



# **MORTALITY AND MORBIDITY FROM EXPOSURE TO EXCESSIVE NATURAL HEAT IN ARIZONA, 2008-2018**



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# **MORTALITY AND MORBIDITY FROM EXPOSURE TO EXCESSIVE NATURAL HEAT IN ARIZONA, 2008-2018**

by

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# MORTALITY AND MORBIDITY FROM EXPOSURE TO EXCESSIVE NATURAL HEAT IN ARIZONA, 2008-2018

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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 2008-2018 period, and heat illness cases during 2018 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.

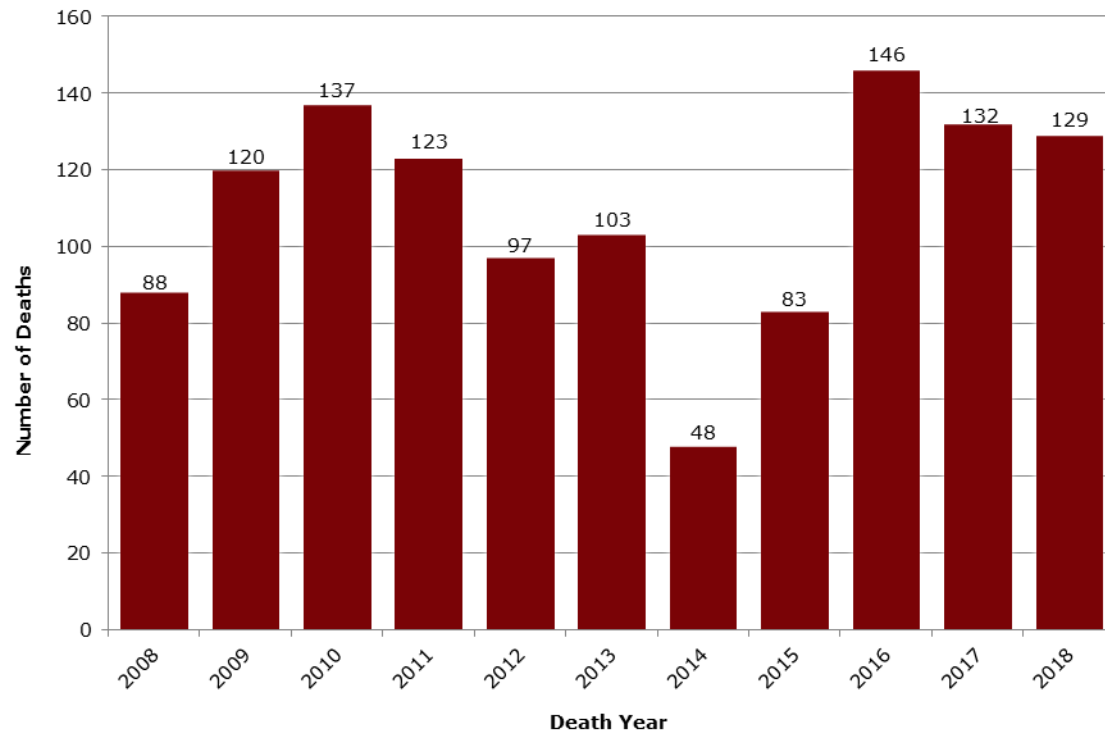
## Summary of Findings

- ✓ From 2008 to 2018, there were 1,206 deaths from exposure to heat due to weather conditions occurred in Arizona.
- ✓ The annual number of deaths due to this cause increased to 88 in 2008 to about 120 deaths between 2009 and 2011, then a decline to 97 in 2012, and 48 in 2014. The number of deaths from exposure to excessive natural heat, increased from 83 in 2015 to 146 in 2016, then a decline to 132 in 2017, and 129 in 2018.
- ✓ There were 657 deaths from exposure to excessive natural heat among the residents of Arizona (54.5 percent of the total), or 60 deaths on average per year in 2008-2018.
- ✓ Visitors to Arizona from other U.S. states, Canada or Europe experienced around 86 deaths from exposure to heat due to weather conditions in 2008-2018.
- ✓ The state or country of residence of about 110 decedents in 2008-2018 remains unidentified.
- ✓ Approximately eight out of every ten deaths from exposure to excessive natural heat in 2008-2018 were males, and 41.2 percent were Hispanic or Latino.
- ✓ In 2008-2018, seventy-four percent of all deaths from exposure to heat due to weather conditions occurred during the five months from May through September.
- ✓ In 2008-2018, 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 78.5 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 42.9 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 2008-2018, the four counties along the southern border of Arizona (Cochise, Pima, Santa Cruz, and Yuma) accounted for 43.0 percent of deaths from excessive heat. Individually, Pima county (35.2 percent) and Maricopa county (40.8 percent) accounted for most of the deaths due to exposure to natural heat.
- ✓ Residents from Mexico, Central or South America (59.4 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 (86.0 percent).
- ✓ The median age at illness from exposure to excessive natural heat in 2018 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, 2008-2018

**Figure 1A**  
**Deaths from Exposure to Excessive Natural Heat\***  
**occurring in Arizona by Year, 2008-2018**



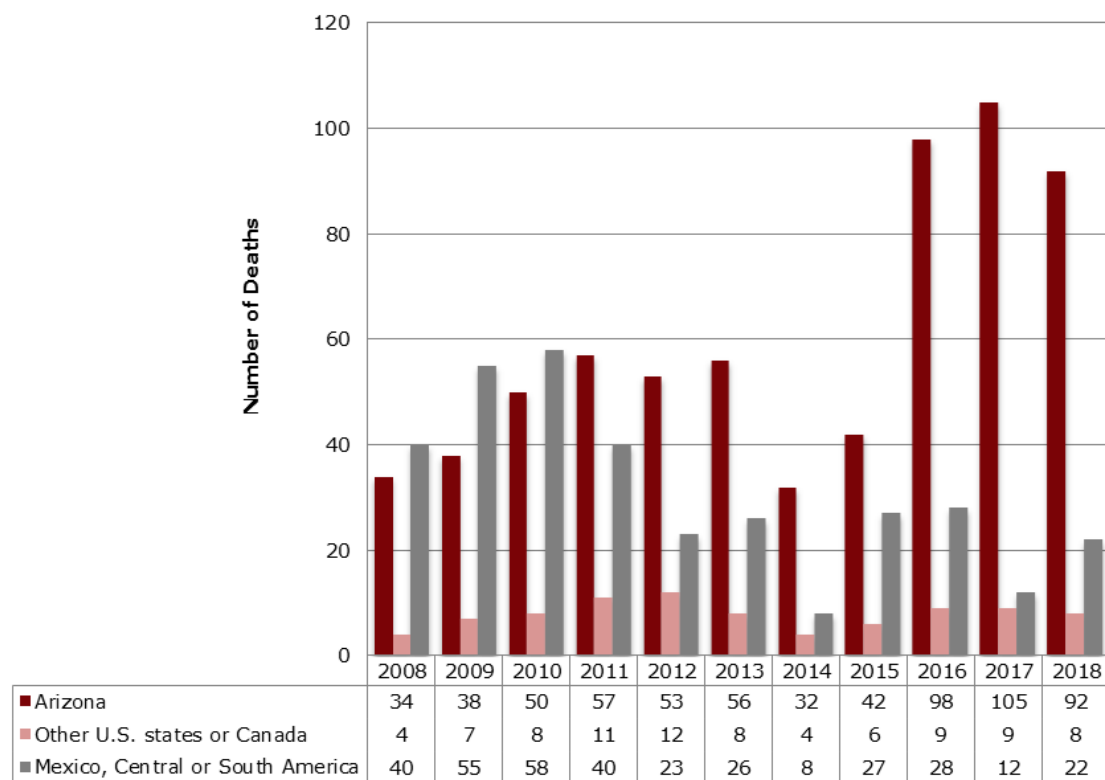
In the year period from 2008 to 2018 1,206 deaths related to exposure to excessive natural heat occurred in Arizona.

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 = 146 deaths in 2016). On average, 110 people died every year from a heatstroke or sunstroke between 2008-2018 (**Figure 1A, Table 1A**).

