Mortality and Morbidity From Exposure to Excessive Natural Heat in Arizona, 2006-2016

ARIZONA DEPARTMENT
OF HEALTH SERVICES

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MORTALITY AND MORBIDITY FROM EXPOSURE TO EXCESSIVE NATURAL HEAT IN ARIZONA, 2006-2016

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Purpose

The purpose of this report is to provide information on trends in deaths from exposure to heat due to weather conditions occurring in Arizona, 2006-2016 and heat illness cases during 2016 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 2006 to 2016, there were 1,193 deaths from exposure to heat due to weather conditions occurred in Arizona.

√ The annual number of deaths due to this cause decreased from 137 in 2006 to 88 in 2008, followed by a period of increase of 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 .

√ There were 557 deaths from exposure to excessive natural heat among the residents of Arizona (46.7 percent of the total), or 51 deaths on average per year in 2006-2016.

√ Visitors to Arizona from other U.S. states, Canada or Europe experienced around 80 deaths from exposure to heat due to weather conditions in 2006-2016.

√ The state or country of residence of about 120 decedents in 2006-2016 remains unidentified.

√ Approximately eight out of every ten deaths from exposure to excessive natural heat in 2006-2016 were males, and 48.3 percent were Hispanic or Latino.

√ In 2006-2016, ninety-five percent of all deaths from exposure to heat due to weather conditions occurred during the five months from May through September.

√ In 2006-2016, 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 66 percent of deaths from exposure to excessive natural heat among the migrants from Mexico and other Central/South American countries.

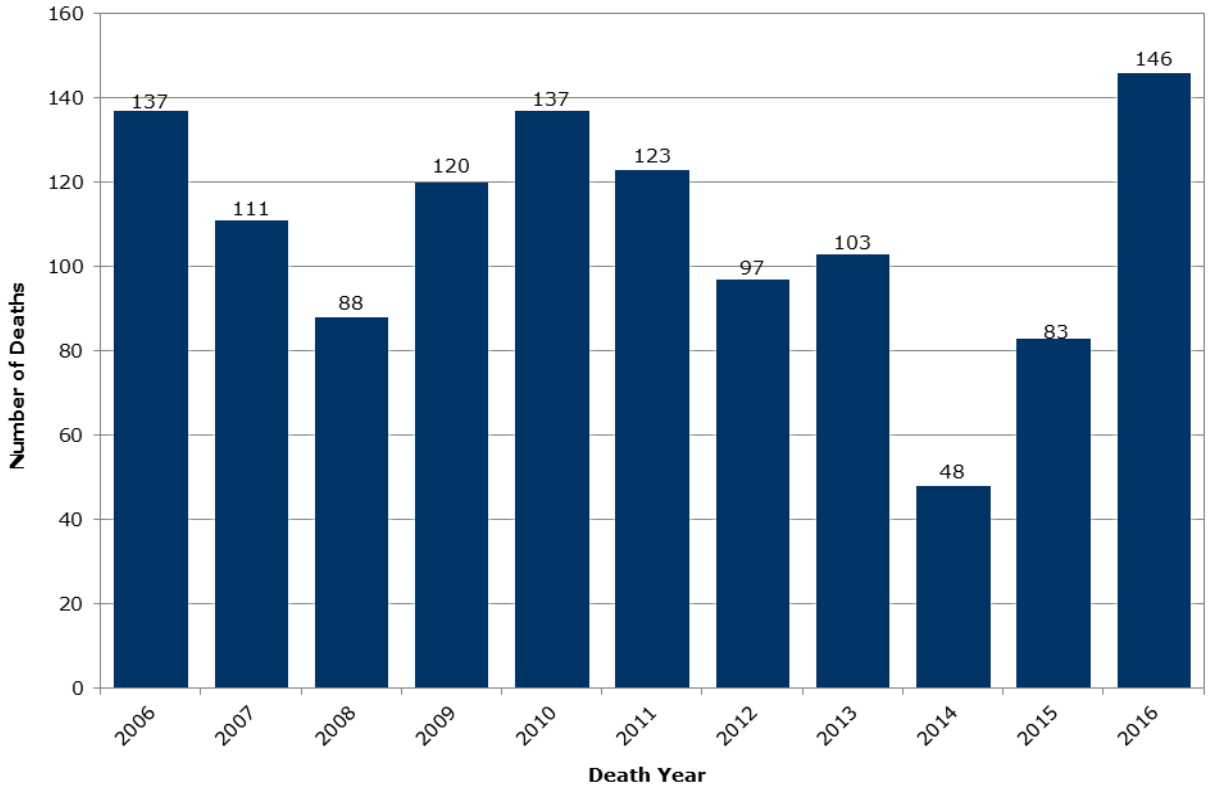
√ In contrast, older adults 65 years or older have been at the highest risk of heatstroke or sunstroke among the age groups of Arizona residents. Approximately 38.6 percent of fatalities due to exposure to heat among Arizona residents were this old, while there were no deaths from natural heat recorded among migrants aged 65 years and older.

√ In 2006-2016, the four counties along the southern border of Arizona (Cochise, Pima, Santa Cruz, and Yuma) accounted for 49.6 percent of deaths from excessive heat. Individually, Pima county (40.0 percent) and Maricopa county (37.55 percent) accounted for most of the deaths due to exposure to natural heat.

√ Residents from Mexico, Central or South America (88.3 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 (80.4 percent) .

Section A: Heat-Related Mortality, 2006-2016

Figure 1A
Deaths from Exposure to Excessive Natural Heat* occurring in Arizona by Year, 2006-2016



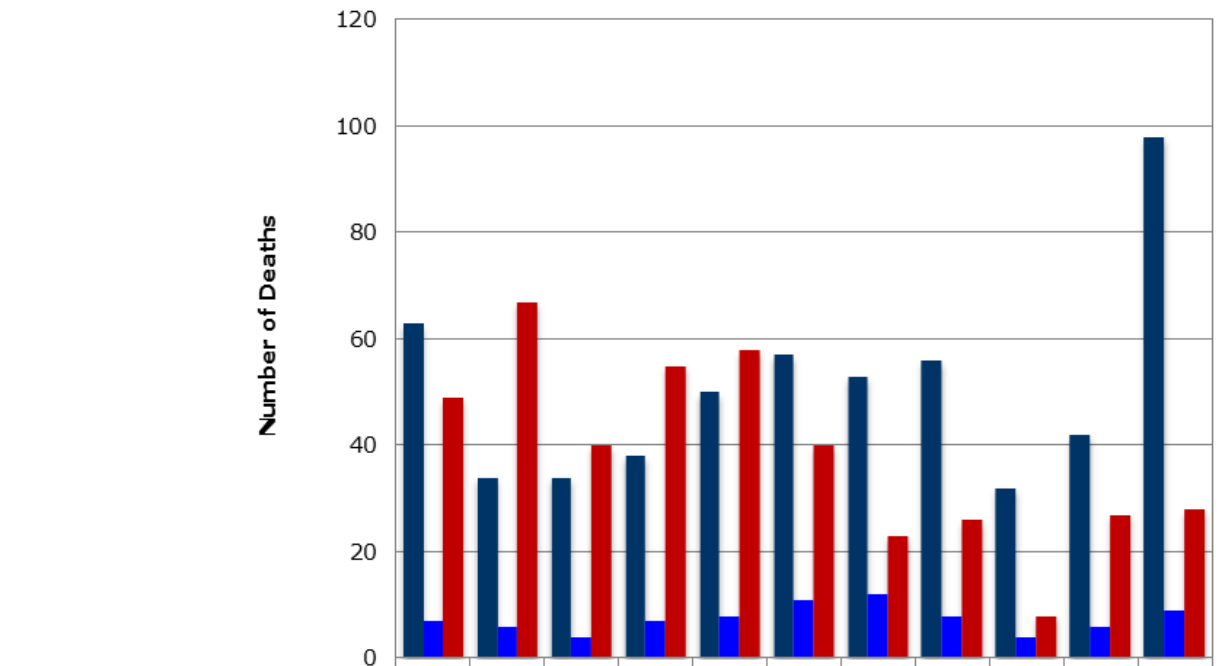
In the year period from 2006 to 2016 1,193 deaths related to exposure to excessive natural heat occurred in Arizona.

