Mortality and Morbidity From Exposure to Excessive Natural Heat in Arizona, 2007-2017

ARIZONA DEPARTMENT
OF HEALTH SERVICES

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MORTALITY AND MORBIDITY FROM EXPOSURE TO EXCESSIVE NATURAL HEAT IN ARIZONA, 2007-2017

by
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Purpose

The purpose of this report is to provide information on mortality trends from exposure to heat due to weather conditions occurring in Arizona during the 2007-2017 period, and heat illness cases during 2017 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 2007 to 2017, there were 1,188 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, then a decline to 132 in 2017.

√ There were 599 deaths from exposure to excessive natural heat among the residents of Arizona (50.4 percent of the total), or 54 deaths on average per year in 2007-2017.

√ Visitors to Arizona from other U.S. states, Canada or Europe experienced around 84 deaths from exposure to heat due to weather conditions in 2007-2017.

√ The state or country of residence of about 110 decedents in 2007-2017 remains unidentified.

√ Approximately eight out of every ten deaths from exposure to excessive natural heat in 2007-2017 were males, and 44.9 percent were Hispanic or Latino.

√ In 2007-2017, eighty-four percent of all deaths from exposure to heat due to weather conditions occurred during the five months from May through September.

√ In 2007-2017, 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 64 percent of deaths from exposure to excessive natural heat among the migrants from Mexico and other Central/South American countries.

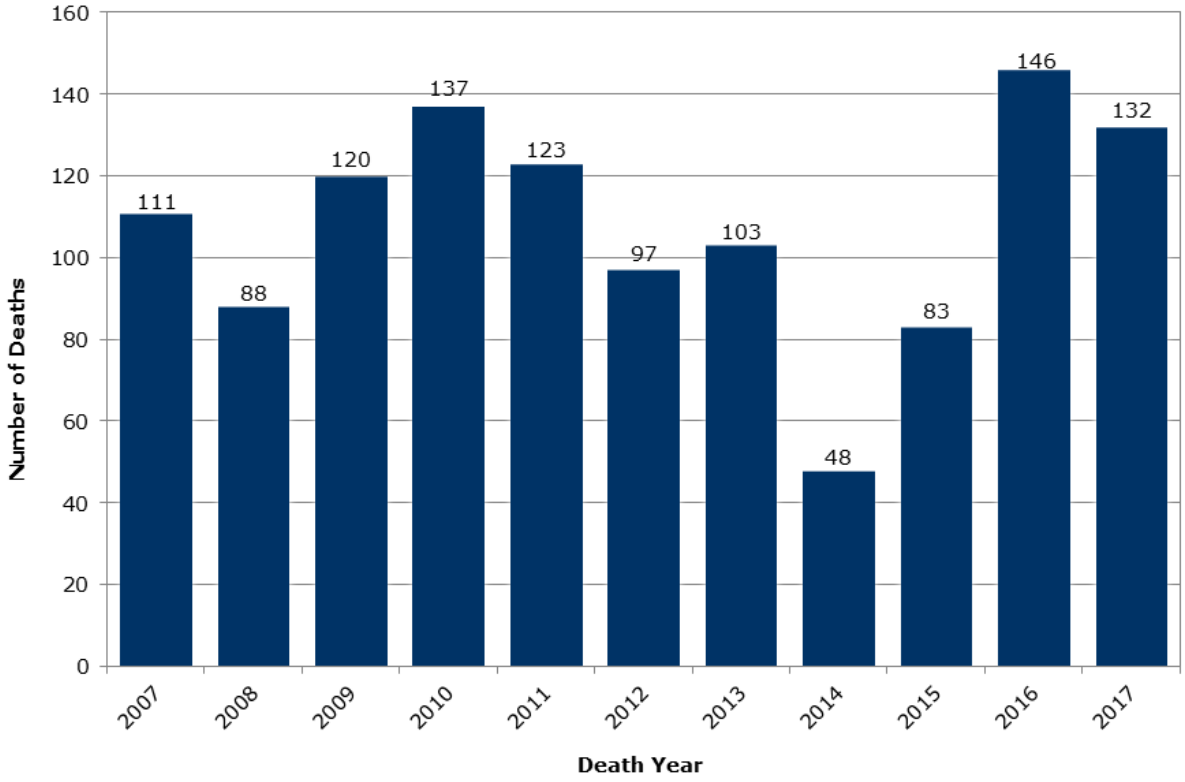
√ In contrast, older adults 65 years or older have been at the highest risk of heatstroke or sunstroke among the age groups of Arizona residents. Approximately 41.4 percent of fatalities due to exposure to heat among Arizona residents were this old, while there were no deaths from natural heat recorded among migrants aged 65 years and older.

√ In 2007-2017, the four counties along the southern border of Arizona (Cochise, Pima, Santa Cruz, and Yuma) accounted for 46.5 percent of deaths from excessive heat. Individually, Pima county (38.1 percent) and Maricopa county (38.2 percent) accounted for most of the deaths due to exposure to natural heat.

√ Residents from Mexico, Central or South America (84.8 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 (75.8 percent).

Section A: Heat-Related Mortality, 2007-2017

Figure 1A
Deaths from Exposure to Excessive Natural Heat* occurring in Arizona by Year, 2007-2017



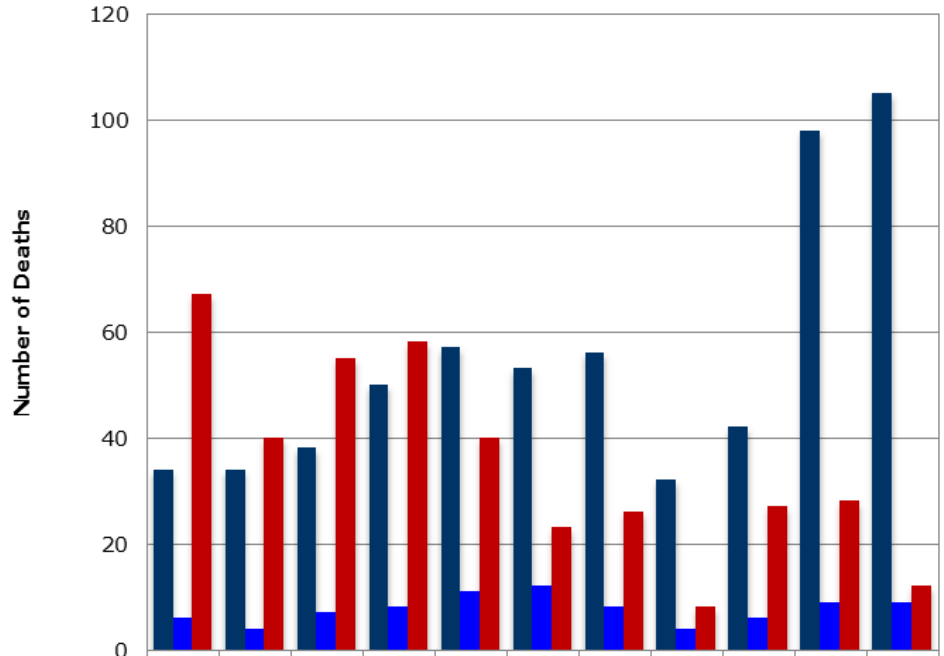
In the year period from 2007 to 2017 1,188 deaths related to exposure to excessive natural heat occurred in Arizona.

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 2007-2017 (**Figure 1A, Table 1A**).

