
			Central	Northern	Southern	Western
Gender	Male	980	470	85	416	9
	Female	300†	169	39	86	*
	Unknown	0†	0	0	*	0
Race/Ethnicity	White non-Hispanic	623	380	90	145	8
	Hispanic or Latino	488	139	9	340	0
	Black or African American	50†	42	0	*	*
	American Indian or Alaska Native	60†	33	19	7	*
	Asian or Pacific Islander	10†	9	*	*	0
	Unknown	50†	36	*	8	0
Month of Death	January	0†	*	0	*	0
	February	0	0	0	0	0
	March	0†	*	*	*	0
	April	10†	*	*	7	0
	May	50†	11	*	36	*
	June	210†	89	*	115	*
	July	300†	144	24	127	*
	August	190†	96	10	84	*
	September	60†	34	*	24	*
	October	22	14	0	8	0
	November	10†	7	*	*	0
	December	0†	*	*	*	0
	Unknown	410†	235	74	95	*
Autopsy Performed	No	374	189	97	80	8
	Yes	900†	450	27	423	*
	Unknown	0	0	0	0	0

Notes: * Cell suppressed due to non-zero count less than 6; † Sum rounded to nearest tens unit due to non-zero addend less than 6; ^a Classification of geographic regions: Central = Gila, Graham, Maricopa, Pinal, and Yavapai; Eastern = Greenlee; Northern = Apache, Coconino, Mohave, and Navajo; Southern = Cochise, Pima, Santa Cruz, and Yuma; Western = La Paz.

Table 4A
Deaths from Exposure to Excessive Natural Heat by Geographic Region of Occurrence in Arizona,
and Residence Status, 2009-2019

		Total	Geographic Region of Occurrence ^a			
			Central	Northern	Southern	Western
State or Country of Residence	Arizona	740	527	100	104	9
	Other U.S. states or Canada	90†	30	22	36	*
	Mexico, Central or South America	317	36	0	281	0
	Other	10†	*	*	*	0
	Unknown	120	42	0	78	0
Total		1,278	640†	120†	500†	10†

Notes: * Cell suppressed due to non-zero count less than 6; † Sum rounded to nearest tens unit due to non-zero addend less than 6; ^a Classification of geographic regions: Central = Gila, Graham, Maricopa, Pinal, and Yavapai; Eastern = Greenlee; Northern = Apache, Coconino, Mohave, and Navajo; Southern = Cochise, Pima, Santa Cruz, and Yuma; Western = La Paz.

Table 5A
Median Age at Death from Exposure to Excessive Natural Heat by Geographic Region of Occurrence in Arizona,
and Residence Status, 2009-2019

		Geographic Region of Occurrence ^a			
		Central	Northern	Southern	Western
State or Country of Residence	Arizona	60	69	65	56
	Other U.S. states or Canada	41	49	36	63
	Mexico, Central or South America	29	0	29	0
	Other	48	38	34	0

Notes: ^a Classification of geographic regions: Central = Gila, Graham, Maricopa, Pinal, and Yavapai; Eastern = Greenlee; Northern = Apache, Coconino, Mohave, and Navajo; Southern = Cochise, Pima, Santa Cruz, and Yuma; Western = La Paz.

Table 6A
Median Age at Death from Exposure to Excessive Natural Heat by Race/Ethnicity and Gender, 2009-2019

Race/Ethnicity	Gender	Median Age at Death
White non-Hispanic	Male	63
	Female	69
	Total	63
Hispanic or Latino	Male	33
	Female	37
	Total	37
Black or African American	Male	54
	Female	54
	Total	56
American Indian or Alaska Native	Male	53
	Female	47
	Total	49
Asian or Pacific Islander	Male	44
	Female	58
	Total	56
Unknown	Male	63
	Female	62
	Total	58