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, 108 people died every year from a heatstroke or sunstroke between 2006-2016 (**Figure 1A, Table 1A**).

Approximately seven out of every ten deaths from exposure to excessive natural heat in 2006-2016 were males (910/1,193 or 76.3 percent, **Table 1A**), and 48.3 percent (576/1,193, **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, 2006-2016



	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Arizona	63	34	34	38	50	57	53	56	32	42	98
Other U.S. states or Canada	7	6	4	7	8	11	12	8	4	6	9
Mexico, Central or South America	49	67	40	55	58	40	23	26	8	27	28

* 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.

There were 557 deaths from exposure to excessive natural heat among the residents of Arizona (46.7 percent of the total), or 51 deaths on average per year in 2006-2016.

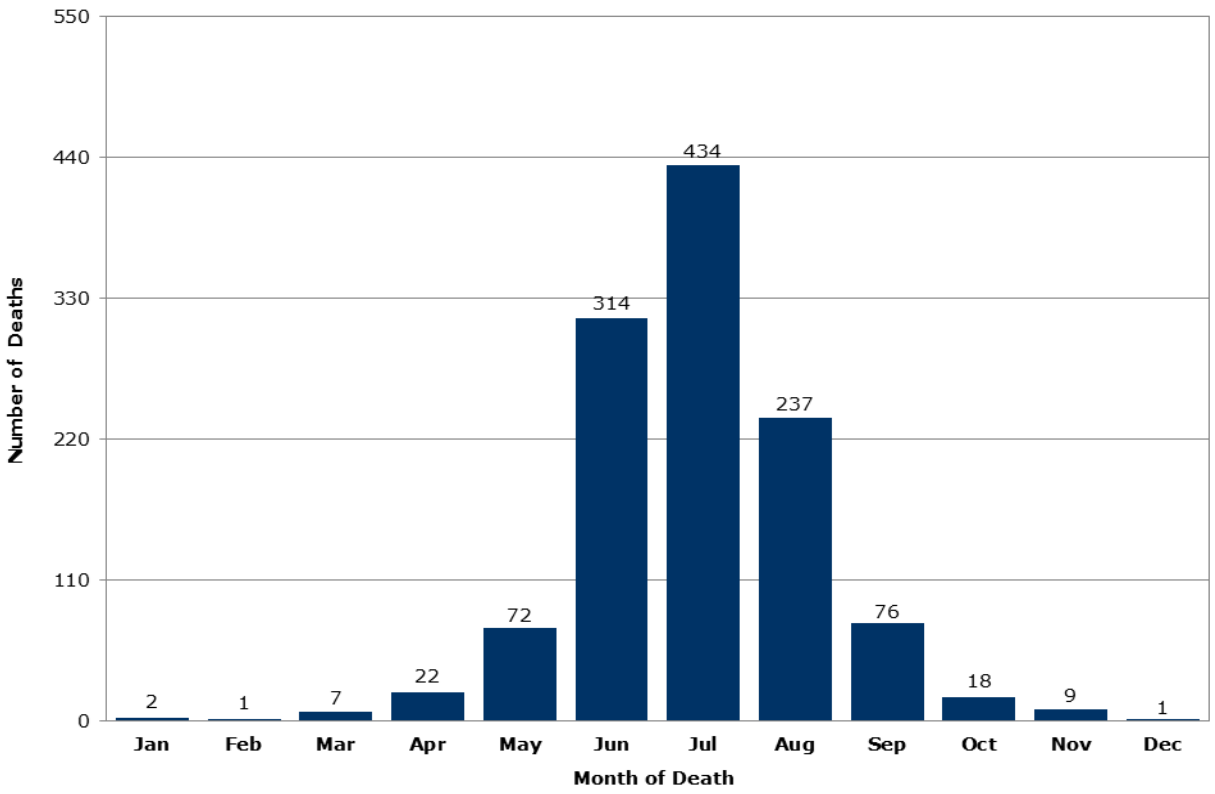
Migrants from Mexico, Central America or South America accounted for 35.3 percent of the total deaths from exposure to heat due to weather conditions during the 2006 to 2016 period.

Visitors to Arizona from other U.S. states or migrants from Canada experienced 82 deaths from exposure to excessive natural heat during the 2006-2016, 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 were highest for both Arizona residents and migrants from Mexico, Central American, and South American countries during 2006, however, the highest reported temperatures for the Greater Phoenix area during this period were in 2006 and 2010, both reporting temperatures of 118 degrees Fahrenheit[1]. No significant climate changes were reported which might explain the number of deaths in Arizona from natural heat.

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, 2006-2016



* 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.

In Phoenix, Arizona, normal daily maximum temperature reaches ≥100^0 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 100^0 can be reached as early as March and continue through October.[2] Temperatures exceeding 125^0 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 wave[4] is a summer-long experience.

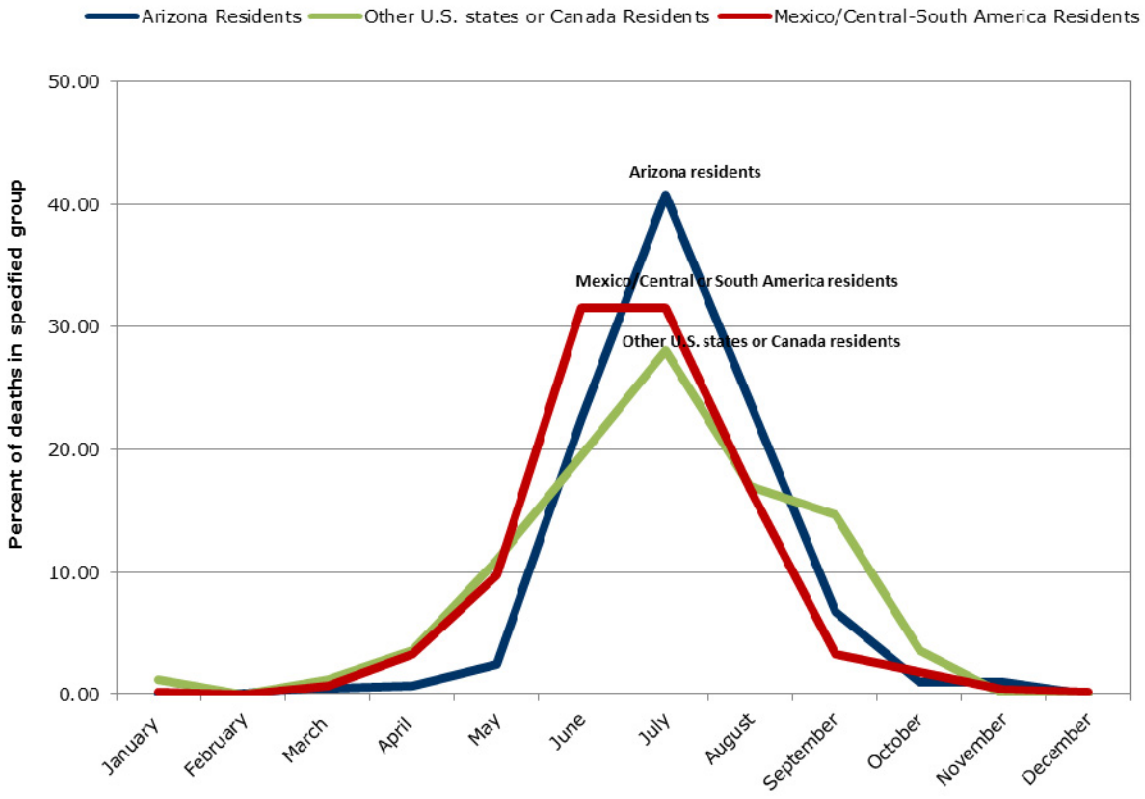
Not surprisingly, most deaths from excessive natural heat occurred during summer and late spring (**Figure 3A**, **Table 2A**, **Table 3A**), with the highest number of deaths occurring during the month of July (434) in 2006-2016, followed by June (314), then August (237) September (76), and May (72). In 2006-2016, approximately ninety-five percent of all deaths from exposure to heat due to weather conditions occurred during the five months from May through September.