Approximately eight out of every ten deaths from exposure to excessive natural heat in 2007-2017 were males (897/1,188 or 75.5 percent, **Table 1A**), and 44.9 percent (534/1,188, **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, 2007-2017



	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Arizona	34	34	38	50	57	53	56	32	42	98	105
Other U.S. states or Canada	6	4	7	8	11	12	8	4	6	9	9
Mexico, Central or South America	67	40	55	58	40	23	26	8	27	28	12

* 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 599 deaths from exposure to excessive natural heat among the residents of Arizona (50.4 percent of the total), or 54 deaths on average per year in 2007-2017.

Migrants from Mexico, Central America or South America accounted for 32.3 percent of the total deaths from exposure to heat due to weather conditions during the 2007 to 2017 period.

Visitors to Arizona from other U.S. states or migrants from Canada experienced 84 deaths from exposure to excessive natural heat during the 2007-2017, 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 2007, 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.

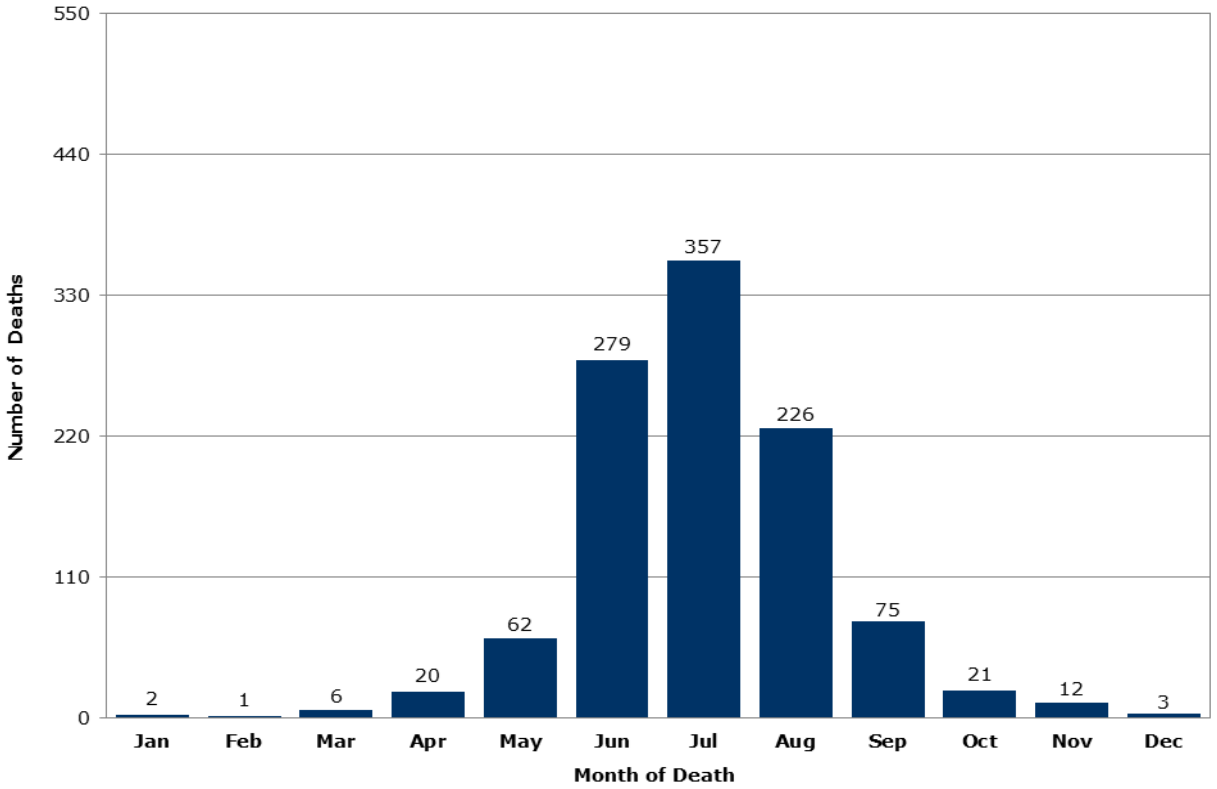
1 http://phoenix.about.com/cs/weather/a/weathertrivia_2.htm

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 (357) in 2007-2017, followed by June (279), then August (226) September (75), and May (62). In 2007-2017, approximately eighty-four percent of all deaths from exposure to heat due to weather conditions occurred during the five months from May through September.

Figure 3A
Deaths from Exposure to Excessive Natural Heat* occurring in Arizona by Month, 2007-2017



* 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.

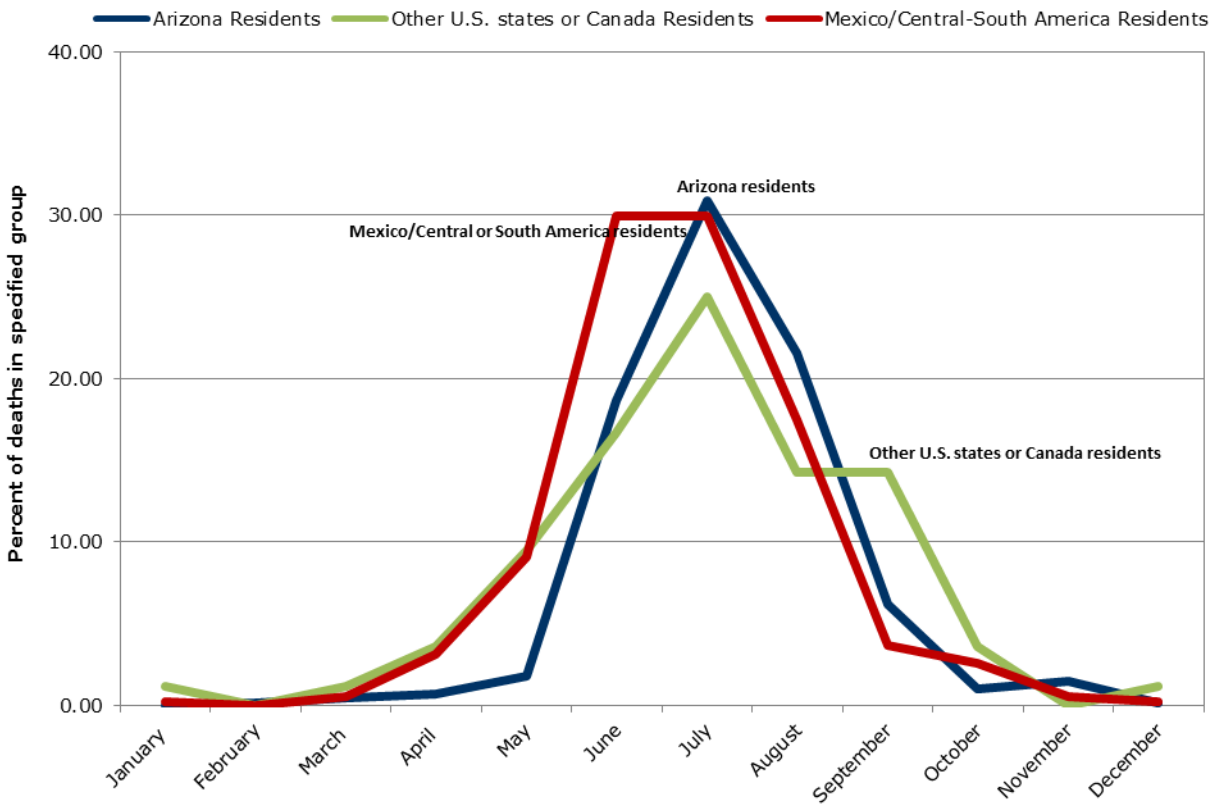
Excluded are deaths due to excessive heat of man-made origin.

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, 2007-2017**



* 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.