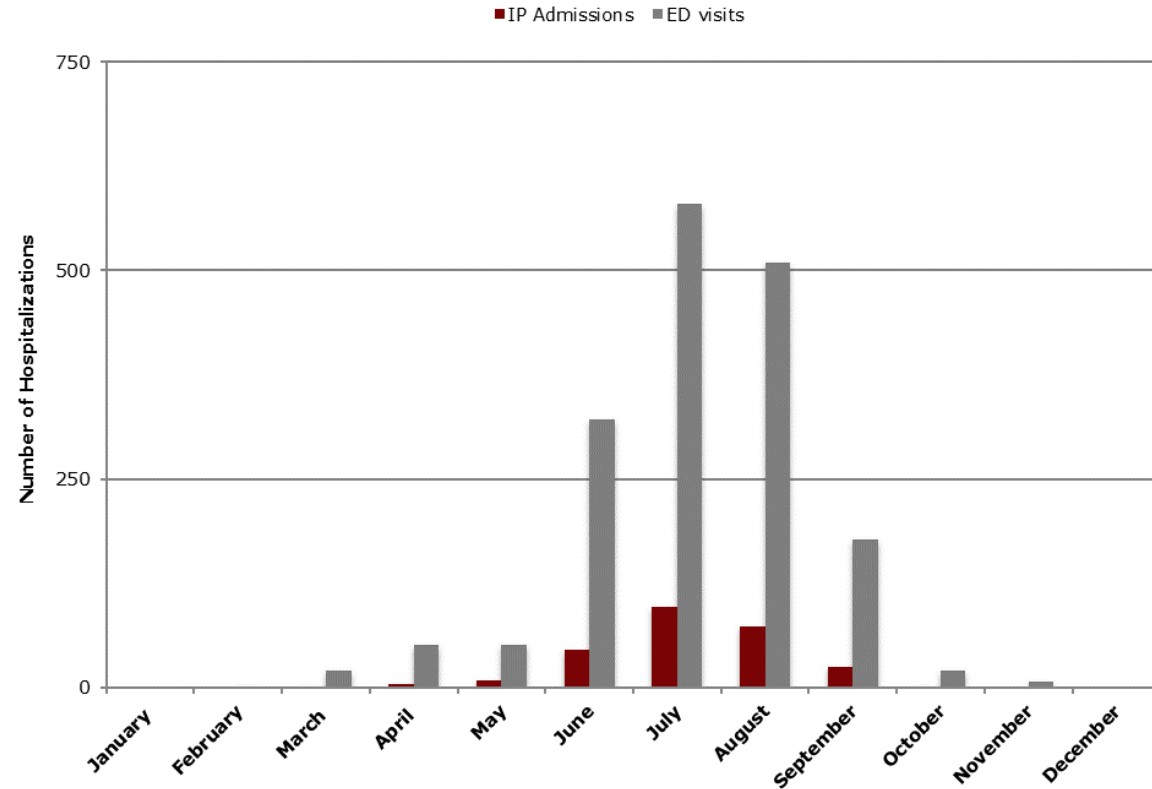
Section B: Heat-Related Morbidity, 2019

Figure 1B
Hospitalizations from Exposure to Excessive Natural Heat
occurring in Arizona by Month, 2019

Arizona's Sonoran Desert covers a majority of the land in the southern half of Arizona. The Greater Phoenix metropolitan area is located in Central Arizona in the Sonoran Desert. Temperatures in Phoenix and elsewhere in the Sonoran Desert region oftentimes reach triple digits during the summer months (May-September). The mean high temperature in July is 107° F in the Central Arizona urbanized region.⁵ The hot and arid climate during the summer months can increase the risk for getting a heat illness.