Approximately eight out of every ten deaths from exposure to excessive natural heat in 2008-2018 were males (925/1,206 or 76.7 percent, **Table 1A**), and 41.2 percent (497/1,206, **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, 2008-2018**



There were 657 deaths from exposure to excessive natural heat among the residents of Arizona (54.5 percent of the total), or 60 deaths on average per year in 2008-2018.

Migrants from Mexico, Central America or South America accounted for 28.1 percent of the total deaths from exposure to heat due to weather conditions during the 2008 to 2018 period.

Visitors to Arizona from other U.S. states or migrants from Canada experienced 86 deaths from exposure to excessive natural heat during the 2008-2018, 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 2018. 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.

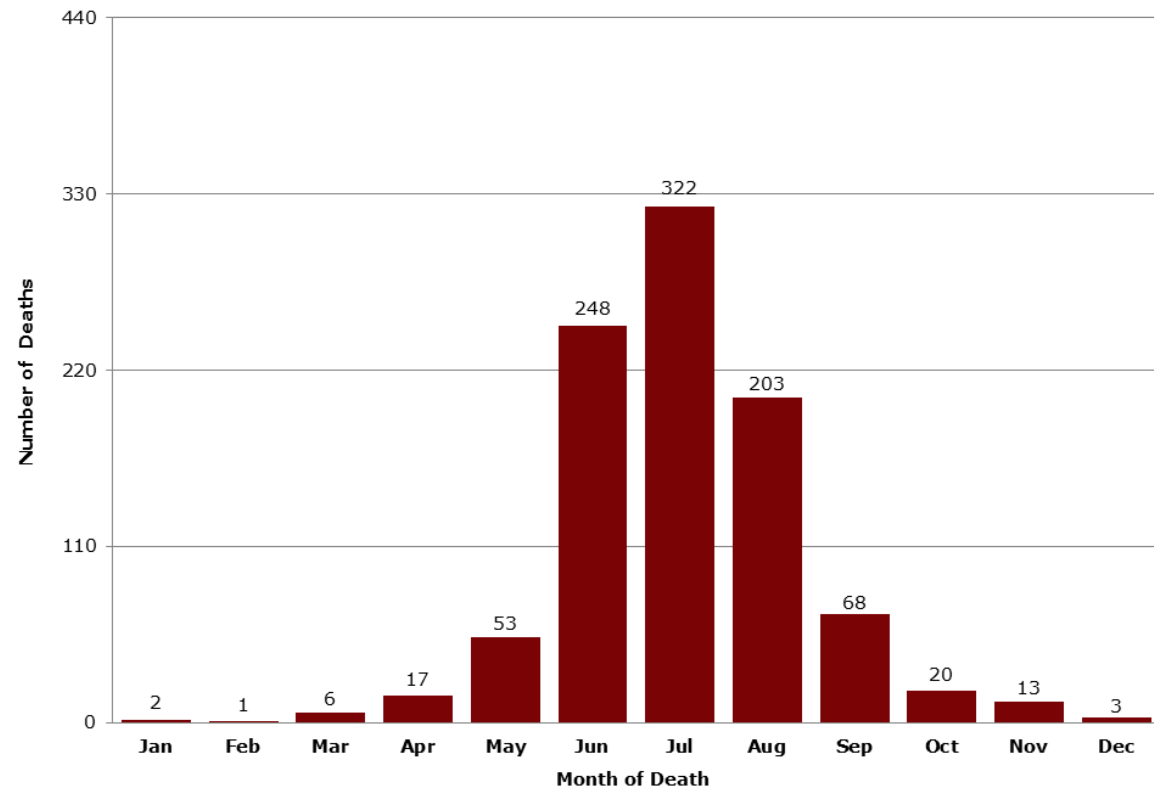
<sup>1</sup> [http://phoenix.about.com/cs/weather/a/weathertrivia\\_2.htm](http://phoenix.about.com/cs/weather/a/weathertrivia_2.htm)

**Figure 3A**  
**Deaths from Exposure to Excessive Natural Heat\* occurring in Arizona**  
**by Month, 2008-2018**

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  $100^{\circ}$  can be reached as early as March and continue through October.<sup>2</sup> Temperatures exceeding  $125^{\circ}$  F have been observed in the desert area.

The authors of "Impact of Excess Heat Events in Maricopa County, Arizona, 2000-2005"<sup>3</sup> rightly point out that in a desert environment such as Maricopa County where summer temperatures average  $98^{\circ}$  F –  $107^{\circ}$  F, a heat wave<sup>4</sup> 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 (322) in 2008-2018, followed by June (248), then August (203) September (68), and May (53). In 2008-2018, approximately seventy-four percent of all deaths from exposure to heat due to weather conditions occurred during the months of May through September.



<sup>2</sup> <http://www.wrcc.dri.edu/cgi-bin/cliicd.pl?az23183>

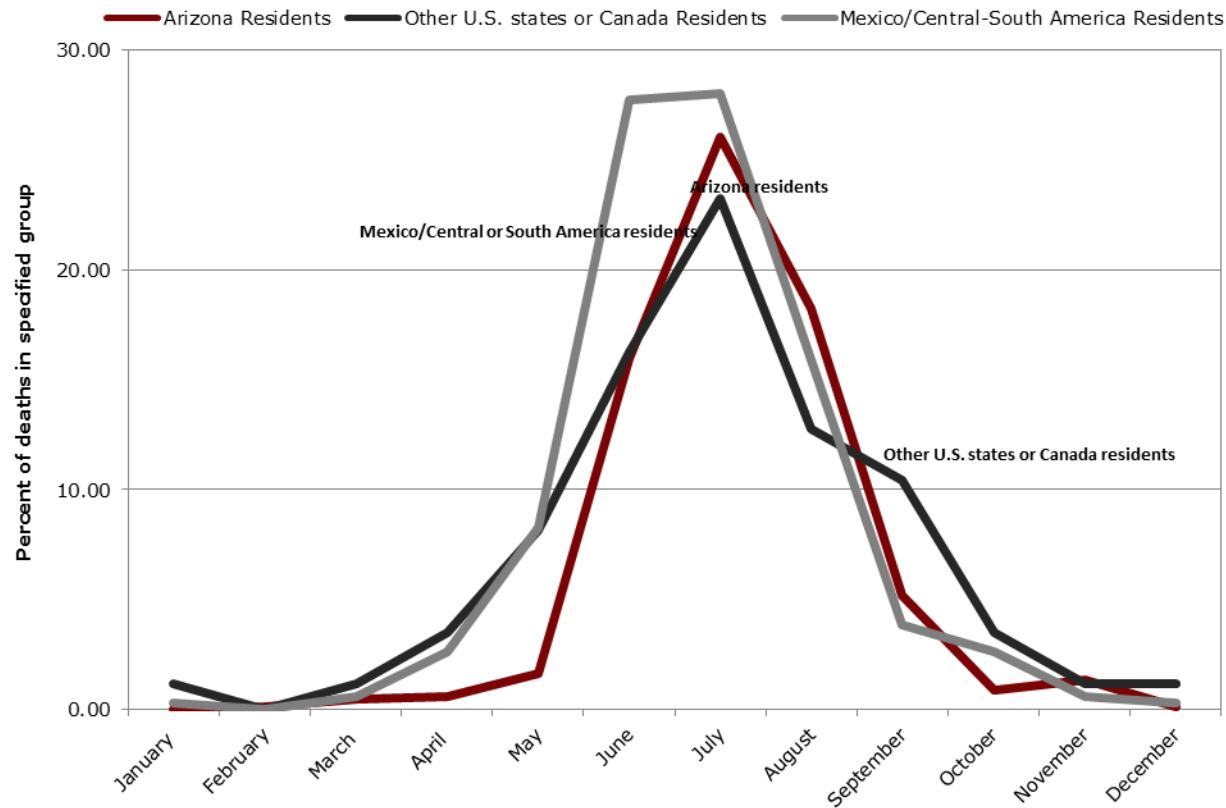
<sup>3</sup> Fuyuen Yip, W.D Flanders, A. Wolkin, D. Engelthaler, W. Humble, A. Neri, L. Lewis, L. Backer, C. Rubin. CDC: National Center for Environmental Health, Health Studies Branch, 2006

<sup>4</sup> 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, 2008-2018**



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 2008-2018 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**).