2 http://www.wrcc.dri.edu/cgi-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 >90o F

Figure 4A
**Percent Distribution of Deaths from Exposure to Excessive Natural Heat*
occurring in Arizona by Month and Residence Status, 2006-2016**



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 2006-2016 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**).

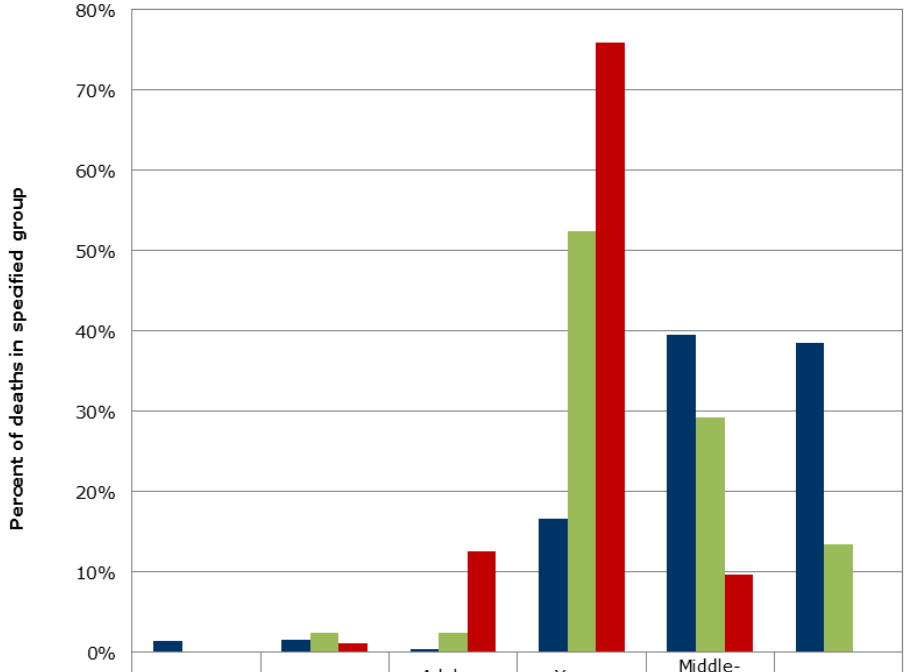
* The underlying cause of death was classified as X30 by ICD-10.

Deaths from other or unknown county of residents are not represented in the graph.

In 2006-2016, 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 2006-2016 accounted for 76.0 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. Thirty eight 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.

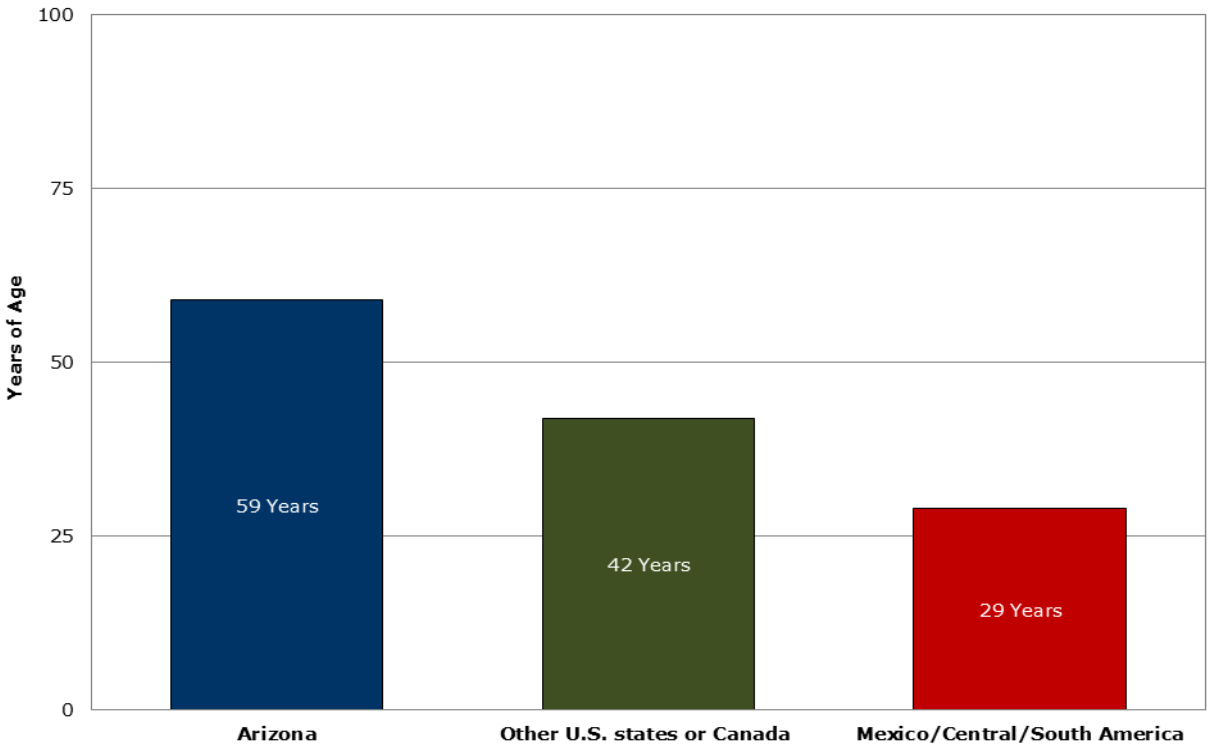
Figure 5A
Percent Distribution of Deaths from Exposure to Excessive Natural Heat* occurring in Arizona by Age Group and Residence Status, 2006-2016



	Infants <1	Children 1 - 14	Adoles-cents 15 - 19	Young Adults 20 - 44	Middle-Aged Adults 45 - 64	Elderly 65+
Arizona	1.44	1.62	0.36	16.70	39.50	38.60
Other U.S. states or Canada	0.00	2.44	2.44	52.44	29.27	13.41
Mexico/Central/South America	0.00	1.19	12.59	76.01	9.74	0.00