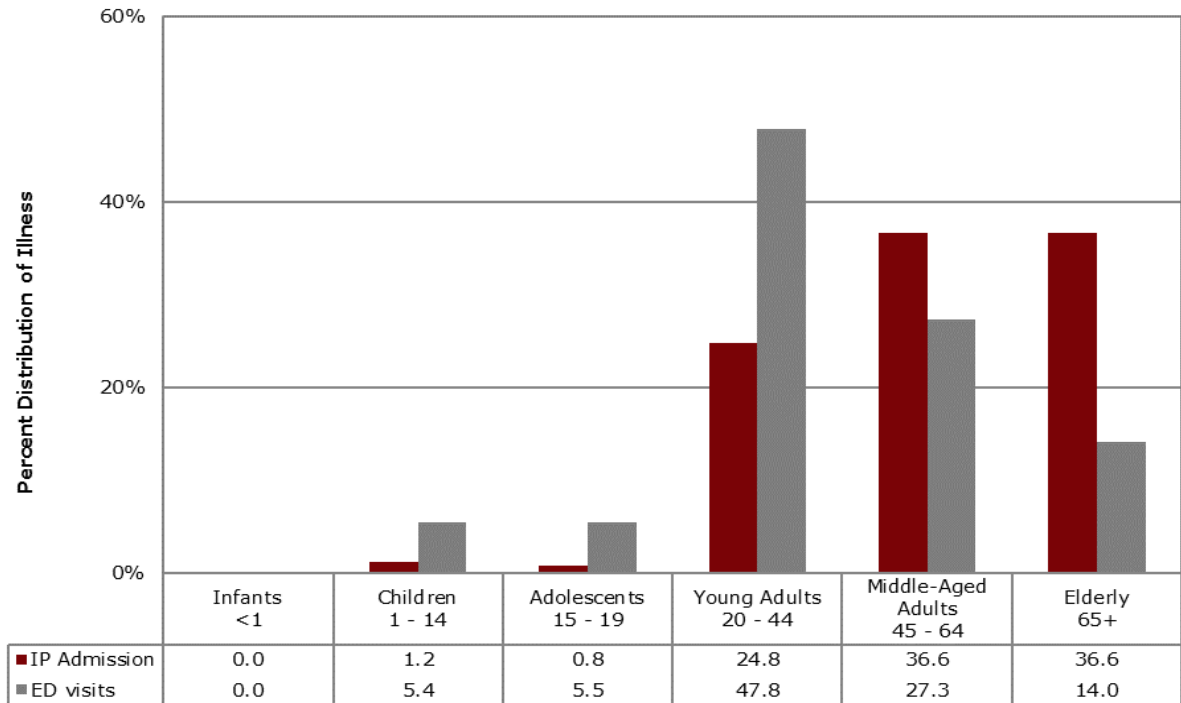
Not surprisingly, most illnesses from excessive natural heat occurred during late spring and summer (**Figure 1B, Table 1B**), with the highest number of heat illness emergency department (ED) visits and heat illness inpatient admissions occurring during the months of June, July, August, and September.

The warm season between June and September accounts for 94.5 percent of hospitalizations and 91.3 percent of the total ED visits from exposure to excessive natural heat.



⁵ See http://ral.ucar.edu/csap/events/climatehealth/2013/docs/s_harlan_heat_mortality.pdf

Figure 2B
Percent Distribution of Illness from Exposure to Excessive Natural Heat
occurring in Arizona by Age Group, 2019



In 2019, illnesses (ED visits and IP admissions) from exposure to excessive natural heat affected all age groups except the infant group (<1 year old). Young adult residents of Arizona 20-44 years old accounted for 24.8 percent of IP admissions and 47.8 percent of heat illness ED visits. On the other hand, middle aged and elderly Arizona residents accounted for only 41.3 percent of heat illness ED visits for exposure to excessive natural heat, but represent 73.2 percent of IP admissions (**Figure 2B**).

Nearly 5.1 percent of heat illness emergency department visits were from Arizona resident children ages 1-14 years old, but Arizona resident adolescents 15-19 years old accounted for 5.5 percent of the total.

Figure 3B
Median Age at Illness from Exposure to Excessive Natural Heat
by Gender, 2019

The median age at illness from exposure to excessive natural heat in 2019 was consistently higher among females for both IP admissions and ED visits. Gender differences with respect to age at illness tend to be larger for IP admissions compared to ED visits (**Figure 3B**). The median age of males visiting the emergency department for a heat illness was 2 years lower than the female median age at illness, but 18 years lower at time of admission for inpatient care. In 2019, the median age at admission to hospital due to exposure to excessive natural heat was generally higher compared to heat illness ED visits.