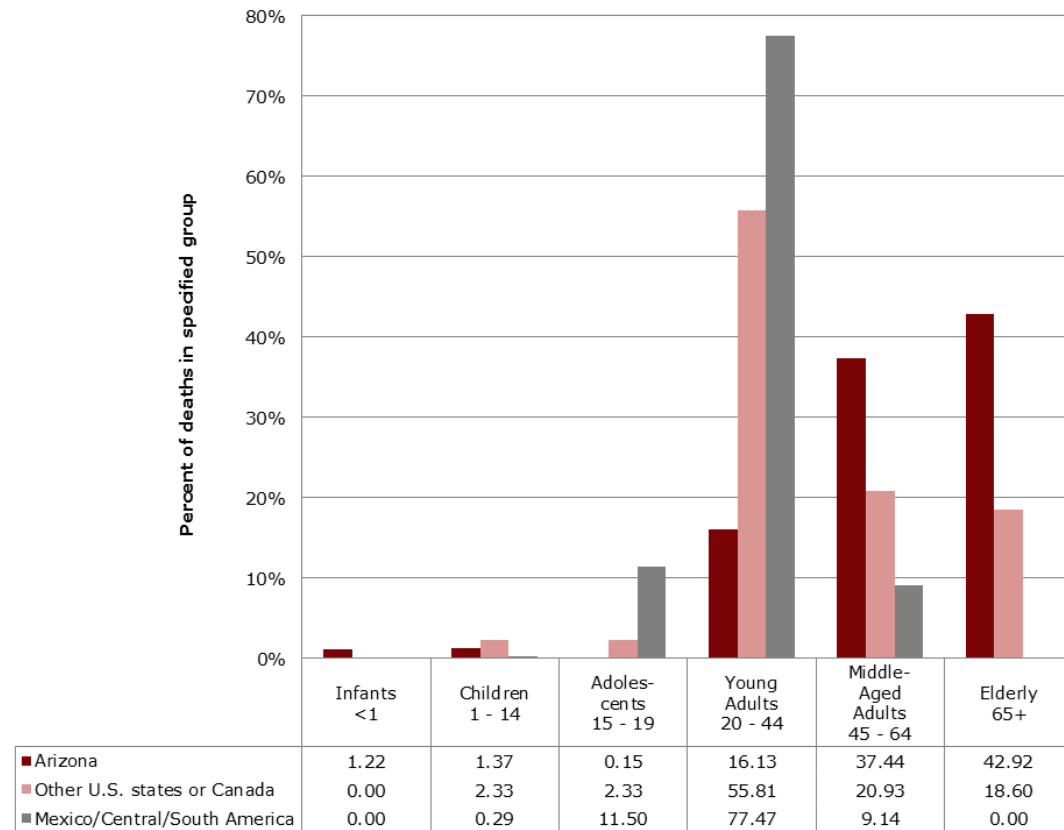
\* The underlying cause of death was classified as X30 by ICD-10.

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, 2008-2018**

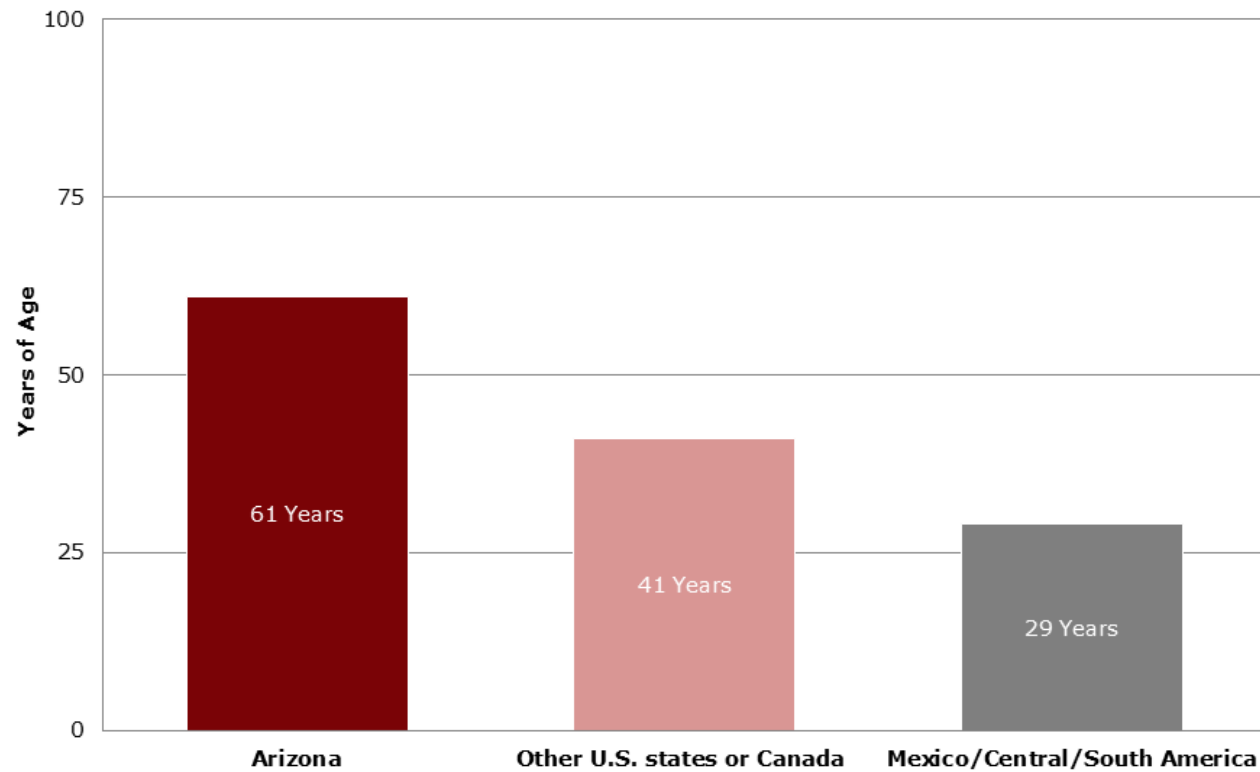
In 2008-2018, deaths from exposure to excessive natural heat among migrants to Arizona occurred at younger ages compared to deaths from natural heat among the State's residents (**Figure 5A**). In fact, young adults 20-44 years old during 2008-2018 accounted for 78.5 percent of deaths from exposure to 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 three 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, 2008-2018**



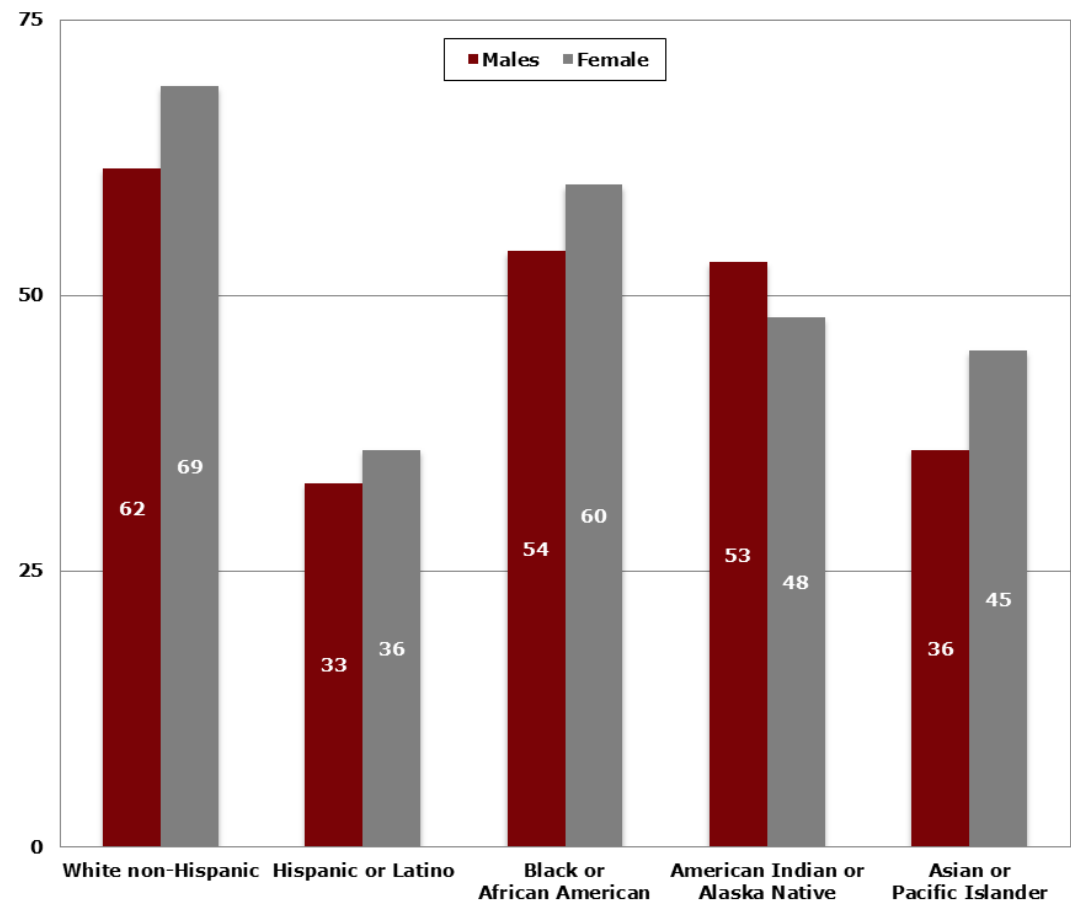
One out of two Arizonans who died from exposure to excessive natural heat in 2008-2018 was older than 61 years of age (**Figure 6A, Table 5A**).