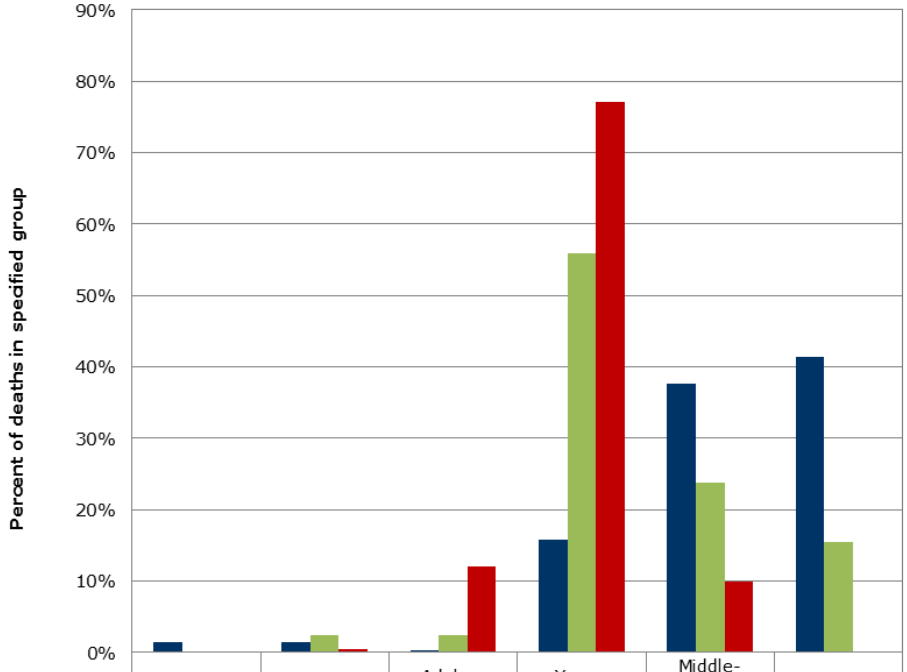
Regardless of the residence status, most deaths from excessive natural heat occurred during the month of July (**Figure 4A, Table 2A**). Compared to the residents of Arizona there were substantially more deaths among residents of Mexico, Central America, and South America from March–June during the 2007-2017 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**).

In 2007-2017, 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 2007-2017 accounted for 77.0 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. Forty one 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.

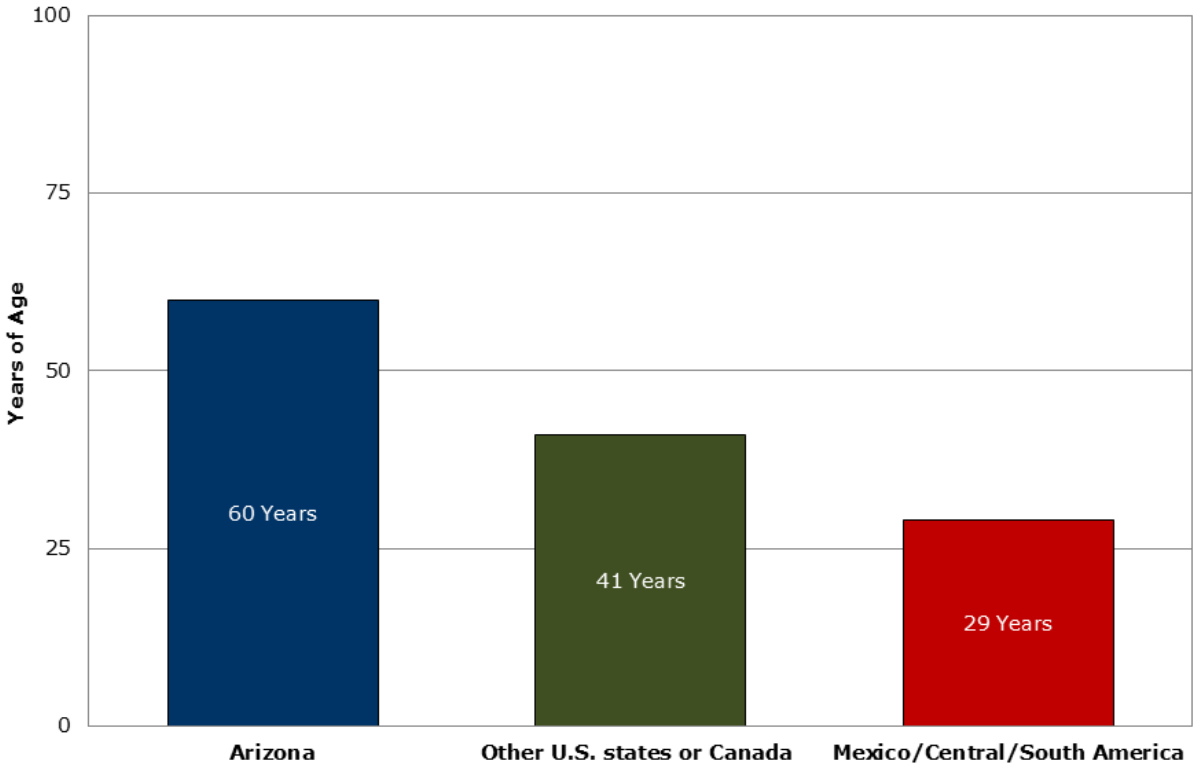
Figure 5A
Percent Distribution of Deaths from Exposure to Excessive Natural Heat* occurring in Arizona by Age Group and Residence Status, 2007-2017



	Infants <1	Children 1 - 14	Adoles-cents 15 - 19	Young Adults 20 - 44	Middle-Aged Adults 45 - 64	Elderly 65+
Arizona	1.50	1.50	0.33	15.86	37.73	41.40
Other U.S. states or Canada	0.00	2.38	2.38	55.95	23.81	15.48
Mexico/Central/South America	0.00	0.52	11.98	77.08	9.90	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, 2007-2017