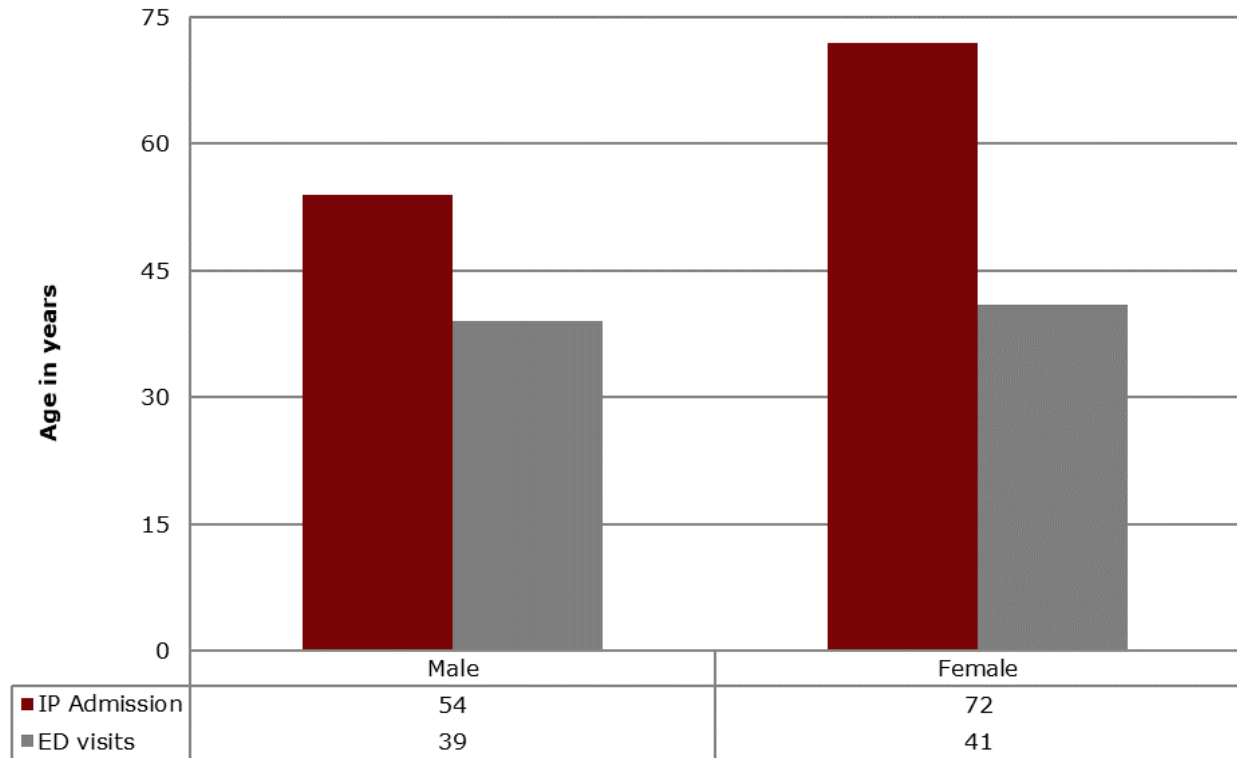
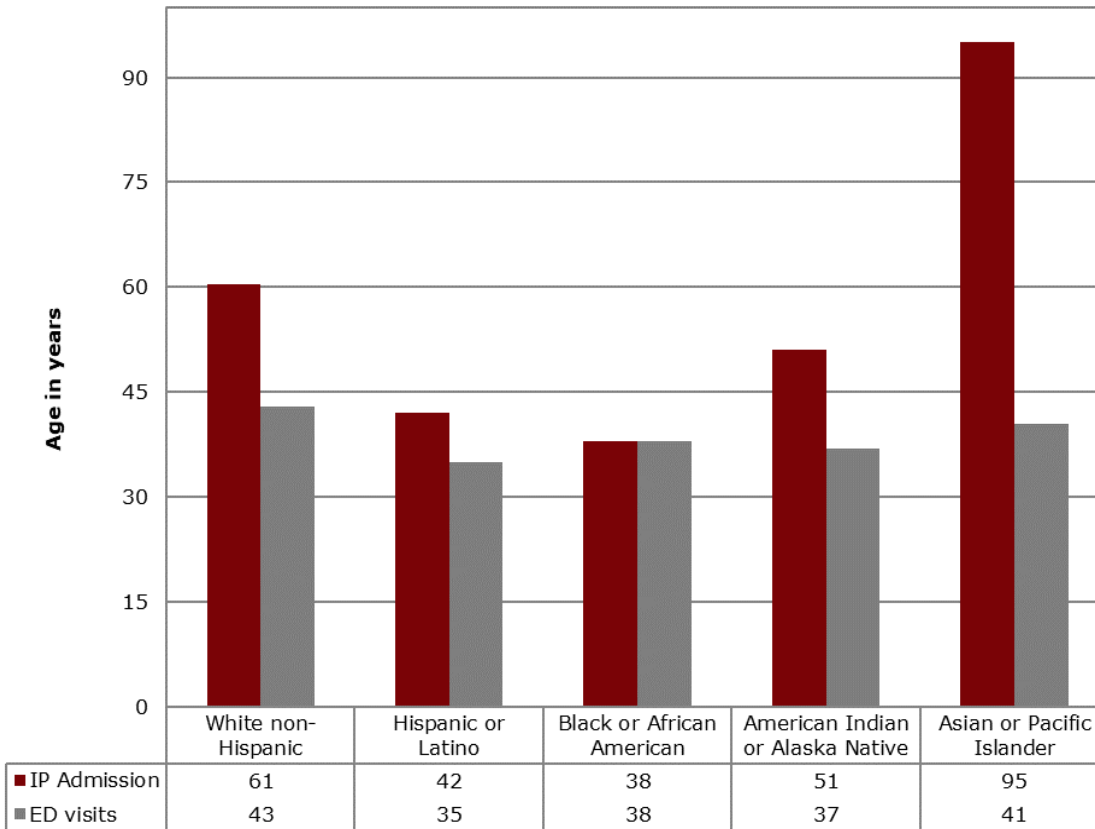