* 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, 2006-2016**

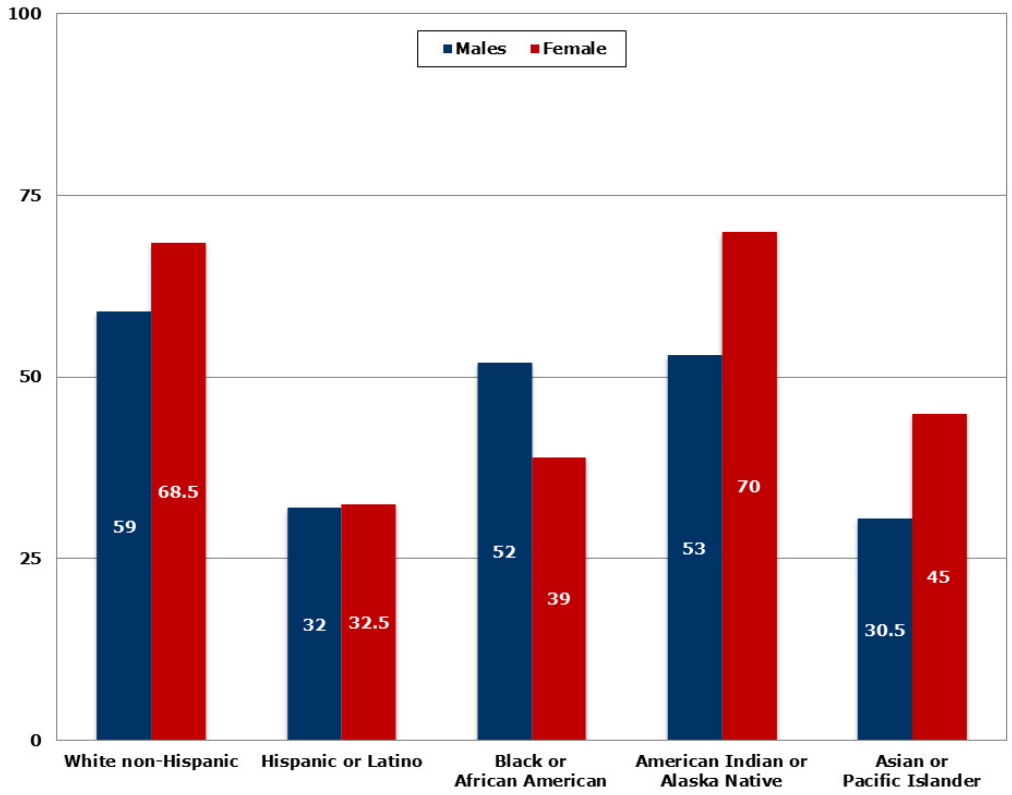


One out of two Arizonans who died from exposure to excessive natural heat in 2006-2016 was older than 59 years of age (**Figure 6A**, **Table 5A**).

In 2006-2016, compared to the residents of Arizona, on average visitors from other states were 17 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 30 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, 2006-2016



In 2006-2016, White non-Hispanic females ranked highest with median age at death from exposure to excessive natural heat at 68.5 years, exceeding by 36.0 years the median age at death for Hispanic or Latino females (**Figure 7A, Table 6A**). White non-Hispanic males had the highest (59.0 years), and Hispanic males had the lowest (32 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, 2006-2016

		Total	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Total		1,193	137	111	88	120	137	123	97	103	48	83	146
State or Country of Residence	Arizona	557	63	34	34	38	50	57	53	56	32	42	98
	Other U.S. states or Canada	80†	7	6	*	7	8	11	12	8	*	6	9
	Mexico, Central or South America	421	49	67	40	55	58	40	23	26	8	27	28
	Other	20†	0	*	*	0	*	*	*	*	0	*	*
	Unknown	120†	18	*	6	20	19	14	8	12	*	6	8
Geographic Region of Occurrence[a]	Central	525	58	39	33	51	48	61	55	45	27	39	69
	Eastern	0	0	0	0	0	0	0	0	0	0	0	0
	Northern	60†	*	*	*	*	6	7	0	13	*	*	12
	Southern	592	72	67	50	64	81	55	41	45	18	39	60
	Western	20†	*	*	*	*	*	0	*	0	0	*	*
County of Occurrence	Apache	10†	*	0	*	0	0	*	0	*	0	0	0
	Cochise	10†	*	0	0	*	*	0	0	*	0	*	*
	Coconino	20†	0	*	0	*	*	*	0	*	*	*	0
	Gila	0†	0	0	0	0	0	*	0	*	0	0	*
	Graham	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	20†	*	*	*	*	*	0	*	0	0	*	*
	Maricopa	448	53	30	26	43	40	54	50	35	21	32	64
	Mohave	30†	*	*	*	0	*	*	0	7	*	*	11
	Navajo	0†	*	*	*	0	0	0	0	0	0	0	*
	Pima	477	50	54	41	50	74	49	35	38	13	28	45
	Pinal	50†	*	8	7	6	6	6	*	*	*	*	*
	Santa Cruz	50†	7	10	6	9	*	*	0	*	*	*	*
	Yavapai	20†	*	0	0	*	*	0	*	*	*	*	*
	Yuma	60†	14	*	*	*	*	*	6	*	*	7	12
Age Group	0 - 4	10†	*	*	*	0	*	0	*	*	*	*	*
	5 - 9	0	0	0	0	0	0	0	0	0	0	0	0
	10 - 14	10†	*	*	0	*	*	0	0	0	0	*	*
	15 - 19	60†	8	9	9	7	7	*	*	*	*	*	*
	20 - 24	90†	10	7	9	10	15	8	*	13	*	7	8
	25 - 29	110†	9	16	8	14	14	12	7	*	6	8	11
	30 - 34	90†	12	15	9	11	8	14	7	*	0	*	11
	35 - 39	110†	12	9	*	13	13	12	10	7	*	10	11
	40 - 44	90†	11	14	8	8	10	10	8	*	*	*	7
	45 - 49	80†	13	*	7	8	10	9	12	11	0	6	*

Table 1A (continued)
Characteristics of Deaths from Exposure to Excessive Natural Heat Occurring in Arizona by Year, 2006-2016

		Total	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Age Group (continued)	50 - 54	90†	12	10	9	10	11	8	*	8	*	*	10
	55 - 59	80†	10	*	*	*	*	6	7	6	*	9	18
	60 - 64	60†	10	*	*	*	*	10	7	*	*	*	13
	65 - 69	50†	*	*	*	6	*	*	*	*	*	7	7
	70 - 74	40†	*	0	*	0	*	*	7	*	*	7	9
	75 - 79	60†	*	*	*	6	6	6	7	*	*	*	11
	80 - 84	30†	*	*	*	*	*	*	*	6	*	*	*
	85+	50†	*	*	*	*	*	10	*	6	*	*	12
	Unknown	90†	7	*	*	14	19	7	*	12	*	*	*
Gender	Male	910	104	76	68	97	111	97	74	83	32	65	103
	Female	282	33	35	20	22	26	26	23	20	16	18	43
	Unknown	0†	0	0	0	*	0	0	0	0	0	0	0
Race/Ethnicity	White non-Hispanic	528	58	36	32	43	59	53	46	48	28	44	81
	Hispanic or Latino	576	70	72	50	69	70	59	43	43	16	32	52
	Black or African American	10†	0	0	0	0	0	0	0	0	*	*	*
	American Indian or Alaska Native	20†	0	0	0	0	0	0	0	0	*	*	10
	Asian or Pacific Islander	0†	0	0	0	0	0	0	0	0	0	*	*
	Unknown	70†	9	*	6	8	8	11	8	12	0	0	0
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
	March	10†	*	0	*	*	0	*	0	*	0	0	*
	April	20†	*	*	*	*	*	*	*	*	*	*	*
	May	70†	10	9	*	12	8	*	9	9	*	*	*
	June	314	35	31	38	10	23	27	24	30	12	32	52
	July	434	77	35	24	53	71	30	28	39	17	9	51
	August	237	11	23	10	29	18	39	26	14	7	34	26
	September	80†	*	7	*	9	12	15	6	6	*	*	8
	October	20†	0	*	*	*	*	*	*	*	*	*	*
	November	10†	0	0	0	0	*	*	*	*	*	*	*
	December	0†	0	0	0	*	0	0	0	0	0	0	0
Autopsy Performed	No	294	51	20	16	24	19	36	34	27	12	18	37
	Yes	898	86	90	72	96	118	87	63	76	36	65	109
	Unknown	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, 2006-2016