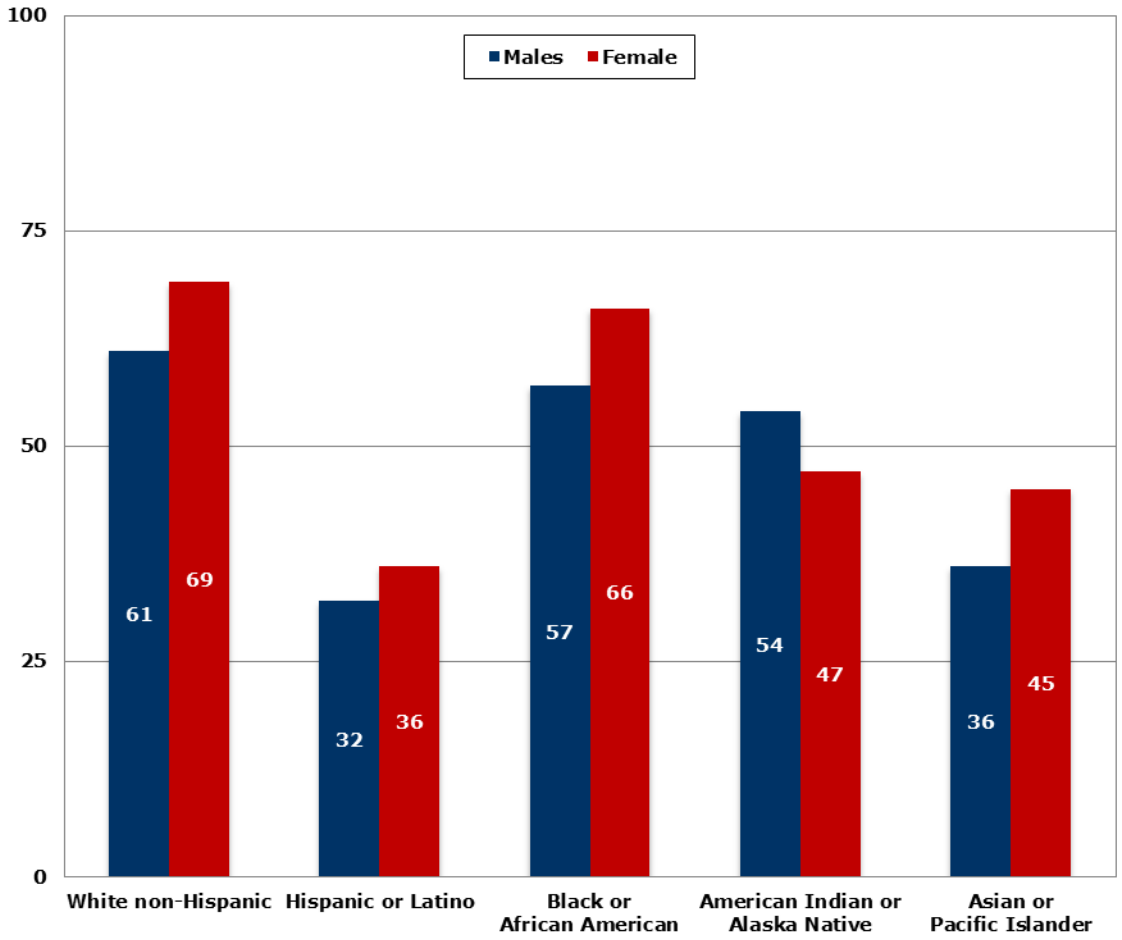
One out of two Arizonans who died from exposure to excessive natural heat in 2007-2017 was older than 60 years of age (**Figure 6A**, **Table 5A**).

In 2007-2017, compared to the residents of Arizona, on average visitors from other states were 19 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 31 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.

In 2007-2017, 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 (61.0 years), and Hispanic males had the lowest (32 years), median age at death from exposure to excessive natural heat, respectively.

Figure 7A
**Median Age at Death from Exposure to Excessive Natural Heat*
by Gender and Race/Ethnic Group, 2007-2017**



* 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, 2007-2017

		Total	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Total		1,188	111	88	120	137	123	97	103	48	83	146	132
State or Country of Residence	Arizona	599	34	34	38	50	57	53	56	32	42	98	105
	Other U.S. states or Canada	80†	6	*	7	8	11	12	8	*	6	9	9
	Mexico, Central or South America	384	67	40	55	58	40	23	26	8	27	28	12
	Other	20†	*	*	0	*	*	*	*	0	*	*	0
	Unknown	110†	*	6	20	19	14	8	12	*	6	8	6
Geographic Region of Occurrence[a]	Central	534	39	33	51	48	61	55	45	27	39	69	67
	Eastern	0	0	0	0	0	0	0	0	0	0	0	0
	Northern	90†	*	*	*	6	7	0	13	*	*	12	33
	Southern	552	67	50	64	81	55	41	45	18	39	60	32
	Western	10†	*	*	*	*	0	*	0	0	*	*	0
County of Occurrence	Apache	0†	0	*	0	0	*	0	*	0	0	0	0
	Cochise	10†	0	0	*	*	0	0	*	0	*	*	*
	Coconino	30†	*	0	*	*	*	0	*	*	*	0	8
	Gila	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	10†	*	*	*	*	0	*	0	0	*	*	0
	Maricopa	454	30	26	43	40	54	50	35	21	32	64	59
	Mohave	60†	*	*	0	*	*	0	7	*	*	11	25
	Navajo	0†	*	*	0	0	0	0	0	0	0	*	0
	Pima	453	54	41	50	74	49	35	38	13	28	45	26
	Pinal	60†	8	7	6	6	6	*	*	*	*	*	*
	Santa Cruz	40†	10	6	9	*	*	0	*	*	*	*	0
	Yavapai	20†	0	0	*	*	0	*	*	*	*	*	*
	Yuma	50†	*	*	*	*	*	6	*	*	7	12	*
Age Group	0 - 4	20†	*	*	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	50†	9	9	7	7	*	*	*	*	*	*	*
	20 - 24	80†	7	9	10	15	8	*	13	*	7	8	*
	25 - 29	110†	16	8	14	14	12	7	*	6	8	11	9
	30 - 34	90†	15	9	11	8	14	7	*	0	*	11	10
	35 - 39	100†	9	*	13	13	12	10	7	*	10	11	7
	40 - 44	80†	14	8	8	10	10	8	*	*	*	7	*
	45 - 49	80†	*	7	8	10	9	12	11	0	6	*	7
	50 - 54	90†	10	9	10	11	8	*	8	*	*	10	13
	55 - 59	80†	*	*	*	*	6	7	6	*	9	18	11
	60 - 64	60†	*	*	*	*	10	7	*	*	*	13	8
	65 - 69	60†	*	*	6	*	*	*	*	*	7	7	12
	70 - 74	50†	0	*	0	*	*	7	*	*	7	9	12
	75 - 79	60†	*	*	6	6	6	7	*	*	*	11	13
	80 - 84	40†	*	*	*	*	*	*	6	*	*	*	10
	85+	60†	*	*	*	*	10	*	6	*	*	12	7
	Unknown	80†	*	*	14	19	7	*	12	*	*	*	*

Table 1A (continued)

Characteristics of Deaths from Exposure to Excessive Natural Heat Occurring in Arizona by Year, 2007-2017

		Total	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Gender	Male	897	76	68	97	111	97	74	83	32	65	103	91
	Female	290	35	20	22	26	26	23	20	16	18	43	41
	Unknown	0†	0	0	*	0	0	0	0	0	0	0	0
Race/Ethnicity	White non-Hispanic	547	36	32	43	59	53	46	48	28	44	81	77
	Hispanic or Latino	534	72	50	69	70	59	43	43	16	32	52	28
	Black or African American	30†	*	*	*	6	6	*	6	*	*	*	*
	American Indian or Alaska Native	60†	*	*	*	*	*	*	6	*	*	10	11
	Asian or Pacific Islander	10†	0	0	*	0	0	*	0	0	*	*	*
	Unknown	12	0	0	0	0	0	0	0	0	0	0	12
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	*	0
	April	20†	*	*	*	*	*	*	*	*	*	*	0
	May	60†	9	*	12	8	*	9	9	*	*	*	0
	June	279	31	38	10	23	27	24	30	12	32	52	0
	July	357	35	24	53	71	30	28	39	17	9	51	0
	August	226	23	10	29	18	39	26	14	7	34	26	0
	September	80†	7	*	9	12	15	6	6	*	*	8	0
	October	20†	*	*	*	*	*	*	*	*	*	*	*
	November	10†	0	0	0	*	*	*	*	*	*	*	*
	December	0†	0	0	*	0	0	0	0	0	0	0	*
	Unknown	124	0	0	0	0	0	0	0	0	0	0	124
Autopsy Performed	No	306	20	16	24	19	36	34	27	12	18	37	63
	Yes	881	90	72	96	118	87	63	76	36	65	109	69
	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, 2007-2017