Figure 4B
Median Age at Illness from Exposure to Excessive Natural Heat
by Race/Ethnic Group, 2019



Median age at illness from exposure to excessive natural heat varies by race/ethnic groups. With respect to IP admissions, the median age at illness for Asians, was substantially the greatest while Black or African American had the youngest age at illness. The median age of White non-Hispanics visiting the emergency department for a heat illness was 43 years of age, the highest among all race/ethnic groups, the lowest being recorded among Hispanic or Latinos (35) and American Indian or Alaska Natives (37), Black or African American (38) followed by Asian or Pacific Islanders (41 years).

Table 1B
Inpatient stays and ED visits from Exposure to Excessive Natural Heat by Region and Demographic Characteristics, 2019

		Total	IP Admissions	ED Visits
Total		1,993	254	1,739
Geographic Region of Occurrence^a	Central	1,370	167	1,203
	Eastern	10	0	10
	Northern	114	15	99
	Southern	462	69	393
	Western	0	0	0
	Unknown	40†	*	34
County of Occurrence	Apache	0†	0	*
	Cochise	40†	*	35
	Coconino	14	0	14
	Gila	22	0	22
	Graham	6	0	6
	Greenlee	0	0	0
	La Paz	10	0	10
	Maricopa	1,174	156	1,018
	Mohave	95	14	81
	Navajo	0†	*	*
	Pima	205	43	162
	Pinal	136	8	128
	Santa Cruz	0†	0	*
	Yavapai	30†	*	29
	Yuma	218	24	194
Unknown	40†	*	34	
Age Group	0 - 4	20†	*	21
	5 - 9	20†	*	22
	10 - 14	50†	*	45
	15 - 19	100†	*	95
	20 - 24	156	7	149
	25 - 29	192	13	179
	30 - 34	184	11	173
	35 - 39	208	20	188
	40 - 44	155	12	143
	45 - 49	144	19	125
	50 - 54	140	24	116
	55 - 59	156	26	130
	60 - 64	127	24	103
	65 - 69	94	13	81
	70 - 74	78	20	58
	75 - 79	73	23	50
	80 - 84	54	23	31
	85+	38	14	24
Unknown	6	0	6	