		Total	State or Country of Residence				
			Arizona	Other U.S. states or Canada	Mexico, Central or South America	Other	Unknown
Total		1,193	557	80†	421	20†	120†
	2006	137	63	7	49	0	18
	2007	110†	34	6	67	*	*
	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
Geographic Region of Occurrence[a]	Central	530†	406	29	54	*	31
	Eastern	0	0	0	0	0	0
	Northern	60†	41	15	*	*	0
	Southern	592	97	35	366	7	87
	Western	20†	13	*	0	0	0
Age Group	0 - 4	10†	13	0	*	0	0
	5 - 9	0	0	0	0	0	0
	10 - 14	10†	*	*	*	0	0
	15 - 19	60†	*	*	53	0	*
	20 - 24	90†	8	*	76	*	*
	25 - 29	110†	18	*	78	*	9
	30 - 34	90†	13	13	63	*	*
	35 - 39	110†	26	13	59	*	*
	40 - 44	90†	28	12	44	0	*
	45 - 49	80†	51	*	17	*	8
	50 - 54	90†	63	*	14	*	7
	55 - 59	80†	56	10	6	*	*
	60 - 64	60†	50	*	*	0	*
	65 - 69	50†	41	6	0	0	*
	70 - 74	40†	37	*	0	*	*
	75 - 79	60†	52	*	0	0	0
	80 - 84	30†	31	*	0	*	0
	85+	54	54	0	0	0	0
	Unknown	90†	10	0	*	0	73

Table 2A (continued

Characteristics of Arizona Deaths from Exposure to Excessive Natural Heat by Residence Status, 2006-2016

		Total	State or Country of Residence				
			Arizona	Other U.S. states or Canada	Mexico, Central or South America	Other	Unknown
Gender	Male	910	389	63	343	12	103
	Female	280†	168	19	78	*	14
	Unknown	0†	0	0	0	0	*
Race/Ethnicity	White non-Hispanic	530†	373	51	*	8	91
	Hispanic or Latino	580†	107	27	415	*	22
	Black or African American	10†	*	0	0	0	*
	American Indian or Alaska Native	16	16	0	0	0	0
	Asian or Pacific Islander	0†	*	0	0	*	0
	Unknown	70†	56	*	*	0	*
Month of Death	January	0†	0	*	*	0	0
	February	0†	*	0	0	0	0
	March	10†	*	*	*	0	0
	April	20†	*	*	14	0	*
	May	70†	14	9	41	*	*
	June	314	125	16	133	6	34
	July	430†	227	23	133	*	48
	August	237	133	14	71	0	19
	September	80†	38	12	14	*	9
	October	20†	6	*	8	0	*
	November	10†	6	0	*	0	*
	December	0†	0	0	*	0	0
Autopsy Performed	No	290†	234	21	23	*	13
	Yes	898	323	61	397	12	105
	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 3A

Characteristics of Arizona Deaths from Exposure to Excessive Natural Heat by Region, 2006-2016

		Total	Geographic Region of Occurrence[a]			
			Central	Northern	Southern	Western
Total		1,193	525	60†	592	20†
	2006	140†	58	*	72	*
	2007	110†	39	*	67	*
	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	*
State or Country of Residence	Arizona	557	406	41	97	13
	Other U.S. states or Canada	80†	29	15	35	*
	Mexico, Central or South America	420†	54	*	366	0
	Other	20†	*	*	7	0
	Unknown	118	31	0	87	0
County of Occurrence	Apache	10†	0	*	0	0
	Cochise	10	0	0	10	0
	Coconino	17	0	17	0	0
	Gila	0†	*	0	0	0
	Graham	0†	*	0	0	0
	Greenlee	0	0	0	0	0
	La Paz	16	0	0	0	16
	Maricopa	448	448	0	0	0
	Mohave	34	0	34	0	0
	Navajo	0†	0	*	0	0
	Pima	477	0	0	477	0
	Pinal	54	54	0	0	0
	Santa Cruz	45	0	0	45	0
	Yavapai	18	18	0	0	0
	Yuma	60	0	0	60	0
Age Group	0 - 4	10†	10	*	*	0
	5 - 9	0	0	0	0	0
	10 -14	10†	*	0	6	0
	15 - 19	60†	8	*	49	0
	20 - 24	90†	13	*	74	0
	25 - 29	110†	28	*	80	*
	30 - 34	90†	21	*	69	0
	35 - 39	105	25	7	73	0
	40 - 44	90†	39	*	42	*
	45 - 49	80†	54	*	26	0

Table 3A (continued

Characteristics of Arizona Deaths from Exposure to Excessive Natural Heat by Region, 2006-2016

		Total	Geographic Region of Occurrence[a]			
			Central	Northern	Southern	Western
Age Group (continued)	50 - 54	90†	64	*	21	*
	55 - 59	80†	44	9	22	*
	60 - 64	60†	45	*	11	*
	65 - 69	50†	32	*	11	*
	70 - 74	40†	31	*	6	*
	75 - 79	60†	36	7	11	*
	80 - 84	30†	21	6	*	*
	85+	50†	42	*	6	*
	Unknown	85	8	0	77	0
Gender	Female	910	387	38	474	11
	Male	280†	138	22	117	*
	Unknown	0†	0	0	*	0
Race/Ethnicity	White non-Hispanic	528	326	36	154	12
	Hispanic or Latino	580†	138	8	429	*
	Black or African American	10†	*	0	0	0
	American Indian or Alaska Native	20†	10	*	*	*
	Asian or Pacific Islander	0†	*	*	0	0
	Unknown	65	44	14	7	0
Month of Death	January	0†	*	0	*	0
	February	0†	0	*	0	0
	March	10†	*	*	*	0
	April	20†	6	*	14	0
	May	70†	15	*	54	*
	June	310†	119	7	183	*
	July	434	214	25	189	6
	August	240†	112	13	109	*
	September	80†	41	6	28	*
	October	18	11	0	7	0
	November	10†	*	*	*	0
	December	0†	0	0	*	0
Autopsy Performed	No	294	161	40	83	10
	Yes	898	364	20	508	6
	Unknown	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, 2006-2016

		Total	Geographic Region of Occurrence[a]			
			Central	Northern	Southern	Western
State or Country of Residence	Arizona	557	406	41	97	13
	Other U.S. states or Canada	80†	29	15	35	*
	Mexico, Central or South America	420†	54	*	366	0
	Other	20†	*	*	7	0
	Unknown	118	31	0	87	0
Total		1,193	530†	60†	592	20†

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, 2006-2016

		Geographic Region of Occurrence[a]			
		Central	**Northern**	**Southern**	**Western**
State or Country of Residence	Arizona	59	63	59	61
	Other U.S. states or Canada	45	48	36	63
	Mexico, Central or South America	31	24	29	0
	Other	50	37	33	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 6A
Median Age at Death from Exposure to Excessive Natural Heat by Race/Ethnicity and Gender, 2006-2016

Race/Ethnicity	Gender	Median Age at Death
White non-Hispanic	Male	59
	Female	69
	Total	**63**
Hispanic or Latino	Male	32
	Female	33
	Total	**35**
Black or African American	Male	52
	Female	39
	Total	**52**
American Indian or Alaska Native	Male	53
	Female	70
	Total	**48**
Asian or Pacific Islander	Male	31
	Female	45
	Total	**40.5**
Unknown	Male	59
	Female	50
	Total	**58.5**