		Total	State or Country of Residence				
			Arizona	Other U.S. states or Canada	Mexico, Central or South America	Other	Unknown
Total		1,188	599	80†	384	20†	110†
	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
	2017	132	105	9	12	0	6
Geographic Region of Occurrence[a]	Central	530†	427	28	51	*	23
	Eastern	0	0	0	0	0	0
	Northern	90†	66	20	*	*	0
	Southern	552	96	34	332	7	83
	Western	10†	10	*	0	0	0
Age Group	0 - 4	15	15	0	0	0	0
	5 - 9	0	0	0	0	0	0
	10 - 14	10†	*	*	*	0	0
	15 - 19	50†	*	*	46	0	*
	20 - 24	80†	9	*	69	*	*
	25 - 29	110†	20	*	76	*	7
	30 - 34	90†	15	14	59	*	*
	35 - 39	100†	28	13	53	*	*
	40 - 44	80†	23	13	39	0	*
	45 - 49	80†	49	*	16	*	7
	50 - 54	90†	66	*	14	*	6
	55 - 59	80†	61	9	*	*	*
	60 - 64	60†	50	*	*	0	*
	65 - 69	60†	48	7	0	0	*
	70 - 74	50†	46	*	0	*	*
	75 - 79	60†	60	*	0	0	0
	80 - 84	40†	37	*	0	*	0
	85+	57	57	0	0	0	0
	Unknown	80†	10	0	*	0	71

Table 2A (continued)
Characteristics of Arizona Deaths from Exposure to Excessive Natural Heat by Residence Status, 2007-2017

		Total	State or Country of Residence				
			Arizona	Other U.S. states or Canada	Mexico, Central or South America	Other	Unknown
Gender	Male	897	410	64	319	12	92
	Female	290†	189	20	65	*	13
	Unknown	0†	0	0	0	0	*
Race/Ethnicity	White non-Hispanic	550†	402	52	*	8	81
	Hispanic or Latino	530†	106	27	379	*	17
	Black or African American	30†	27	*	*	0	*
	American Indian or Alaska Native	60†	54	*	0	0	0
	Asian or Pacific Islander	10†	*	*	0	*	0
	Unknown	12	6	0	0	0	6
Month of Death	January	0†	0	*	*	0	0
	February	0†	*	0	0	0	0
	March	10†	*	*	*	0	0
	April	20†	*	*	12	0	*
	May	60†	11	8	35	*	*
	June	279	112	14	115	6	32
	July	360†	185	21	115	*	33
	August	226	129	12	67	0	18
	September	80†	37	12	14	*	9
	October	20†	6	*	10	0	*
	November	10†	9	0	*	0	*
	December	0†	*	*	*	0	0
	Unknown	120†	101	8	10	0	*
Autopsy Performed	No	310†	252	21	21	*	9
	Yes	881	347	63	362	12	97
	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, 2007-2017

		Total	Geographic Region of Occurrence[a]			
			Central	Northern	Southern	Western
Total		1,188	534	90†	552	10†
	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	*
	2017	132	67	33	32	0
State or Country of Residence	Arizona	599	427	66	96	10
	Other U.S. states or Canada	80†	28	20	34	*
	Mexico, Central or South America	380†	51	*	332	0
	Other	20†	*	*	7	0
	Unknown	106	23	0	83	0
County of Occurrence	Apache	0†	0	*	0	0
	Cochise	10	0	0	10	0
	Coconino	25	0	25	0	0
	Gila	0†	*	0	0	0
	Graham	0†	*	0	0	0
	Greenlee	0	0	0	0	0
	La Paz	12	0	0	0	12
	Maricopa	454	454	0	0	0
	Mohave	58	0	58	0	0
	Navajo	0†	0	*	0	0
	Pima	453	0	0	453	0
	Pinal	55	55	0	0	0
	Santa Cruz	38	0	0	38	0
	Yavapai	19	19	0	0	0
	Yuma	51	0	0	51	0
Age Group	0 - 4	20†	11	*	*	0
	5 - 9	0	0	0	0	0
	10 -14	10†	*	0	*	0
	15 - 19	50†	9	*	41	0
	20 - 24	80†	12	*	68	0
	25 - 29	110†	28	*	78	*
	30 - 34	90†	22	*	64	0
	35 - 39	100	27	8	65	0
	40 - 44	80†	35	*	37	*
	45 - 49	80†	48	*	25	0
	50 - 54	91	63	6	22	0
	55 - 59	80†	45	13	18	*
	60 - 64	60†	44	*	10	*
	65 - 69	60†	36	7	12	*
	70 - 74	50†	34	7	8	*
	75 - 79	60†	38	12	12	*
	80 - 84	40†	26	8	*	*
	85+	60†	44	*	7	*
	Unknown	83	8	0	75	0

Table 3A (continued)
Characteristics of Arizona Deaths from Exposure to Excessive Natural Heat by Region, 2007-2017

		Total	Geographic Region of Occurrence			
			Central	Northern	Southern	Western
Gender	Female	897	385	60	445	7
	Male	290†	149	30	106	*
	Unknown	0†	0	0	*	0
Race/Ethnicity	White non-Hispanic	547	330	61	147	9
	Hispanic or Latino	534	135	9	390	0
	Black or African American	30†	29	0	*	0
	American Indian or Alaska Native	60†	28	18	8	*
	Asian or Pacific Islander	10†	*	*	0	0
	Unknown	10†	7	0	*	0
Month of Death	January	0†	*	0	*	0
	February	0†	0	*	0	0
	March	10†	*	*	*	0
	April	20†	6	*	12	0
	May	60†	13	*	46	*
	June	280†	110	6	160	*
	July	360†	169	25	159	*
	August	230†	110	11	102	*
	September	80†	41	6	27	*
	October	21	12	0	9	0
	November	10†	7	*	*	0
	December	0†	*	*	*	0
	Unknown	124	62	32	30	0
Autopsy Performed	No	306	160	64	75	7
	Yes	880†	374	26	476	*
	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, 2007-2017

		Total	Geographic Region of Occurrence[a]			
			Central	Northern	Southern	Western
State or Country of Residence	Arizona	599	427	66	96	10
	Other U.S. states or Canada	80†	28	20	34	*
	Mexico, Central or South America	380†	51	*	332	0
	Other	20†	*	*	7	0
	Unknown	106	23	0	83	0
Total		1,188	530†	90†	552	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, 2007-2017

		Geographic Region of Occurrence[a]			
		Central	**Northern**	**Southern**	**Western**
State or Country of Residence	Arizona	59	64	61	61
	Other U.S. states or Canada	43	46	37	71
	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, 2007-2017

Race/Ethnicity	Gender	Median Age at Death
White non-Hispanic	Male	61
	Female	69
	Total	**64**
Hispanic or Latino	Male	32
	Female	36
	Total	**32**
Black or African American	Male	57
	Female	67
	Total	**58**
American Indian or Alaska Native	Male	54
	Female	47
	Total	**53**
Asian or Pacific Islander	Male	36
	Female	45
	Total	**36**
Unknown	Male	58
	Female	55
	Total	**55**