Table 1B (continued)
Inpatient stays and ED visits from Exposure to Excessive Natural Heat by Region and Demographic Characteristics, 2019

		Total	IP Admissions	ED Visits
Gender	Male	1,385	187	1,198
	Female	608	67	541
Race/Ethnicity	White non-Hispanic	1,193	180	1,013
	Hispanic or Latino	521	43	478
	Black or African American	144	19	125
	American Indian or Alaska Native	80†	*	79
	Asian or Pacific Islander	30†	*	28
	Unknown	22	6	16
Month of Occurrence	January	0	0	0
	February	0†	0	*
	March	20†	*	21
	April	60†	*	51
	May	59	8	51
	June	366	45	321
	July	677	97	580
	August	582	73	509
	September	202	25	177
	October	20†	*	21
	November	7	0	7
	December	0	0	0

Notes: * Cell suppressed due to non-zero count less than 6; † Sum rounded to nearest tens unit due to non-zero addend less than 6; ^a Classification of geographic regions: Central = Gila, Graham, Maricopa, Pinal, and Yavapai; Eastern = Greenlee; Northern = Apache, Coconino, Mohave, and Navajo; Southern = Cochise, Pima, Santa Cruz, and Yuma; Western = La Paz.

Table 2B

Inpatient stays and ED visits from Exposure to Excessive Natural Heat by Region and Demographic Characteristics, 2019

		Total	Geographic Region of Occurrence ^a											
			IP Admissions					ED Visits						
			Central	Eastern	Northern	Southern	Western	Un-known	Central	Eastern	Northern	Southern	Western	Un-known
Total		1,993	170†	0	20†	70†	0	3	1,203	10	100†	390†	0	34
County of Occurrence	Apache	0†	0	0	0	0	0	0	0	0	*	0	0	0
	Cochise	40†	0	0	0	*	0	0	0	0	0	35	0	0
	Coconino	14	0	0	0	0	0	0	0	0	14	0	0	0
	Gila	22	0	0	0	0	0	0	22	0	0	0	0	0
	Graham	6	0	0	0	0	0	0	6	0	0	0	0	0
	Greenlee	0	0	0	0	0	0	0	0	0	0	0	0	0
	La Paz	10	0	0	0	0	0	0	0	10	0	0	0	0
	Maricopa	1,174	156	0	0	0	0	0	1,018	0	0	0	0	0
	Mohave	95	0	0	14	0	0	0	0	0	81	0	0	0
	Navajo	0†	0	0	*	0	0	0	0	0	*	0	0	0
	Pima	205	0	0	0	43	0	0	0	0	0	162	0	0
	Pinal	136	8	0	0	0	0	0	128	0	0	0	0	0
	Santa Cruz	0†	0	0	0	0	0	0	0	0	0	*	0	0
	Yavapai	30†	*	0	0	0	0	0	29	0	0	0	0	0
Yuma	218	0	0	0	24	0	0	0	0	0	194	0	0	
Unknown	37	0	0	0	0	0	*	0	0	0	0	0	34	
Age Group	0 - 4	20†	*	0	0	0	0	0	16	0	0	*	0	0
	5 - 9	20†	*	0	0	0	0	0	12	0	*	7	0	*
	10 - 14	50†	0	0	0	*	0	0	30	0	*	13	0	*
	15 - 19	100†	*	0	0	0	0	0	64	*	9	20	0	*
	20 - 24	160†	6	0	*	0	0	0	111	0	10	24	0	*
	25 - 29	190†	8	0	*	*	0	0	127	0	*	43	0	6
	30 - 34	180†	9	0	0	*	0	0	113	0	12	46	0	*
	35 - 39	210†	14	0	*	*	0	0	133	*	8	42	0	*
	40 - 44	160†	8	0	0	*	0	*	112	*	*	22	0	*
	45 - 49	140†	11	0	0	7	0	*	92	0	*	25	0	*
	50 - 54	140	16	0	0	8	0	0	80	0	7	27	0	*
	55 - 59	160†	19	0	*	*	0	*	91	*	8	30	0	0
	60 - 64	130†	15	0	*	7	0	0	68	*	7	24	0	*
	65 - 69	90†	8	0	0	*	0	0	43	*	8	27	0	*
	70 - 74	80†	9	0	*	10	0	0	39	0	11	7	0	*
	75 - 79	70†	16	0	*	*	0	0	30	*	*	15	0	0
	80 - 84	50†	15	0	*	*	0	0	17	0	0	13	0	*
	85+	40†	9	0	*	*	0	0	20	*	*	*	0	0
Unknown	10†	0	0	0	0	0	0	*	0	0	*	0	0	