In 2008-2018, compared to the residents of Arizona, on average visitors from other states were 20 years younger at the time of death. The median age of residents from Mexico, Central American or South American countries that died from exposure to excessive natural heat was 29 years of age, which was 32 years younger than the median age of deaths from residents of Arizona.

\* 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, 2008-2018**

In 2008-2018, White non-Hispanic females ranked highest with median age at death from exposure to excessive natural heat at 69 years, exceeding by 33.0 years the median age at death for Hispanic or Latino females (**Figure 7A, Table 6A**). White non-Hispanic males had the highest (62 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, 2008-2018**

		Total	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
<b>Total</b>		1,206	88	120	137	123	97	103	48	83	146	132	129
<b>State or Country of Residence</b>	Arizona	657	34	38	50	57	53	56	32	42	98	105	92
	Other U.S. states or Canada	90†	*	7	8	11	12	8	*	6	9	9	8
	Mexico, Central or South America	339	40	55	58	40	23	26	8	27	28	12	22
	Other	10†	*	0	*	*	*	*	0	*	*	0	0
	Unknown	110†	6	20	19	14	8	12	*	6	8	6	7
<b>Geographic Region of Occurrence<sup>a</sup></b>	Central	571	33	51	48	61	55	45	27	39	69	67	76
	Eastern	0	0	0	0	0	0	0	0	0	0	0	0
	Northern	110†	*	*	6	7	0	13	*	*	12	33	19
	Southern	519	50	64	81	55	41	45	18	39	60	32	34
	Western	10†	*	*	*	0	*	0	0	*	*	0	0
<b>County of Occurrence</b>	Apache	10†	*	0	0	*	0	*	0	0	0	0	*
	Cochise	10†	0	*	*	0	0	*	0	*	*	*	*
	Coconino	30†	0	*	*	*	0	*	*	*	0	8	*
	Gila	10†	0	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	492	26	43	40	54	50	35	21	32	64	59	68
	Mohave	70†	*	0	*	*	0	7	*	*	11	25	15
	Navajo	0†	*	0	0	0	0	0	0	0	*	0	0
	Pima	424	41	50	74	49	35	38	13	28	45	26	25
	Pinal	50†	7	6	6	6	*	*	*	*	*	*	*
	Santa Cruz	30†	6	9	*	*	0	*	*	*	*	0	*
	Yavapai	20†	0	*	*	0	*	*	*	*	*	*	*
	Yuma	50†	*	*	*	*	6	*	*	7	12	*	*
<b>Age Group</b>	0 - 4	10†	*	0	*	0	*	*	*	*	*	*	0
	5 - 9	0	0	0	0	0	0	0	0	0	0	0	0
	10 - 14	10†	0	*	*	0	0	0	0	*	*	0	*
	15 - 19	40†	9	7	7	*	*	*	*	*	*	*	*
	20 - 24	80†	9	10	15	8	*	13	*	7	8	*	*
	25 - 29	100†	8	14	14	12	7	*	6	8	11	9	7
	30 - 34	90†	9	11	8	14	7	*	0	*	11	10	12
	35 - 39	100†	*	13	13	12	10	7	*	10	11	7	10
	40 - 44	70†	8	8	10	10	8	*	*	*	7	*	6
	45 - 49	80†	7	8	10	9	12	11	0	6	*	7	7
	50 - 54	90†	9	10	11	8	*	8	*	*	10	13	9
	55 - 59	80†	*	*	*	6	7	6	*	9	18	11	7
	60 - 64	70†	*	*	*	10	7	*	*	*	13	8	12
	65 - 69	70†	*	6	*	*	*	*	*	7	7	12	15
	70 - 74	70†	*	0	*	*	7	*	*	7	9	12	17
	75 - 79	70†	*	6	6	6	7	*	*	*	11	13	10
	80 - 84	40†	*	*	*	*	*	6	*	*	*	10	6
	85+	60†	*	*	*	10	*	6	*	*	12	7	*
	Unknown	80†	*	14	19	7	*	12	*	*	*	*	0

**Table 1A (continued)**  
**Characteristics of Deaths from Exposure to Excessive Natural Heat Occurring in Arizona by Year, 2008-2018**

		<b>Total</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>	<b>2017</b>	<b>2018</b>
<b>Gender</b>	Male	925	68	97	111	97	74	83	32	65	103	91	104
	Female	280	20	22	26	26	23	20	16	18	43	41	25
	Unknown	0†	0	*	0	0	0	0	0	0	0	0	0
<b>Race/Ethnicity</b>	White non-Hispanic	581	32	43	59	53	46	48	28	44	81	77	70
	Hispanic or Latino	497	50	69	70	59	43	43	16	32	52	28	35
	Black or African American	40†	*	*	6	6	*	6	*	*	*	*	7
	American Indian or Alaska Native	60†	*	*	*	*	*	6	*	*	10	11	6
	Asian or Pacific Islander	10†	0	*	0	0	*	0	0	*	*	*	*
	Unknown	22	0	0	0	0	0	0	0	0	0	12	10
<b>Month of Death</b>	January	0†	0	0	0	*	0	0	0	0	0	0	0
	February	0†	*	0	0	0	0	0	0	0	0	0	0
	March	10†	*	*	0	*	0	*	0	0	*	0	0
	April	20†	*	*	*	*	*	*	*	*	*	0	0
	May	50†	*	12	8	*	9	9	*	*	*	0	0
	June	248	38	10	23	27	24	30	12	32	52	0	0
	July	322	24	53	71	30	28	39	17	9	51	0	0
	August	203	10	29	18	39	26	14	7	34	26	0	0
	September	70†	*	9	12	15	6	6	*	*	8	0	0
	October	20†	*	*	*	*	*	*	*	*	*	*	*
	November	10†	0	0	*	*	*	*	*	*	*	*	*
	December	0†	0	*	0	0	0	0	0	0	0	*	0
	Unknown	250	0	0	0	0	0	0	0	0	0	124	126
<b>Autopsy Performed</b>	No	328	16	24	19	36	34	27	12	18	37	63	42
	Yes	878	72	96	118	87	63	76	36	65	109	69	87
	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; <sup>a</sup> 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, 2008-2018**

