Mortality and Morbidity From Exposure to Excessive Natural Heat in Arizona, 2011-2021

ARIZONA DEPARTMENT
OF HEALTH SERVICES

~ Health and Wellness for all Arizonans ~

Katie Hobbs, Governor
State of Arizona

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MORTALITY AND MORBIDITY FROM EXPOSURE TO EXCESSIVE NATURAL HEAT IN ARIZONA, 2011-2021

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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 2011-2021 period, and heat illness cases during 2021 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 (i.e. hospitals regulated by the Arizona Department of Health Services). Discharge records do not capture illness cases that recover without medical intervention or were treated at an urgent care facility. Furthermore, under Arizona Revised Statute (A.R.S.) § 36-125-05 and Arizona Administrative Code Title 9, Chapter 11, Articles 4 and 5, the collection of data from hospitals is only required for licensed hospitals. Therefore, discharge records from hospitals such as Veteran's Administration, Department of Defense, and those located on tribal land are not included in the 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

√ During the 2011-2021 period, there were 1,643 deaths from exposure to heat due to weather conditions occurred in Arizona.

√ The annual number of deaths from exposure to excessive natural heat varied considerably. In 2011 there were 123 deaths from exposure to excessive natural heat recorded in Arizona, this was followed by a decrease in 2012 (97 deaths), then an uptick in 2013 (103 deaths). In 2014, the number of deaths due to exposure to excessive heat fell sharply to 48 deaths, the lowest level recorded. Between 2015 and 2016, the number of deaths due to excessive heat increased to 83 and 146, respectively, then declined to 132 in 2017, and 129 in 2018. In 2019, the number of casualties (160 deaths) was 24.0 percent higher than the count recorded in the preceding year, yet in 2020 the percent was much higher at 95.6 percent (313 deaths) compared to 2019. The largest annual number of deaths of the entire period occurred in 2020, where 313 people died from exposure to excessive natural heat and then minimally decreased to 309 deaths (1.3 percent) in 2021.

√ There were 1,048 deaths from exposure to excessive natural heat among the residents of Arizona (63.8 percent of the total), or 95 deaths on average per year in 2011-2021.

√ Visitors to Arizona from other U.S. states, Canada or Europe experienced around 130 deaths from exposure to heat due to weather conditions in 2011-2021.

√ The state or country of residence of about 120 decedents in 2011-2021 remains unidentified.

√ Approximately eight out of every ten deaths from exposure to excessive natural heat in 2011-2021 were males, and 33.6 percent were Hispanic or Latino.

√ In 2011-2021, ninety-five percent of all deaths from exposure to heat due to weather conditions occurred during the five months from May through September.

√ In 2011-2021, deaths from exposure to excessive natural heat among migrants to Arizona occurred at younger ages compared to deaths from natural heat among the state's residents. Young adults 20-44 years old accounted for 80.0 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 had the highest risk of heatstroke or sunstroke among Arizona residents, all age considered. Arizona residents aged 65 years or older accounted for approximately 46.7 percent of excessive heat fatalities. In contrast, among migrants, those aged 65 years and older represented less than one percent of the total deaths in 2011-2021.

√ In 2011-2021, the four counties along the southern border of Arizona (Cochise, Pima, Santa Cruz, and Yuma) accounted for 34.3 percent of deaths from excessive heat. Individually, Pima county (23.2 percent) and Maricopa county (44.4 percent) accounted for most of the deaths due to exposure to natural heat.

√ In 2021, 97.3 percent of inpatient admissions and 93.9 percent of emergency department visits from exposure to excessive natural heat occurred during the five months from May through September.

√ In 2021, the median age at illness from exposure to excessive natural heat was 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.

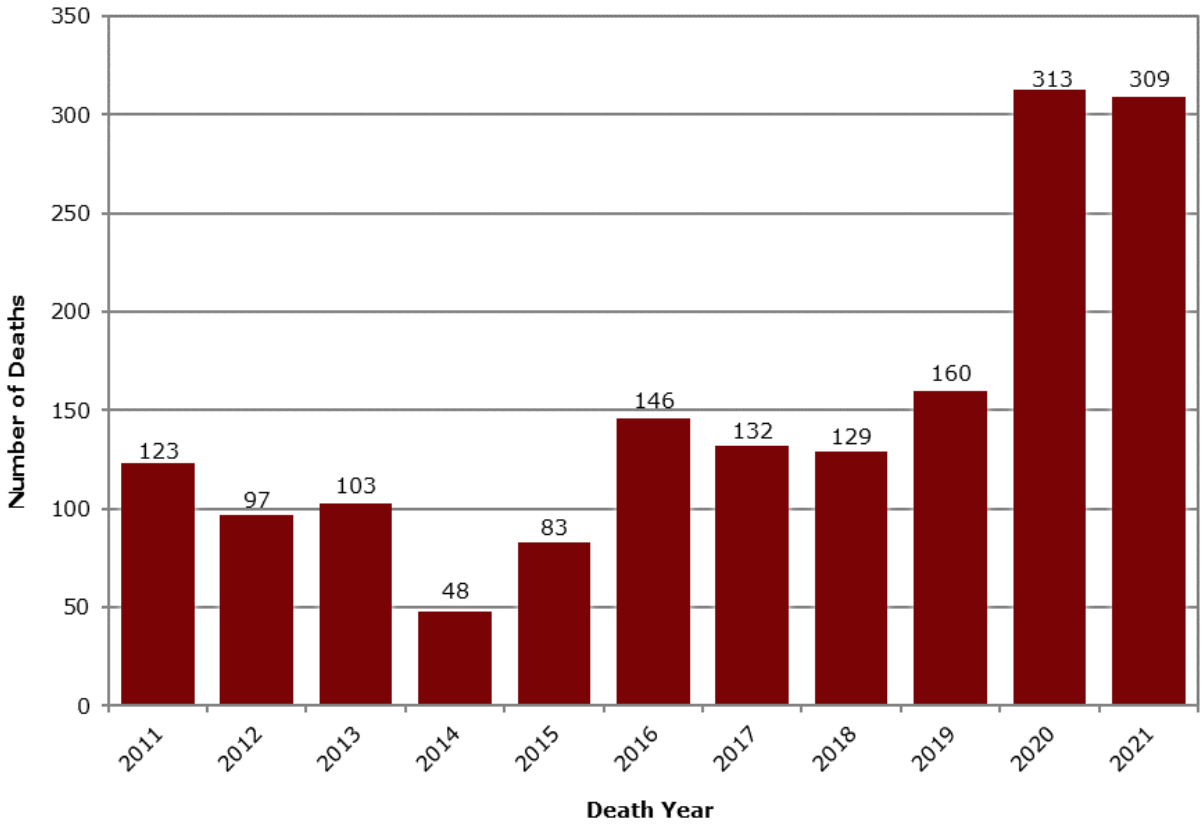
Section A: Heat-Related Mortality, 2011-2021