Table 2B (continued)

Inpatient stays and ED visits from Exposure to Excessive Natural Heat by Region and Demographic Characteristics, 2019

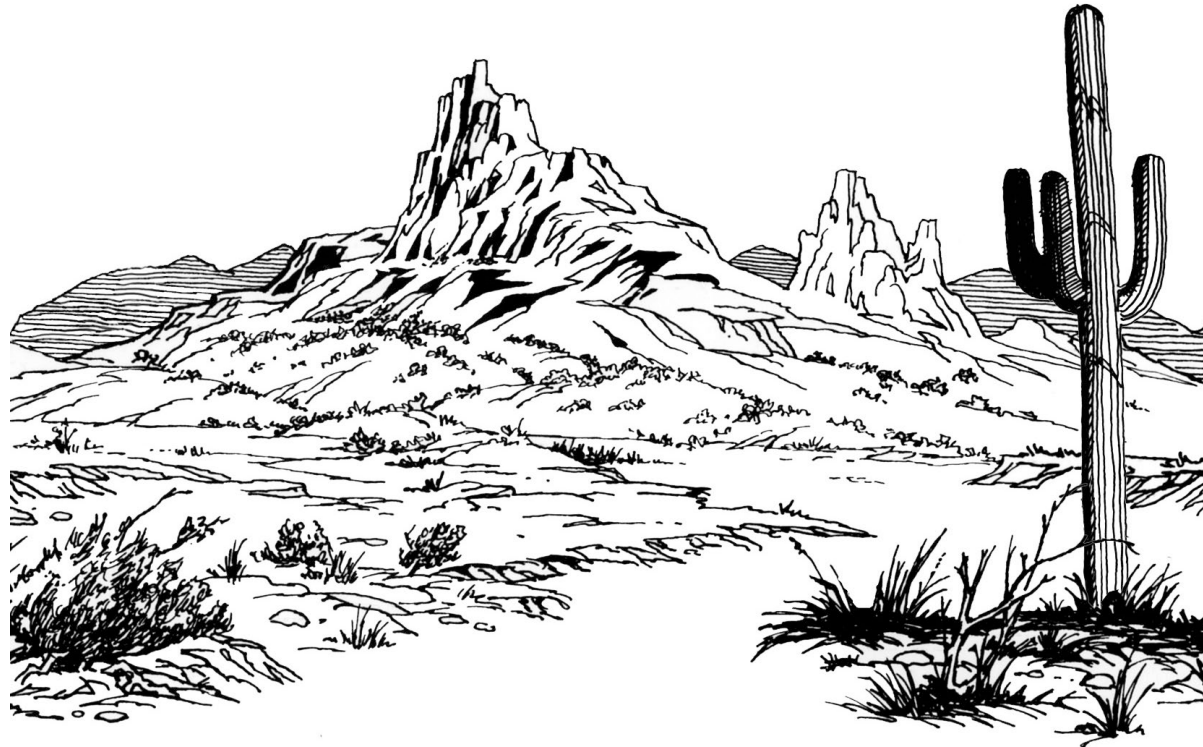
		Total	Geographic Region of Occurrence ^a											
			IP Admissions						ED Visits					
			Central	Eastern	Northern	Southern	Western	Un-known	Central	Eastern	Northern	Southern	Western	Un-known
Gender	Male	1,385	120	0	12	52	0	*	848	6	63	257	24	0
	Female	610†	47	0	*	17	0	0	355	*	36	136	10	0
Race/ Ethnicity	White non-Hispanic	1,193	114	0	12	51	0	*	700	8	82	204	19	0
	Hispanic or Latino	520†	27	0	*	13	0	0	304	*	7	155	11	0
	Black or African American	140†	15	0	0	*	0	0	108	0	0	15	*	0
	American Indian or Alaska Native	80†	*	0	0	*	0	0	57	*	9	12	0	0
	Asian or Pacific Islander	30†	*	0	0	0	0	0	21	0	*	6	0	0
	Unknown	20†	6	0	0	0	0	0	13	0	0	*	*	0
Month of Illness	January	0	0	0	0	0	0	0	0	0	0	0	0	0
	February	0†	0	0	0	0	0	0	0	0	0	*	0	0
	March	20†	*	0	0	0	0	0	12	0	*	7	0	0
	April	60†	*	0	*	*	0	0	32	0	6	13	0	0
	May	60†	*	0	0	*	0	*	32	*	*	13	*	0
	June	370†	32	0	*	10	0	0	223	*	24	71	*	0
	July	680†	63	0	*	31	0	0	407	*	27	127	15	0
	August	580†	48	0	7	17	0	*	357	*	28	111	9	0
	September	200†	16	0	*	7	0	*	123	0	8	41	*	0
	October	20†	*	0	0	0	0	0	14	0	*	6	0	0
	November	10†	0	0	0	0	0	0	*	0	0	*	*	0
	December	0	0	0	0	0	0	0	0	0	0	0	0	0