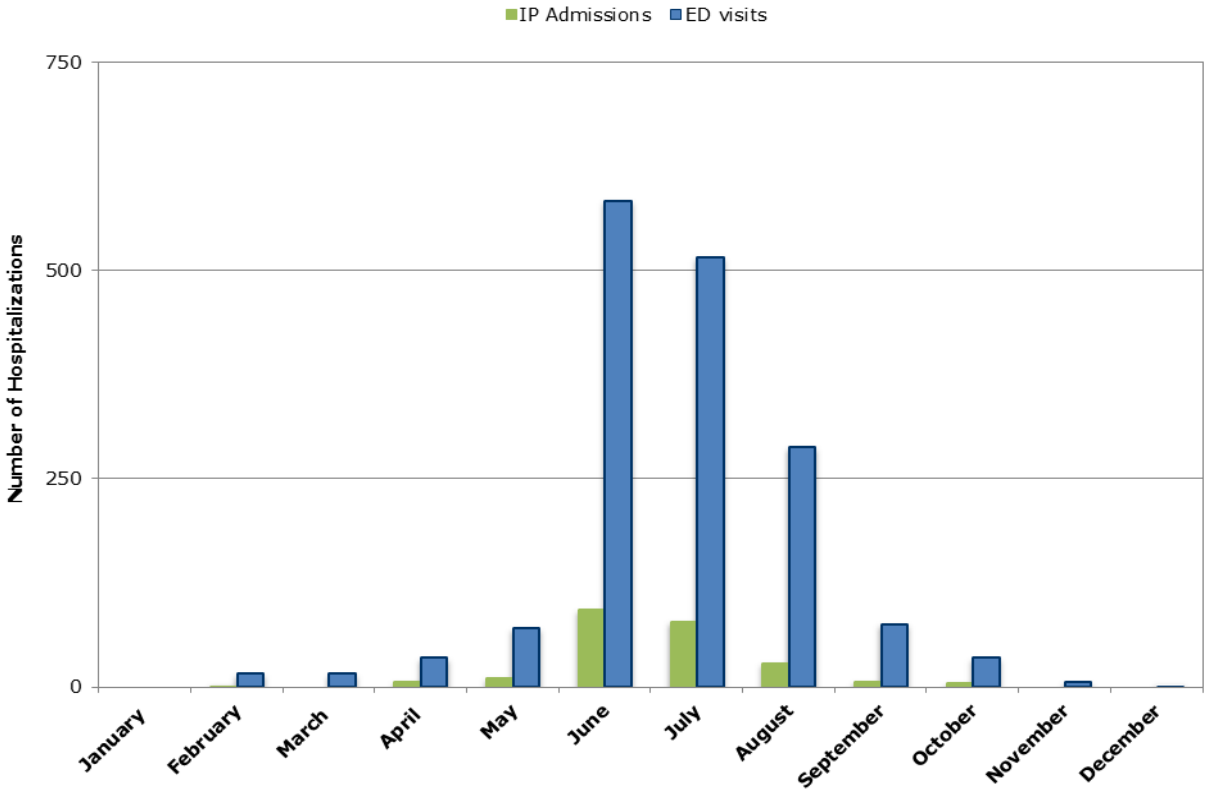
Section B: Heat-Related Morbidity, 2016

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.

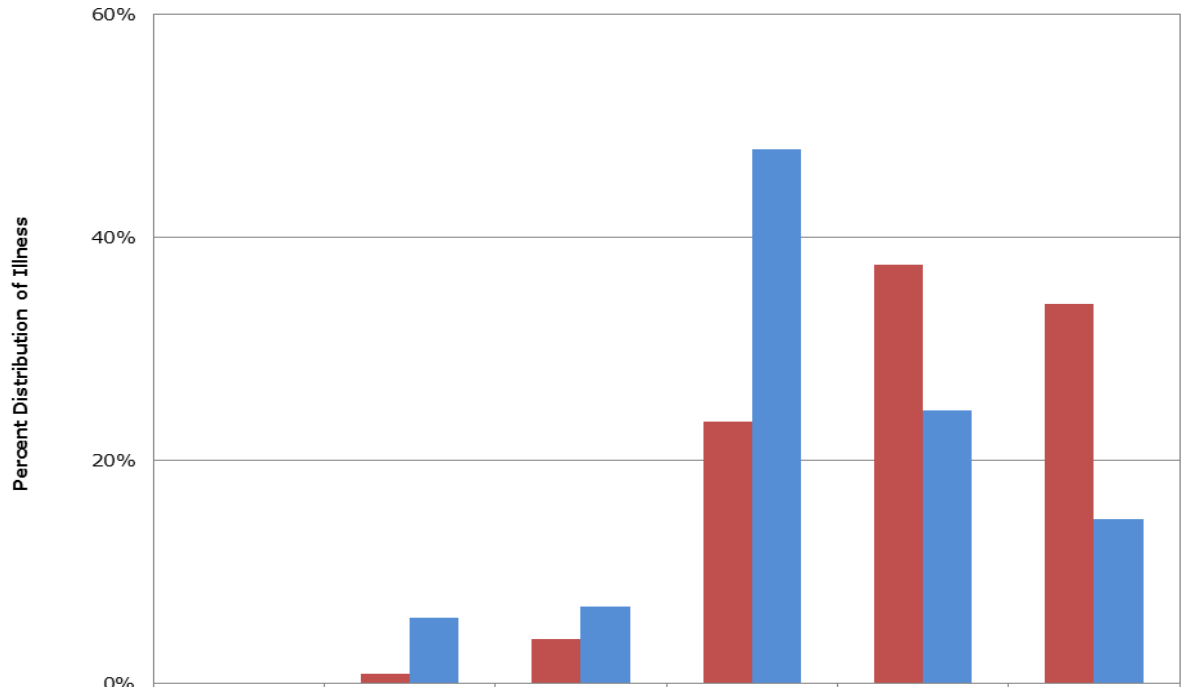
The warm season between June and September accounts for 90.27 percent of hospitalizations and 89.24 percent of the total ED visits from exposure to excessive natural heat.

Figure 1B
Hospitalizations from Exposure to Excessive Natural Heat occuring in Arizona by Month, 2016



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 occuring in Arizona by Age Group, 2016



	Infants <1	Children 1 - 14	Adolescents 15 - 19	Young Adults 20 - 44	Middle-Aged Adults 45 - 64	Elderly 65+
IP Admission	0.0	0.9	4.0	23.5	37.6	34.1
ED visits	0.0	5.9	6.8	47.9	24.5	14.7

In 2016, 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 23.85 percent of IP admissions and 47.9 percent of heat illness ED visits. On the other hand, middle aged and elderly Arizona residents accounted for only 39.2 percent of heat illness ED visits for exposure to excessive natural heat, but represent 71.7 percent of IP admissions (**Figure 2B**).

Nearly 5.9 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 6.8 percent of the total.

The median age at illness form exposure to excessive natural heat in 2016 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 6 years lower than the female median age at illness, but 12.5 years lower at time of admission for inpatient care. In 2016, the median age at admission to hospital due to exposure to excessive natural heat was generally higher compared to heat illness ED visits.

Figure 3B
Median Age at Illness From Exposure to Excessive Natural Heat by Gender, 2016