		Total	State or Country of Residence				
			Arizona	Other U.S. states or Canada	Mexico, Central or South America	Other	Unknown
<b>Total</b>		1,206	657	90†	339	10†	110†
	2008	90†	34	*	40	*	6
	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
<b>Geographic Region of Occurrence<sup>a</sup></b>	Central	570†	470	27	40	*	29
	Eastern	0	0	0	0	0	0
	Northern	110†	81	21	*	*	0
	Southern	519	97	36	298	7	81
	Western	10†	9	*	0	0	0
<b>Age Group</b>	0 - 4	13	13	0	0	0	0
	5 - 9	0	0	0	0	0	0
	10 - 14	10†	*	*	*	0	0
	15 - 19	40†	*	*	39	0	*
	20 - 24	80†	10	*	66	*	*
	25 - 29	100†	21	*	68	*	*
	30 - 34	90†	19	14	51	*	*
	35 - 39	100†	35	13	48	*	*
	40 - 44	70	21	13	33	0	*
	45 - 49	80†	51	*	17	*	8
	50 - 54	90†	70	*	9	*	7
	55 - 59	80†	66	6	*	*	*
	60 - 64	70†	59	*	*	0	*
	65 - 69	68	60	7	0	0	*
	70 - 74	70†	61	*	0	*	*
	75 - 79	70†	67	*	0	0	0
	80 - 84	40†	38	*	0	*	0
	85+	56	56	0	0	0	0
	Unknown	80†	*	0	*	0	71

**Table 2A (continued)**  
**Characteristics of Arizona Deaths from Exposure to Excessive Natural Heat by Residence Status, 2008-2018**

		Total	State or Country of Residence				
			Arizona	Other U.S. states or Canada	Mexico, Central or South America	Other	Unknown
<b>Gender</b>	Male	925	461	66	291	11	96
	Female	280†	196	20	48	*	13
	Unknown	1	0	0	0	0	*
<b>Race/Ethnicity</b>	White non-Hispanic	580†	437	53	*	7	82
	Hispanic or Latino	500†	113	29	336	*	14
	Black or African American	40†	33	*	*	0	*
	American Indian or Alaska Native	60†	59	*	0	0	0
	Asian or Pacific Islander	10†	*	*	0	*	0
	Unknown	22	10	0	0	0	12
<b>Month of Death</b>	January	0†	0	*	*	0	0
	February	0†	*	0	0	0	0
	March	10†	*	*	*	0	0
	April	20†	*	*	9	0	*
	May	50†	11	7	28	*	*
	June	250†	105	14	94	*	30
	July	320†	171	20	95	*	33
	August	203	120	11	54	0	18
	September	70†	34	9	13	*	9
	October	20†	6	*	9	0	*
	November	10†	9	*	*	0	*
	December	0†	*	*	*	0	0
	Unknown	250	192	15	31	0	12
<b>Autopsy Performed</b>	No	330†	277	23	16	*	10
	Yes	878	380	63	323	12	100
	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; <sup>a</sup> 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, 2008-2018**

		Total	Geographic Region of Occurrence <sup>a</sup>			
			Central	Northern	Southern	Western
<b>Total</b>		1,206	571	110†	519	10†
	2008	90†	33	*	50	*
	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
<b>State or Country of Residence</b>	Arizona	657	470	81	97	9
	Other U.S. states or Canada	90†	27	21	36	*
	Mexico, Central or South America	340†	40	*	298	0
	Other	10†	*	*	7	0
	Unknown	110	29	0	81	0
<b>County of Occurrence</b>	Apache	10†	0	*	0	0
	Cochise	13	0	0	13	0
	Coconino	26	0	26	0	0
	Gila	6	6	0	0	0
	Graham	0†	*	0	0	0
	Greenlee	0	0	0	0	0
	La Paz	11	0	0	0	11
	Maricopa	492	492	0	0	0
	Mohave	72	0	72	0	0
	Navajo	0†	0	*	0	0
	Pima	424	0	0	424	0
	Pinal	52	52	0	0	0
	Santa Cruz	30	0	0	30	0
	Yavapai	20	20	0	0	0
	Yuma	52	0	0	52	0
<b>Age Group</b>	0 - 4	10†	9	*	*	0
	5 - 9	0	0	0	0	0
	10 - 14	10†	*	0	*	0
	15 - 19	40†	7	*	36	0
	20 - 24	80†	13	*	64	0
	25 - 29	100†	27	*	69	*
	30 - 34	90†	26	*	58	0
	35 - 39	101	34	6	61	0
	40 - 44	70†	28	*	36	*
	45 - 49	80†	51	*	27	0
	50 - 54	90	66	6	18	0
	55 - 59	80†	46	15	17	*
	60 - 64	70†	53	6	9	*
	65 - 69	70†	44	10	13	*
	70 - 74	70†	43	14	9	*
	75 - 79	70†	43	14	13	*
	80 - 84	40†	25	9	6	*
	85+	60†	43	*	8	*
	Unknown	78	8	0	70	0

**Table 3A (continued)**  
**Characteristics of Arizona Deaths from Exposure to Excessive Natural Heat by Region, 2008-2018**

		Total	Geographic Region of Occurrence			
			Central	Northern	Southern	Western
<b>Gender</b>	Male	925	418	73	427	7
	Female	280†	153	32	91	*
	Unknown	0†	0	0	*	0
<b>Race/Ethnicity</b>	White non-Hispanic	581	355	72	146	8
	Hispanic or Latino	497	131	9	357	0
	Black or African American	40†	35	0	*	0
	American Indian or Alaska Native	60†	30	20	8	*
	Asian or Pacific Islander	10†	6	*	0	0
	Unknown	20†	14	*	6	0
<b>Month of Death</b>	January	0†	*	0	*	0
	February	0†	0	*	0	0
	March	10†	*	*	*	0
	April	20†	6	*	9	0
	May	50†	11	*	40	*
	June	250†	100	*	140	*
	July	320†	155	25	139	*
	August	200†	102	10	88	*
	September	70†	37	*	25	*
	October	20	12	0	8	0
	November	10†	7	*	*	0
	December	0†	*	*	*	0
	Unknown	250	137	51	62	0
<b>Autopsy Performed</b>	No	328	169	79	73	7
	Yes	880†	402	26	446	*
	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; <sup>a</sup> 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, 2008-2018**

		Total	Geographic Region of Occurrence <sup>a</sup>			
			Central	Northern	Southern	Western
<b>State or Country of Residence</b>	Arizona	657	470	81	97	9
	Other U.S. states or Canada	90†	27	21	36	*
	Mexico, Central or South America	340†	40	*	298	0
	Other	10†	*	*	7	0
	Unknown	110	29	0	81	0
<b>Total</b>		1,206	570†	110†	519	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; <sup>a</sup> 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, 2008-2018**

		Geographic Region of Occurrence <sup>a</sup>			
		Central	Northern	Southern	Western
<b>State or Country of Residence</b>	Arizona	60	69	62	56
	Other U.S. states or Canada	41	48	37	71
	Mexico, Central or South America	29	24	29	0
	Other	50	38	33	0

Notes: <sup>a</sup> 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, 2008-2018**

Race/Ethnicity	Gender	Median Age at Death
<b>White non-Hispanic</b>	Male	62
	Female	69
	<b>Total</b>	<b>65</b>
<b>Hispanic or Latino</b>	Male	33
	Female	36
	<b>Total</b>	<b>34</b>
<b>Black or African American</b>	Male	54
	Female	60
	<b>Total</b>	<b>57</b>
<b>American Indian or Alaska Native</b>	Male	53
	Female	48
	<b>Total</b>	<b>52</b>
<b>Asian or Pacific Islander</b>	Male	36
	Female	45
	<b>Total</b>	<b>41</b>
<b>Unknown</b>	Male	63
	Female	55
	<b>Total</b>	<b>62</b>