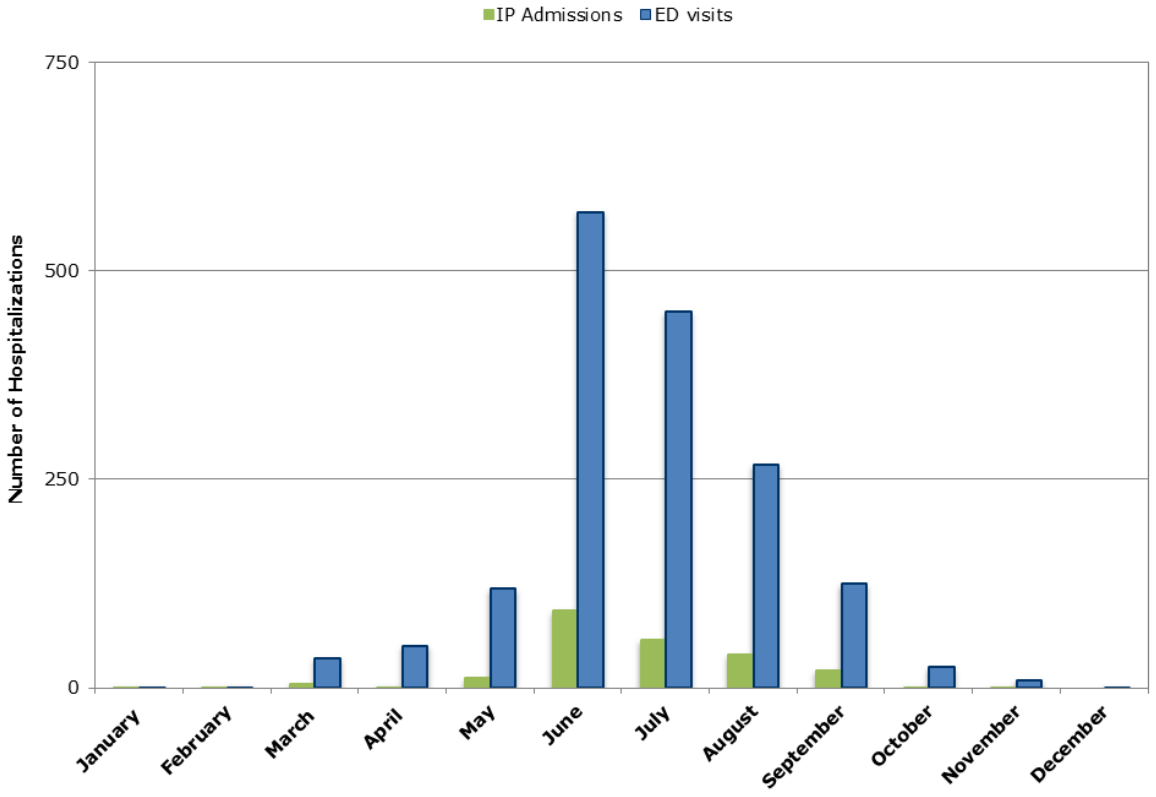
Section B: Heat-Related Morbidity, 2017

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.

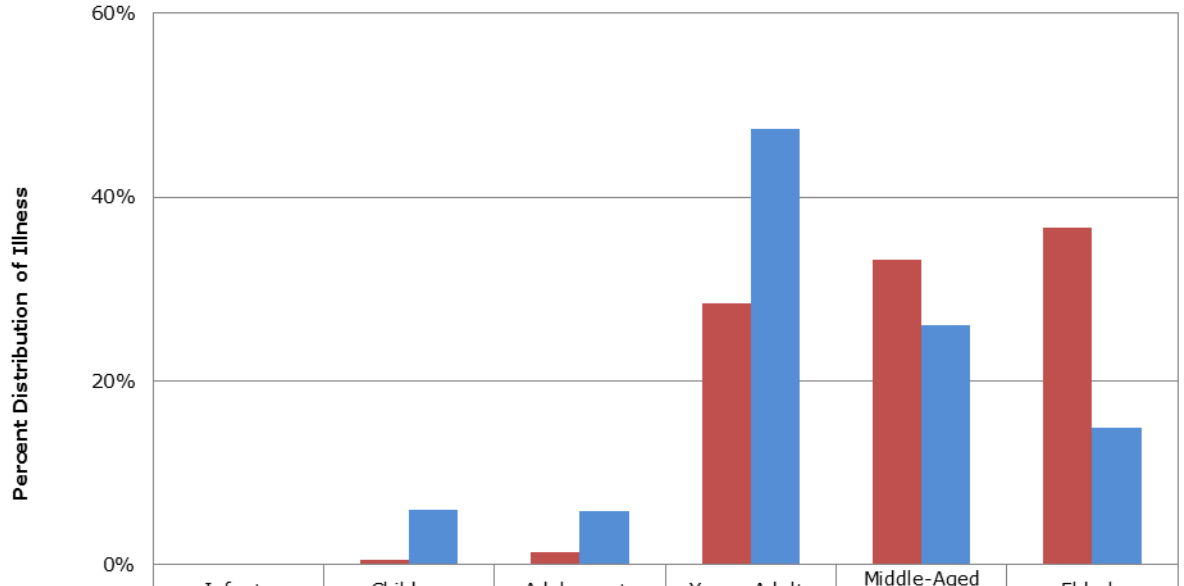
The warm season between June and September accounts for 90.8 percent of hospitalizations and 85.5 percent of the total ED visits from exposure to excessive natural heat.

Figure 1B
Hospitalizations from Exposure to Excessive Natural Heat occuring in Arizona by Month, 2017



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, 2017



	Infants <1	Children 1 - 14	Adolescents 15 - 19	Young Adults 20 - 44	Middle-Aged Adults 45 - 64	Elderly 65+
IP Admission	0.0	0.4	1.3	28.4	33.2	36.7
ED visits	0.0	5.9	5.8	47.4	26.0	14.9

In 2017, 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 28.3 percent of IP admissions and 47.4 percent of heat illness ED visits. On the other hand, middle aged and elderly Arizona residents accounted for only 40.9 percent of heat illness ED visits for exposure to excessive natural heat, but represent 69.9 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 5.8 percent of the total.

The median age at illness form exposure to excessive natural heat in 2017 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 13 years lower at time of admission for inpatient care. In 2017, 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, 2017