Notes: * Cell suppressed due to non-zero count less than 6; † Sum rounded to nearest tens unit due to non-zero addend less than 6; ^a Classification of geographic regions: Central = Gila, Graham, Maricopa, Pinal, and Yavapai; Eastern = Greenlee; Northern = Apache, Coconino, Mohave, and Navajo; Southern = Cochise, Pima, Santa Cruz, and Yuma; Western = La Paz.

Table 3B
Median Age at Illness from Exposure to Excessive Natural Heat by Race/Ethnicity and Gender, 2019

Race/Ethnicity	Gender	Median Age at Death	
		IP Admissions	ED Visits
White non-Hispanic	Male	57	43
	Female	74	43
	Total	61	43
Hispanic or Latino	Male	42	34
	Female	43	36
	Total	42	35
Black or African American	Male	38	37
	Female	55	42
	Total	38	38
American Indian or Alaska Native	Male	44	37
	Female	60	36
	Total	51	37
Asian or Pacific Islander	Male	0	38
	Female	95	43
	Total	95	41
Refused/Unknown	Male	52	34
	Female	49	26
	Total	52	33

Our Web site at <http://pub.azdhs.gov/health-stats> provides access to a wide range of statistical information about the health status of Arizonans. The Arizona Health Status and Vital Statistics annual report examines trends in natality, mortality, and morbidity towards established health objectives. Additional reports and studies include Advance Vital Statistics by County of Residence, Injury Mortality among Arizona Residents (accidents, suicides, homicides, legal intervention, firearm-related fatalities, drug-related deaths, drowning deaths, falls among Arizonans 65 years or older), Hospital Inpatient and Emergency Room Statistics (first-listed diagnosis, procedures, mental disorders, asthma, diabetes, influenza and pneumonia, and substance abuse), Community Vital Statistics, Teenage Pregnancy, Differences in Health Status Among Racial/Ethnic Groups, and Health Status Profile of American Indians in Arizona.



ARIZONA DEPARTMENT OF HEALTH SERVICES
Bureau of Public Health Statistics
Population Health and Vital Statistics Section