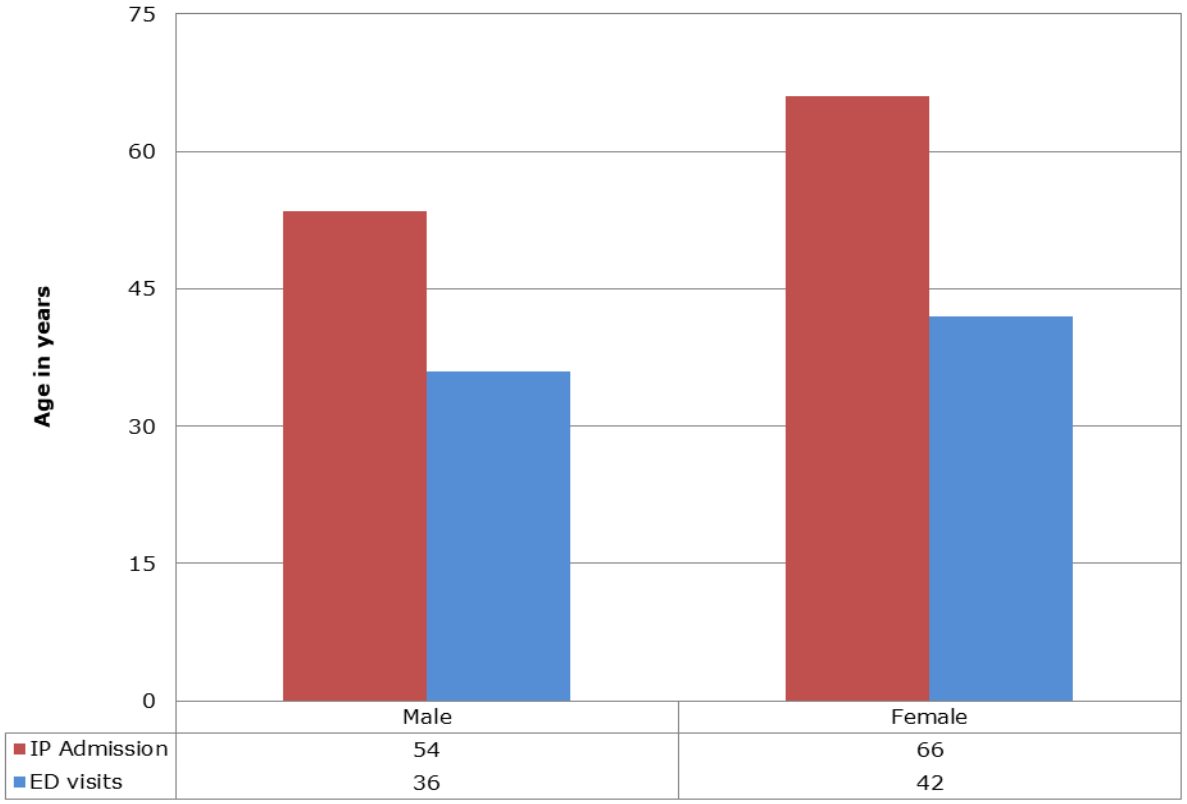
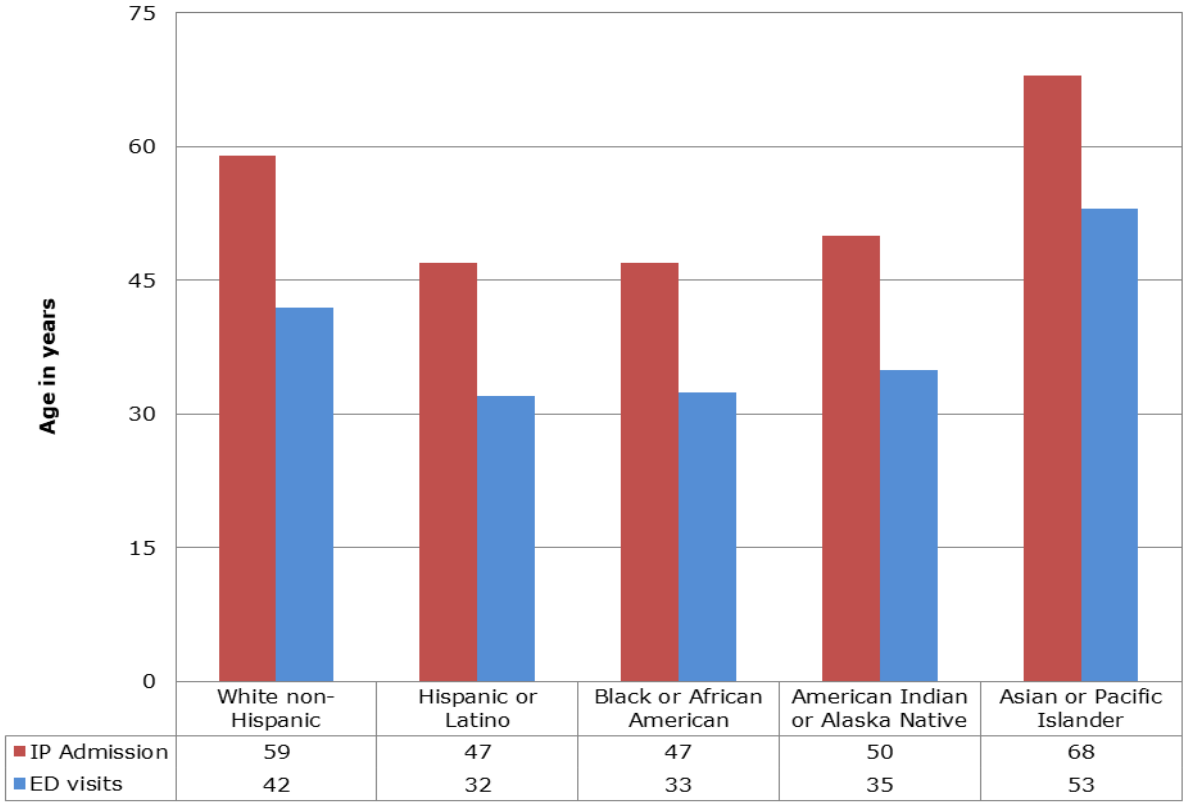


Figure 4B
Median Age at Illness from Exposure to Excessive Natural Heat by Race/Ethnic Group, 2016



	White non-Hispanic	Hispanic or Latino	Black or African American	American Indian or Alaska Native	Asian or Pacific Islander
IP Admission	59	47	47	50	68
ED visits	42	32	33	35	53

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 or Pacific were substantially the greatest while Hispanics or Latinos had the youngest age at illness. The median age of Asian or Pacific Islanders visiting the emergency department for a heat illness was 53 years of age, the highest among all race/ethnic groups, the lowest being recorded among Hispanic or Latinos (32 years) followed by Black or African Americans (32.5), American Indian or Alaska Natives (35), and White non-Hispanic (42).

Table 1B

Inpatient stays and ED visits from Exposure to Excessive Natural Heat by Region and Demographic Characteristics, 2016

		Total	IP Admissions	ED Visits
Total		1,862	226	1,636
Geographic Region of Occurrence[a]	Central	1,244	170	1,074
	Eastern	21	0	21
	Northern	171	12	159
	Southern	426	44	382
	Western	0	0	21
County of Occurrence	Apache	0†	0	*
	Cochise	19	0	19
	Coconino	20†	*	20
	Gila	20†	*	15
	Graham	6	0	6
	Greenlee	0	0	0
	La Paz	21	0	21
	Maricopa	1,079	160	919
	Mohave	139	11	128
	Navajo	9	0	9
	Pima	205	22	183
	Pinal	110	6	104
	Santa Cruz	0†	0	*
	Yavapai	30†	*	30
	Yuma	201	22	179
Age Group	0 - 4	18	0	18
	5 - 9	18	0	18
	10 - 14	60†	*	58
	15 - 19	121	9	112
	20 - 24	150†	*	149
	25 - 29	190	13	177
	30 - 34	190	16	174
	35 - 39	161	12	149
	40 - 44	142	7	135
	45 - 49	146	21	125
	50 - 54	134	24	110
	55 - 59	125	23	102
	60 - 64	81	17	64

Table 1B (continued)
Inpatient stays and ED visits from Exposure to Excessive Natural Heat by Region and Demographic Characteristics, 2016

		Total	IP Admissions	ED Visits
Age Group (continued)	65 - 69	103	21	82
	70 - 74	60	16	44
	75 - 79	56	13	43
	80 - 84	45	11	34
	85+	54	16	38
	Unknown	0†	0	*
Gender	Male	1,295	172	1,123
	Female	567	54	513
Race/Ethnicity	White non-Hispanic	1,116	138	978
	Hispanic or Latino	463	48	415
	Black or African American	149	24	125
	American Indian or Alaska Native	92	10	82
	Asian or Pacific Islander	30†	*	24
	Unknown	20†	*	12
Month of Occurrence	January	0	0	0
	February	20†	*	15
	March	15	0	15
	April	40	6	34
	May	80	10	70
	June	675	92	583
	July	593	78	515
	August	315	28	287
	September	81	6	75
	October	40†	*	34
	November	10†	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; [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, 2016