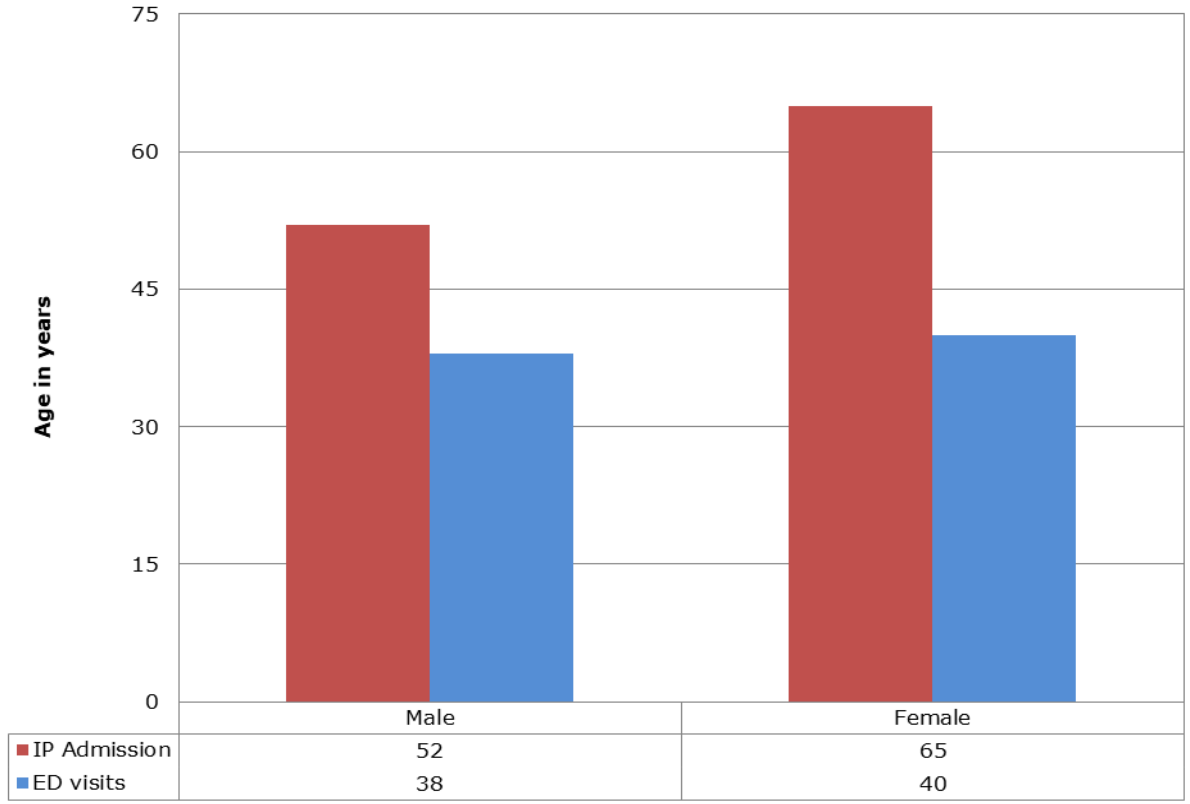
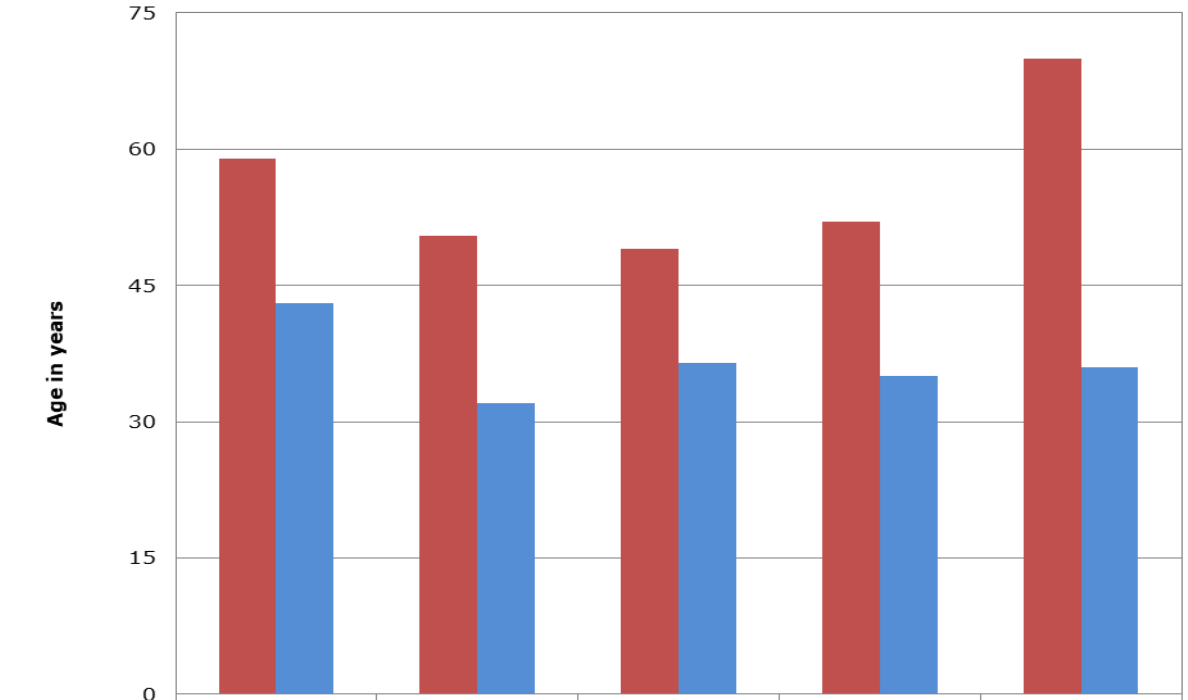


Figure 4B
Median Age at Illness from Exposure to Excessive Natural Heat
by Race/Ethnic Group, 2017



	White non-Hispanic	Hispanic or Latino	Black or African American	American Indian or Alaska Native	Asian or Pacific Islander
IP Admission	59	51	49	52	70
ED visits	43	32	37	35	36

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 Asian or Pacific Islanders were substantially the greatest while Black or African Americans 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 (32 years) followed by American Indian or Alaska Natives (35), Asian or Pacific Islanders (36), and Black or African Americans (37).

Table 1B

Inpatient stays and ED visits from Exposure to Excessive Natural Heat by Region and Demographic Characteristics, 2017

		Total	IP Admissions	ED Visits
Total		1,880	229	1,651
Geographic Region of Occurrence[a]	Central	1,279	170	1,109
	Eastern	15	0	15
	Northern	103	11	92
	Southern	458	48	410
	Western	0	0	0
	Unknown	25	0	25
County of Occurrence	Apache	0†	0	*
	Cochise	20†	*	17
	Coconino	10	0	10
	Gila	10†	*	11
	Graham	6	0	6
	Greenlee	0	0	0
	La Paz	15	0	15
	Maricopa	1,124	165	959
	Mohave	79	10	69
	Navajo	10†	*	9
	Pima	219	26	193
	Pinal	130†	*	128
	Santa Cruz	6	0	6
	Yavapai	10†	0	*
	Yuma	214	20	194
	Unknown	25	0	25
Age Group	0 - 4	16	0	16
	5 - 9	21	0	21
	10 - 14	60†	*	57
	15 - 19	100†	*	95
	20 - 24	174	11	163
	25 - 29	179	12	167
	30 - 34	179	18	161
	35 - 39	182	11	171
	40 - 44	133	13	120
	45 - 49	140	16	124
	50 - 54	142	25	117
	55 - 59	129	20	109
	60 - 64	95	15	80
	65 - 69	94	19	75
	70 - 74	77	27	50
	75 - 79	54	14	40
	80 - 84	53	17	36
	85+	52	7	45
	Unknown	0†	0	*

Table 1B (continued)

Inpatient stays and ED visits from Exposure to Excessive Natural Heat by Region and Demographic Characteristics, 2017

		Total	IP Admissions	ED Visits
Gender	Male	1,305	165	1,140
	Female	575	64	511
Race/Ethnicity	White non-Hispanic	1,128	143	985
	Hispanic or Latino	484	48	436
	Black or African American	145	21	124
	American Indian or Alaska Native	86	11	75
	Asian or Pacific Islander	30†	*	23
	Unknown	10†	*	8
Month of Occurrence	January	0†	*	*
	February	0†	*	*
	March	40†	*	35
	April	50†	*	50
	May	129	11	118
	June	662	92	570
	July	507	57	450
	August	306	39	267
	September	144	20	124
	October	30†	*	24
	November	10†	*	9
	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, 2017