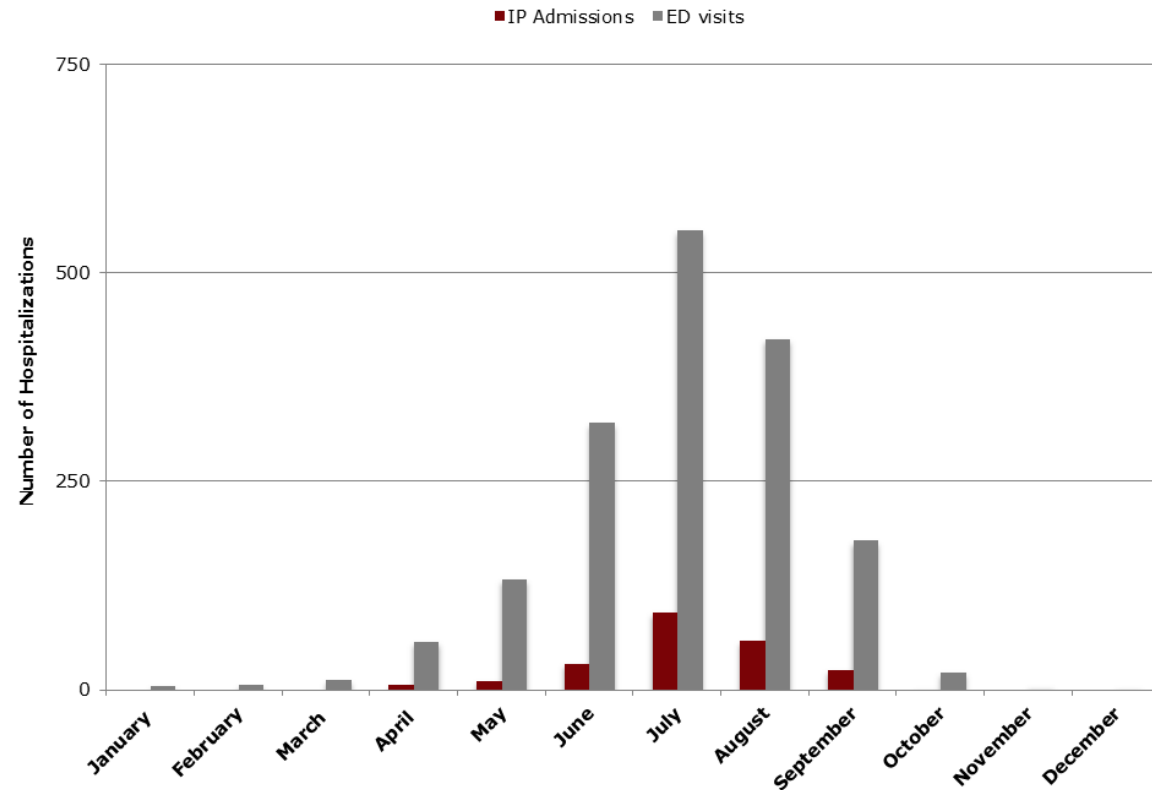
## Section B: Heat-Related Morbidity, 2018

**Figure 1B**  
**Hospitalizations from Exposure to Excessive Natural Heat**  
**occurring in Arizona by Month, 2018**

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.<sup>5</sup> The hot and arid climate during the summer months can increase the risk for getting a heat illness.

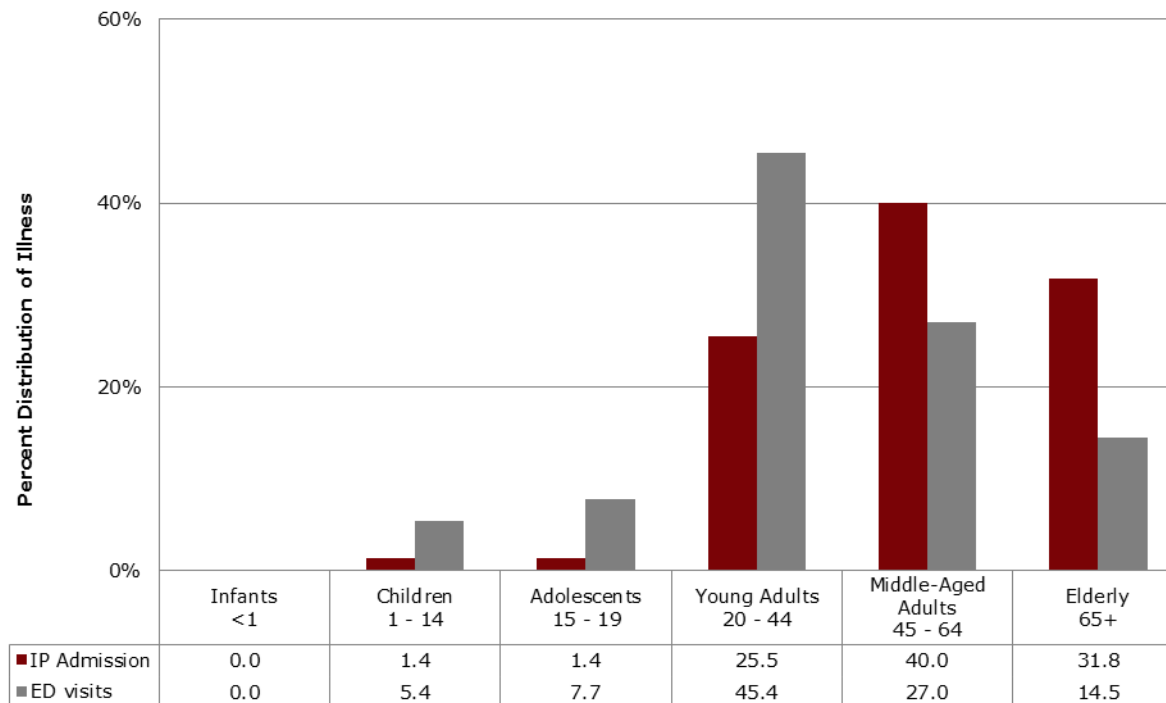
Not surprisingly, most illnesses from excessive natural heat occurred during late spring and summer (**Figure 1B, Table 1B**), with the highest number of heat illness emergency department (ED) visits and heat illness inpatient admissions occurring during the months of June, July, August, and September.

The warm season between June and September accounts for 92.7 percent of hospitalizations and 86.2 percent of the total ED visits from exposure to excessive natural heat.



<sup>5</sup> See [http://ral.ucar.edu/csap/events/climatehealth/2013/docs/s\\_harian\\_heat\\_mortality.pdf](http://ral.ucar.edu/csap/events/climatehealth/2013/docs/s_harian_heat_mortality.pdf)

**Figure 2B**  
**Percent Distribution of Illness from Exposure to Excessive Natural Heat**  
**occurring in Arizona by Age Group, 2018**