		Total	Geographic Region of Occurrence[a]									
			IP Admissions					ED Visits				
			Central	Eastern	Northern	Southern	Western	Central	Eastern	Northern	Southern	Western
Total		1,862	170†	0	10†	44	0	1,074	21	160†	380†	0
County of Occurrence	Apache	0†	0	0	0	0	0	0	0	*	0	0
	Cochise	19	0	0	0	0	0	0	0	0	19	0
	Coconino	20†	0	0	*	0	0	0	0	20	0	0
	Gila	20†	*	0	0	0	0	15	0	0	0	0
	Graham	6	0	0	0	0	0	6	0	0	0	0
	Greenlee	0	0	0	0	0	0	0	0	0	0	0
	La Paz	21	0	0	0	0	0	0	21	0	0	0
	Maricopa	1,079	160	0	0	0	0	919	0	0	0	0
	Mohave	139	0	0	11	0	0	0	0	128	0	0
	Navajo	9	0	0	0	0	0	0	0	9	0	0
	Pima	205	0	0	0	22	0	0	0	0	183	0
	Pinal	110	6	0	0	0	0	104	0	0	0	0
	Santa Cruz	0†	0	0	0	0	0	0	0	0	*	0
	Yavapai	30†	*	0	0	0	0	30	0	0	0	0
	Yuma	201	0	0	0	22	0	0	0	0	179	0
Age Group	0 - 4	18	0	0	0	0	0	14	0	0	*	0
	5 - 9	18	0	0	0	0	0	9	0	*	*	0
	10 - 14	60†	*	0	0	0	0	44	0	*	11	0
	15 - 19	120†	7	0	0	*	0	71	*	9	31	0
	20 - 24	150†	*	0	0	*	0	107	0	8	34	0
	25 - 29	190	7	0	0	6	0	112	*	11	51	0
	30 - 34	190†	13	0	*	*	0	117	*	14	41	0
	35 - 39	160†	10	0	0	*	0	98	*	10	38	0
	40 - 44	140†	*	0	*	*	0	100	0	11	24	0
	45 - 49	150†	17	0	*	*	0	87	*	14	23	0
	50 - 54	130†	22	0	0	*	0	63	*	15	28	0
	55 - 59	130†	19	0	*	*	0	59	*	17	24	0
	60 - 64	80†	13	0	*	*	0	39	*	*	19	0
	65 - 69	103	14	0	0	7	0	47	*	19	15	0
	70 - 74	60†	14	0	0	*	0	29	0	6	9	0
	75 - 79	60†	10	0	*	*	0	29	*	7	6	0
	80 - 84	50†	*	0	*	*	0	24	*	*	7	0
	85+	50†	11	0	*	*	0	22	0	*	11	0
	Unknown	4†	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, 2016

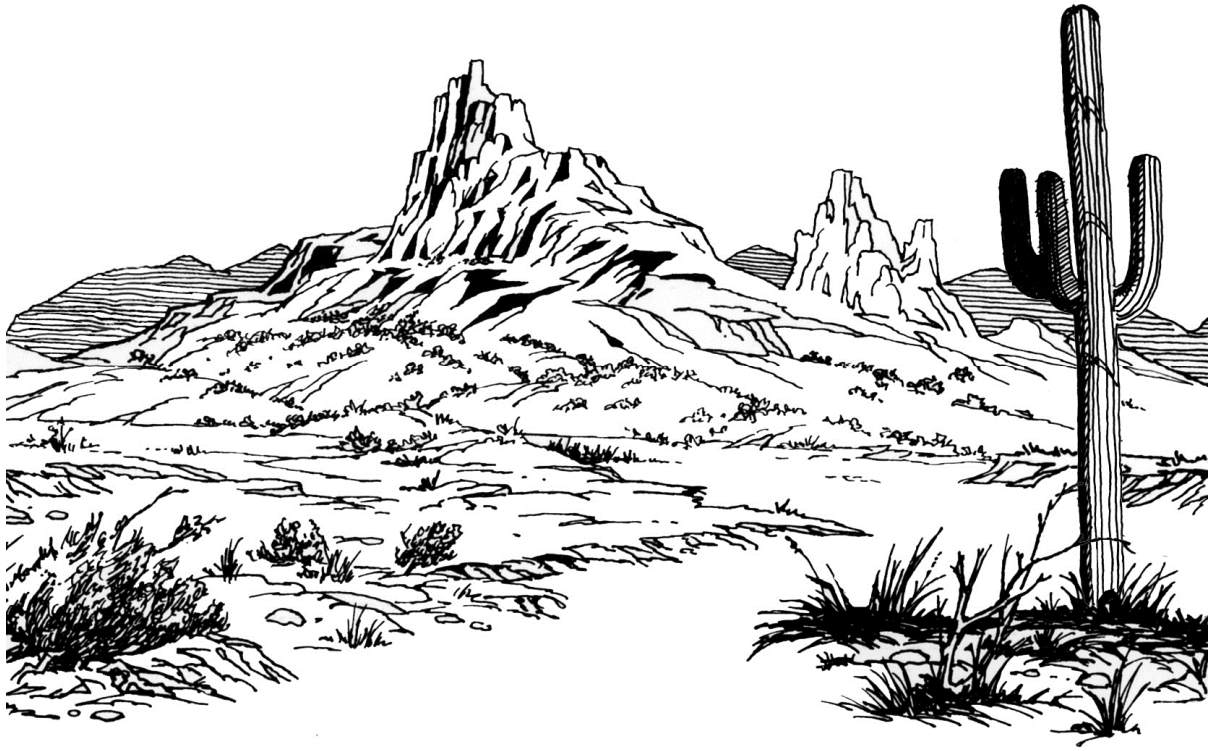
		Total	Geographic Region of Occurrence[a]									
			IP Admissions					ED Visits				
			Central	Eastern	Northern	Southern	Western	Central	Eastern	Northern	Southern	Western
Gender	Male	1,295	131	0	9	32	0	740	15	102	266	0
	Female	570†	39	0	*	12	0	334	6	57	116	0
Race / Ethnicity	White non-Hispanic	1,116	109	0	9	20	0	639	15	132	192	0
	Hispanic or Latino	460†	28	0	*	19	0	256	*	6	151	0
	Black or African American	150†	20	0	*	*	0	92	*	6	25	0
	American Indian or Alaska Native	90†	9	0	*	0	0	63	*	11	6	0
	Asian or Pacific Islander	30†	*	0	0	*	0	19	0	*	*	0
	Unknown	20†	*	0	0	*	0	*	0	*	6	0
Month of Illness	January	0	0	0	0	0	0	0	0	0	0	0
	February	20†	*	0	0	0	0	6	0	*	6	0
	March	15	0	0	0	0	0	9	0	0	6	0
	April	40†	*	0	0	*	0	24	0	*	7	0
	May	80†	7	0	*	*	0	42	*	9	18	0
	June	680†	74	0	*	13	0	377	9	54	143	0
	July	590†	55	0	*	20	0	339	*	50	121	0
	August	320†	19	0	*	6	0	191	*	34	57	0
	September	80†	*	0	0	*	0	57	*	*	13	0
	October	40†	*	0	0	*	0	23	0	*	10	0
	November	10†	0	0	0	0	0	*	0	0	*	0
	December	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, 2016

Race/Ethnicity	Gender	Median Age at Death	
		IP Admissions	ED Visits
White non-Hispanic	Male	55	41
	Female	72	46
	Total	**59**	**42**
Hispanic or Latino	Male	50	33
	Female	36	31
	Total	**47**	**32**
Black or African American	Male	46	34
	Female	50	28
	Total	**47**	**32.5**
American Indian or Alaska Native	Male	50	33
	Female	51.5	43.5
	Total	**50**	**35**
Asian or Pacific Islander	Male	68	52
	Female	0	54
	Total	**68**	**53**
Refused/Unknown	Male	52	29.5
	Female	64	36
	Total	**58.5**	**30**

Our Web site at http://www.azdhs.gov/plan 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. In addition to the print and original online versions, the 2016 report is made available as a mobile-friendly e-book (http://azdhs.gov/plan/epub/rotated-document-layout/). 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