		Total	Geographic Region of Occurrence[a]										
			IP Admissions					ED Visits					
			Central	Eastern	Northern	Southern	Western	Central	Eastern	Northern	Southern	Western	Un-known
Total		1,880	170†	0	10†	50†	0	1,110†	15	90†	410	0	25
County of Occurrence	Apache	0†	0	0	0	0	0	0	0	*	0	0	0
	Cochise	20†	0	0	0	*	0	0	0	0	17	0	0
	Coconino	10	0	0	0	0	0	0	0	10	0	0	0
	Gila	10†	*	0	0	0	0	11	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	15	0	0	0	0	0	0	15	0	0	0	0
	Maricopa	1,124	165	0	0	0	0	959	0	0	0	0	0
	Mohave	79	0	0	10	0	0	0	0	69	0	0	0
	Navajo	10†	0	0	*	0	0	0	0	9	0	0	0
	Pima	219	0	0	0	26	0	0	0	0	193	0	0
	Pinal	130†	*	0	0	0	0	128	0	0	0	0	0
	Santa Cruz	6	0	0	0	0	0	0	0	0	6	0	0
	Yavapai	10†	0	0	0	0	0	*	0	0	0	0	0
	Yuma	214	0	0	0	20	0	0	0	0	194	0	0
	Unknown	25	0	0	0	0	0	0	0	0	0	0	25
Age Group	0 - 4	20†	0	0	0	0	0	10	0	*	*	0	0
	5 - 9	20†	0	0	0	0	0	15	0	*	*	0	0
	10 - 14	60†	*	0	0	0	0	39	*	*	15	0	0
	15 - 19	100†	*	0	0	0	0	62	0	*	27	0	*
	20 - 24	170†	8	0	0	*	0	108	*	7	44	0	*
	25 - 29	180†	12	0	0	0	0	104	*	9	49	0	*
	30 - 34	180†	13	0	*	*	0	120	*	7	30	0	*
	35 - 39	180†	8	0	*	*	0	110	*	8	44	0	6
	40 - 44	130†	12	0	0	*	0	88	0	8	21	0	*
	45 - 49	140†	13	0	0	*	0	89	*	6	24	0	*
	50 - 54	140†	18	0	*	6	0	83	0	8	24	0	*
	55 - 59	130†	17	0	*	*	0	75	*	*	29	0	0
	60 - 64	100†	11	0	0	*	0	52	0	9	19	0	0
	65 - 69	90†	12	0	*	6	0	46	*	*	26	0	0
	70 - 74	80†	20	0	*	*	0	32	0	*	13	0	*
	75 - 79	50†	7	0	*	6	0	24	*	*	10	0	*
	80 - 84	50†	8	0	*	7	0	22	0	*	12	0	0
	85+	50†	7	0	0	0	0	28	*	*	13	0	0
	Unknown	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, 2017

		Total	Geographic Region of Occurrence[a]										
			IP Admissions					ED Visits					
			Central	Eastern	Northern	Southern	Western	Central	Eastern	Northern	Southern	Western	Un-known
Gender	Male	1,305	124	0	6	35	0	758	7	63	294	18	0
	Female	580†	46	0	*	13	0	351	8	29	116	7	0
Race/ Ethnicity	White non-Hispanic	1,128	99	0	11	33	0	677	10	70	217	11	0
	Hispanic or Latino	480†	41	0	0	7	0	276	*	7	140	10	0
	Black or African American	150†	18	0	0	*	0	94	0	*	25	*	0
	American Indian or Alaska Native	90†	7	0	0	*	0	38	*	12	23	0	0
	Asian or Pacific Islander	30†	*	0	0	0	0	17	0	*	*	*	0
	Unknown	10†	*	0	0	*	0	7	0	0	*	0	0
Month of Illness	January	0†	*	0	0	0	0	0	0	0	*	0	0
	February	0†	0	0	0	*	0	*	0	0	*	0	0
	March	40†	*	0	0	*	0	23	*	*	10	0	0
	April	50†	*	0	0	0	0	32	0	0	18	0	0
	May	130†	8	0	*	*	0	78	*	8	30	0	0
	June	660†	66	0	*	21	0	388	*	30	136	12	0
	July	510†	45	0	*	11	0	304	6	30	102	8	0
	August	310†	32	0	*	*	0	183	*	12	67	*	0
	September	140†	11	0	*	7	0	82	*	10	31	0	0
	October	30†	*	0	0	0	0	14	0	*	8	*	0
	November	10†	*	0	0	0	0	*	0	0	6	0	0
	December	0†	0	0	0	0	0	*	0	0	0	0	0

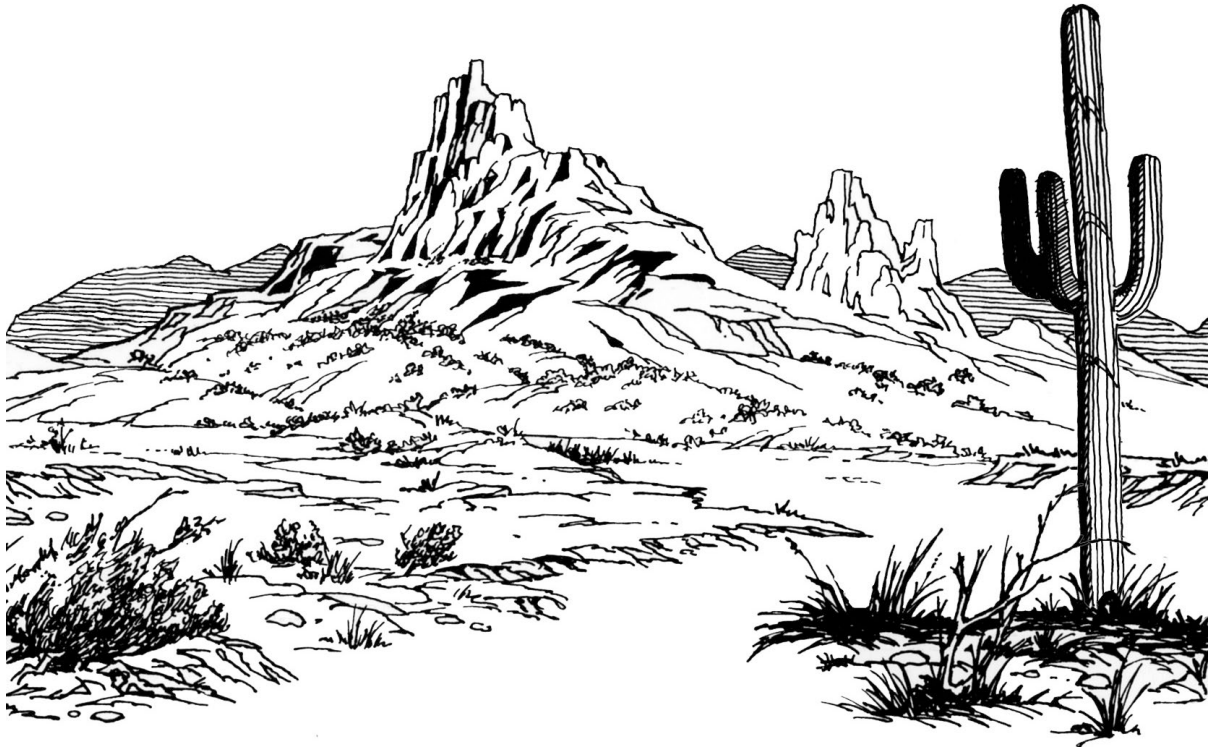
Notes: * Cell suppressed due to non-zero count less than 6; † Sum rounded to nearest tens unit due to non-zero addend less than 6; [a] Classification of geographic regions: Central = Gila, Graham, Maricopa, Pinal, and Yavapai; Eastern = Greenlee; Northern = Apache, Coconino, Mohave, and Navajo; Southern = 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, 2017

Race/Ethnicity	Gender	Median Age at Death	
		IP Admissions	ED Visits
White non-Hispanic	Male	55.5	41
	Female	66	47
	Total	**59**	**43**
Hispanic or Latino	Male	42	32.5
	Female	61	32
	Total	**50.5**	**32**
Black or African American	Male	43	37
	Female	63	35
	Total	**49**	**36.5**
American Indian or Alaska Native	Male	37	36
	Female	73	30.5
	Total	**52**	**35**
Asian or Pacific Islander	Male	70	34
	Female	54	38
	Total	**70**	**36**
Refused/Unknown	Male	40	31.0
	Female	0	37
	Total	**40**	**36.5**

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