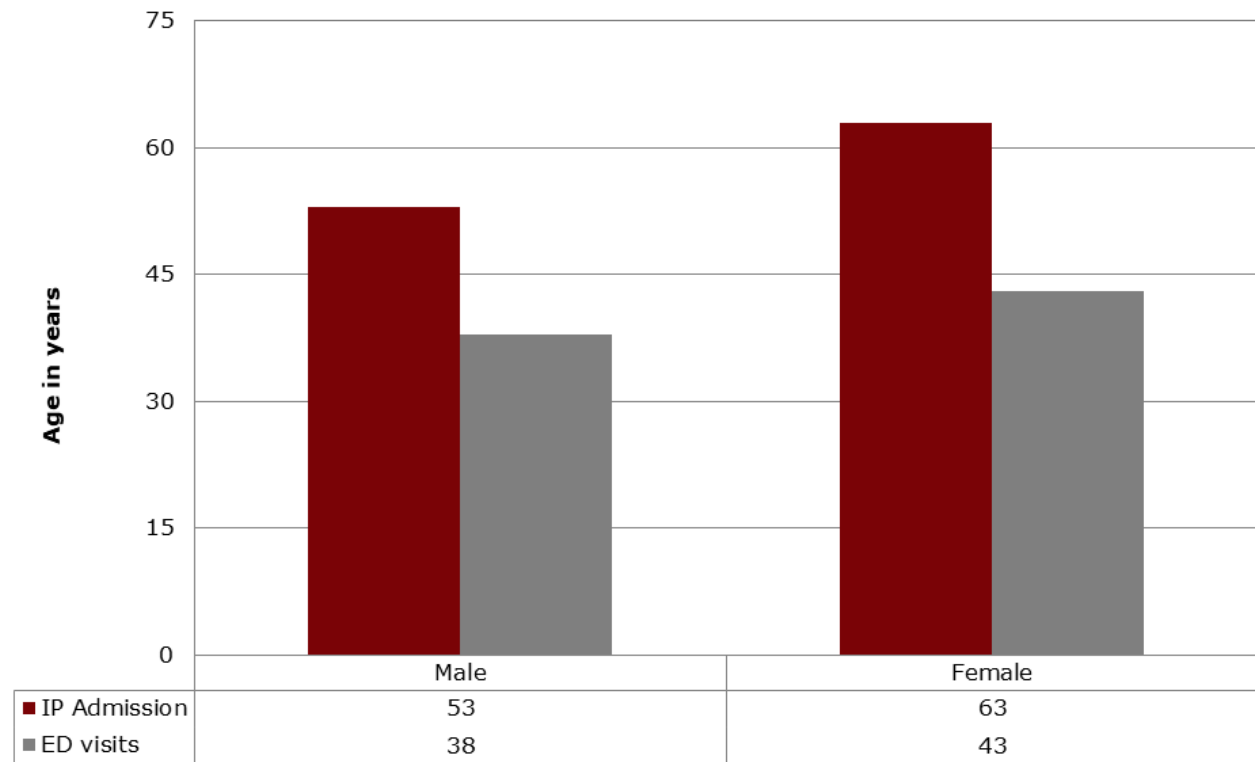


In 2018, illnesses (ED visits and IP admissions) from exposure to excessive natural heat occurred among all age groups except the infant group (<1 year old). Young adult residents of Arizona 20-44 years old accounted for 25.5 percent of IP admissions and 45.4 percent of heat illness ED visits. On the other hand, middle aged and elderly Arizona residents accounted for only 41.4 percent of heat illness ED visits for exposure to excessive natural heat, but represent 71.8 percent of IP admissions (**Figure 2B**).

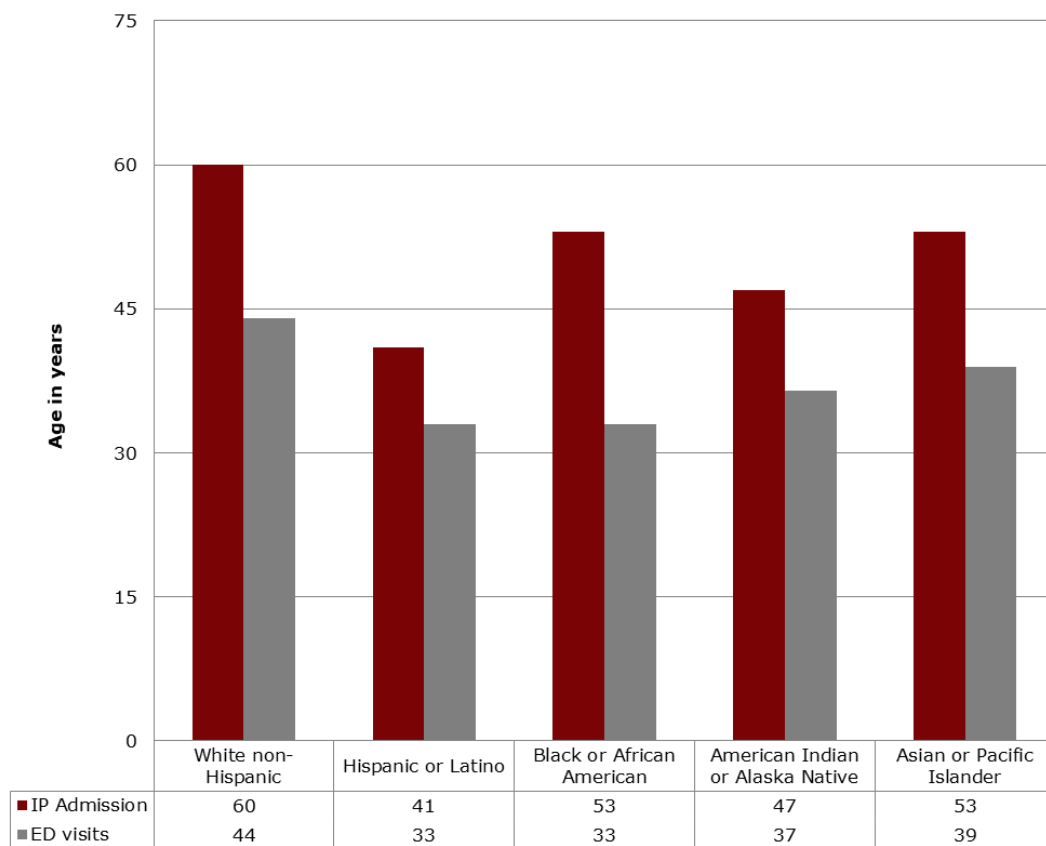
Nearly 5.4 percent of heat illness emergency department visits were from Arizona resident children ages 1-14 years old, but Arizona resident adolescents 15-19 years old accounted for 7.7 percent of the total.

**Figure 3B**  
**Median Age at Illness From Exposure to Excessive Natural Heat**  
**by Gender, 2018**

The median age at illness from exposure to excessive natural heat in 2018 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 5 years lower than the female median age at illness, but 10 years lower at time of admission for inpatient care. In 2018, 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, 2018**



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 White non-Hispanics, were substantially the greatest while Hispanic or Latinos had the youngest age at illness. The median age of White non-Hispanics visiting the emergency department for a heat illness was 44 years of age, the highest among all race/ethnic groups, the lowest being recorded among Hispanic or Latinos and Black or African American (33 years) followed by American Indian or Alaska Natives (37), Asian or Pacific Islanders (39).

**Table 1B**  
**Inpatient stays and ED visits from Exposure to Excessive Natural Heat by Region and Demographic Characteristics, 2018**

		Total	IP Admissions	ED Visits
<b>Total</b>		1,921	220	1,701
<b>Geographic Region of Occurrence<sup>a</sup></b>	Central	1,271	156	1,115
	Eastern	16	0	16
	Northern	134	10	124
	Southern	487	54	433
	Western	0	0	0
	Unknown	13	0	13
<b>County of Occurrence</b>	Apache	0†	0	*
	Cochise	19	0	19
	Coconino	19	0	19
	Gila	22	0	22
	Graham	6	0	6
	Greenlee	0	0	0
	La Paz	16	0	16
	Maricopa	1,087	148	939
	Mohave	107	10	97
	Navajo	6	0	6
	Pima	214	27	187
	Pinal	133	6	127
	Santa Cruz	0†	0	*
	Yavapai	20†	*	21
	Yuma	252	27	225
	Unknown	13	0	13
<b>Age Group</b>	0 - 4	10†	*	10
	5 - 9	21	0	21
	10 - 14	50†	*	53
	15 - 19	130†	*	131
	20 - 24	162	8	154
	25 - 29	167	12	155
	30 - 34	183	13	170
	35 - 39	168	10	158
	40 - 44	149	13	136
	45 - 49	161	23	138
	50 - 54	149	18	131
	55 - 59	134	24	110
	60 - 64	103	23	80
	65 - 69	73	11	62
	70 - 74	87	28	59
	75 - 79	68	12	56
	80 - 84	46	12	34
	85+	42	7	35
	Unknown	8	0	8

**Table 1B (continued)**  
**Inpatient stays and ED visits from Exposure to Excessive Natural Heat by Region and Demographic Characteristics, 2018**

		<b>Total</b>	<b>IP Admissions</b>	<b>ED Visits</b>
<b>Gender</b>	Male	1,333	158	1,175
	Female	588	62	526
<b>Race/Ethnicity</b>	White non-Hispanic	1,131	151	980
	Hispanic or Latino	523	34	489
	Black or African American	155	17	138
	American Indian or Alaska Native	72	12	60
	Asian or Pacific Islander	20†	*	17
	Unknown	20†	*	17
<b>Month of Occurrence</b>	January	0†	0	*
	February	10†	0	*
	March	11	0	11
	April	60†	*	57
	May	142	10	132
	June	350	31	319
	July	642	92	550
	August	478	58	420
	September	201	23	178
	October	20†	*	20
	November	0†	0	*
	December	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; <sup>a</sup> 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, 2018**

		Total	Geographic Region of Occurrence <sup>a</sup>										
			IP Admissions					ED Visits					
			Central	Eastern	Northern	Southern	Western	Central	Eastern	Northern	Southern	Western	Un-known
Total		1,921	160†	0	10	54	0	1,115	16	120†	430†	0	13
County of Occurrence	Apache	0†	0	0	0	0	0	0	0	*	0	0	0
	Cochise	19	0	0	0	0	0	0	0	0	19	0	0
	Coconino	19	0	0	0	0	0	0	0	19	0	0	0
	Gila	22	0	0	0	0	0	22	0	0	0	0	0
	Graham	6	0	0	0	0	0	6	0	0	0	0	0
	Greenlee	0	0	0	0	0	0	0	0	0	0	0	0
	La Paz	16	0	0	0	0	0	0	16	0	0	0	0
	Maricopa	1,087	148	0	0	0	0	939	0	0	0	0	0
	Mohave	107	0	0	10	0	0	0	0	97	0	0	0
	Navajo	6	0	0	0	0	0	0	0	6	0	0	0
	Pima	214	0	0	0	27	0	0	0	0	187	0	0
	Pinal	133	6	0	0	0	0	127	0	0	0	0	0
	Santa Cruz	0†	0	0	0	0	0	0	0	0	*	0	0
	Yavapai	20†	*	0	0	0	0	21	0	0	0	0	0
Yuma	252	0	0	0	27	0	0	0	0	225	0	0	
Unknown		13	0	0	0	0	0	0	0	0	0	0	13
Age Group	0 - 4	10†	*	0	0	*	0	6	0	*	*	0	0
	5 - 9	20†	0	0	0	0	0	13	*	*	*	0	0
	10 - 14	50†	0	0	0	*	0	34	0	*	16	0	0
	15 - 19	130†	*	0	*	0	0	91	0	7	31	0	*
	20 - 24	160†	7	0	0	*	0	100	*	8	44	0	0
	25 - 29	170†	8	0	0	*	0	106	0	15	34	0	0
	30 - 34	180†	9	0	0	*	0	112	0	12	43	0	*
	35 - 39	170†	9	0	0	*	0	106	*	9	40	0	*
	40 - 44	150†	11	0	*	*	0	101	*	8	25	0	*
	45 - 49	160†	20	0	0	*	0	93	*	6	38	0	0
	50 - 54	150†	14	0	0	*	0	77	*	10	38	0	*
	55 - 59	130†	11	0	*	12	0	78	*	*	24	0	*
	60 - 64	100†	19	0	*	*	0	49	0	8	22	0	*
	65 - 69	70†	7	0	0	*	0	39	*	6	15	0	*
	70 - 74	90†	17	0	*	8	0	39	0	6	14	0	0
	75 - 79	70†	8	0	*	*	0	31	*	7	16	0	0
	80 - 84	50†	8	0	*	*	0	21	0	*	9	0	0
	85+	40†	*	0	0	*	0	13	0	*	16	0	*
Unknown		10†	0	0	0	0	0	6	0	0	*	0	0

**Table 2B (continued)**  
**Inpatient stays and ED visits from Exposure to Excessive Natural Heat by Region and Demographic Characteristics, 2018**

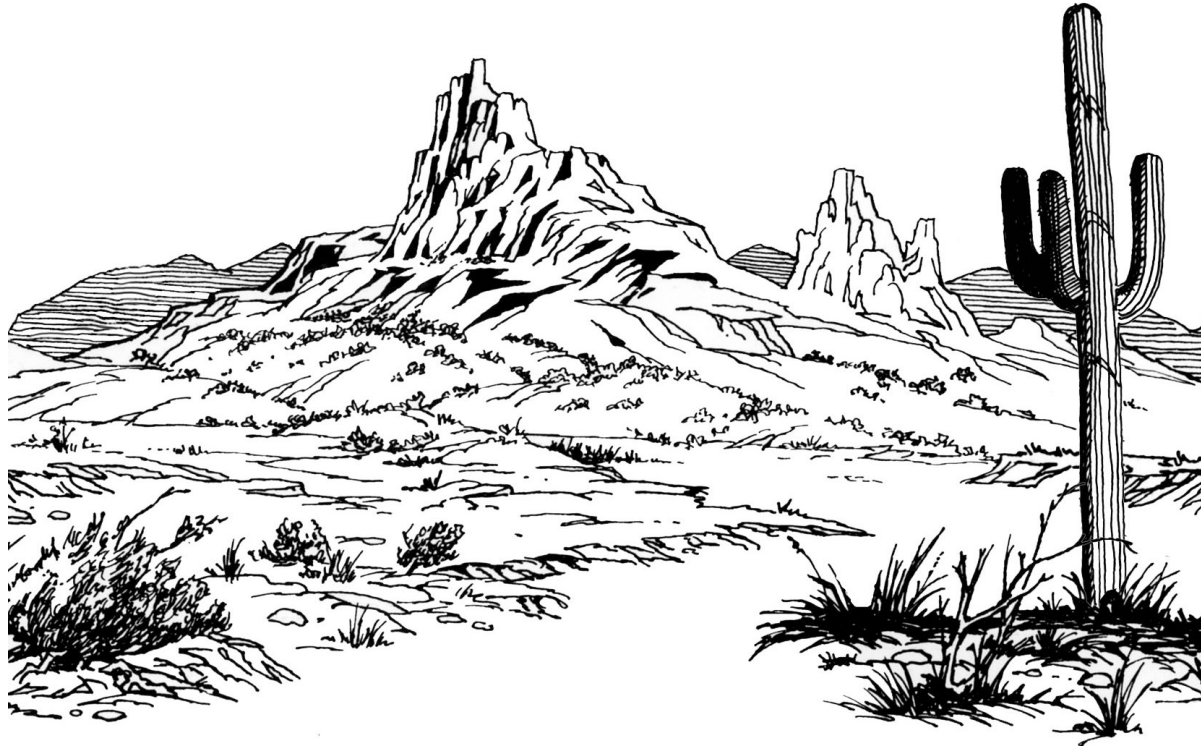
		Total	Geographic Region of Occurrence <sup>a</sup>										
			IP Admissions					ED Visits					
			Central	Eastern	Northern	Southern	Western	Central	Eastern	Northern	Southern	Western	Un-known
Gender	Male	1,333	106	0	7	45	0	772	9	77	309	8	0
	Female	590†	50	0	*	9	0	343	7	47	124	*	0
Race/ Ethnicity	White non-Hispanic	1,130†	104	0	9	38	0	656	*	98	213	9	0
	Hispanic or Latino	520†	26	0	*	7	0	286	9	12	178	*	0
	Black or African American	160†	13	0	0	*	0	111	*	*	25	0	0
	American Indian or Alaska Native	70†	8	0	0	*	0	40	*	11	7	0	0
	Asian or Pacific Islander	20†	*	0	0	0	0	13	0	*	*	0	0
	Unknown	20†	*	0	0	*	0	9	0	*	7	0	0
Month of Illness	January	0†	0	0	0	0	0	*	0	0	*	0	0
	February	10†	0	0	0	0	0	*	0	0	*	0	0
	March	10†	0	0	0	0	0	7	0	0	*	0	0
	April	60†	*	0	0	*	0	37	*	0	19	0	0
	May	140†	6	0	*	*	0	86	*	6	39	0	0
	June	350†	23	0	*	7	0	214	*	22	79	*	0
	July	640†	70	0	*	20	0	363	*	42	136	*	0
	August	480†	36	0	*	19	0	262	7	39	108	*	0
	September	200†	18	0	*	*	0	128	0	14	34	*	0
	October	20†	0	0	0	*	0	10	0	*	8	*	0
	November	0†	0	0	0	0	0	*	0	0	*	0	0
	December	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; <sup>a</sup> 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, 2018**

Race/Ethnicity	Gender	Median Age at Death	
		IP Admissions	ED Visits
White non-Hispanic	Male	56	42
	Female	67	49
	<b>Total</b>	<b>60</b>	<b>44</b>
Hispanic or Latino	Male	34	33
	Female	64	32
	<b>Total</b>	<b>41</b>	<b>33</b>
Black or African American	Male	54	33
	Female	47	32
	<b>Total</b>	<b>53</b>	<b>33</b>
American Indian or Alaska Native	Male	47	36
	Female	55	39
	<b>Total</b>	<b>47</b>	<b>37</b>
Asian or Pacific Islander	Male	53	39
	Female	0	39
	<b>Total</b>	<b>53</b>	<b>39</b>
Refused/Unknown	Male	58	47
	Female	0	48
	<b>Total</b>	<b>58</b>	<b>48</b>

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**