During the 2011-2021 period, 1,643 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 = 313 deaths in 2020. On average, 149 people died every year from a heatstroke or sunstroke between 2011-2021 (**Figure 1A, Table 1A**).

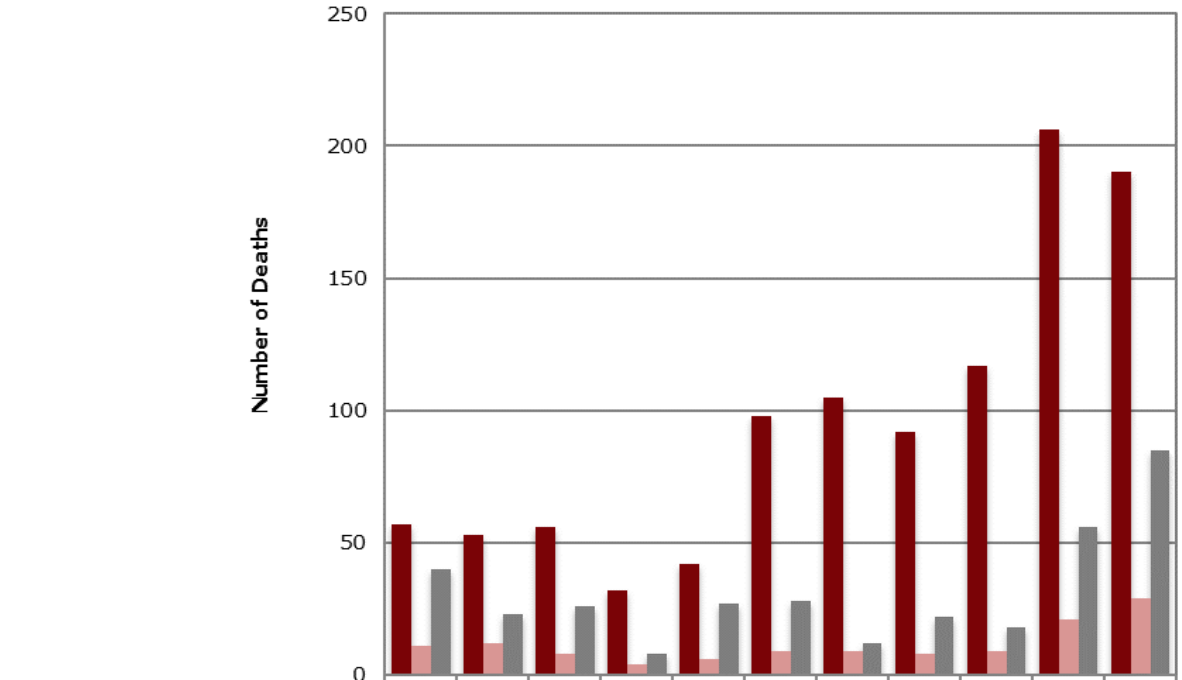
Approximately eight out of every ten deaths from exposure to excessive natural heat in 2011-2021 were males (1,243/1,643 or 75.7 percent, **Table 1A**), and 33.6 percent (552/1,643, **Table 1A**) were Hispanic or Latino.

Figure 1A
Deaths from Exposure to Excessive Natural Heat* occurring in Arizona by Year, 2011-2021



* 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, 2011-2021



	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Arizona	57	53	56	32	42	98	105	92	117	206	190
Other U.S. states or Canada	11	12	8	4	6	9	9	8	9	21	29
Mexico, Central or South America	40	23	26	8	27	28	12	22	18	56	85

There were 1,048 deaths from exposure to excessive natural heat among the residents of Arizona (63.8 percent of the total), or 95 deaths on average per year in 2011-2021.

Migrants from Mexico, Central America or South America accounted for 21.0 percent of the total deaths from exposure to heat due to weather conditions during the 2011 to 2021 period.

Visitors to Arizona from other U.S. states or migrants from Canada experienced 126 deaths from exposure to excessive natural heat during the 2011-2021 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 2021.

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

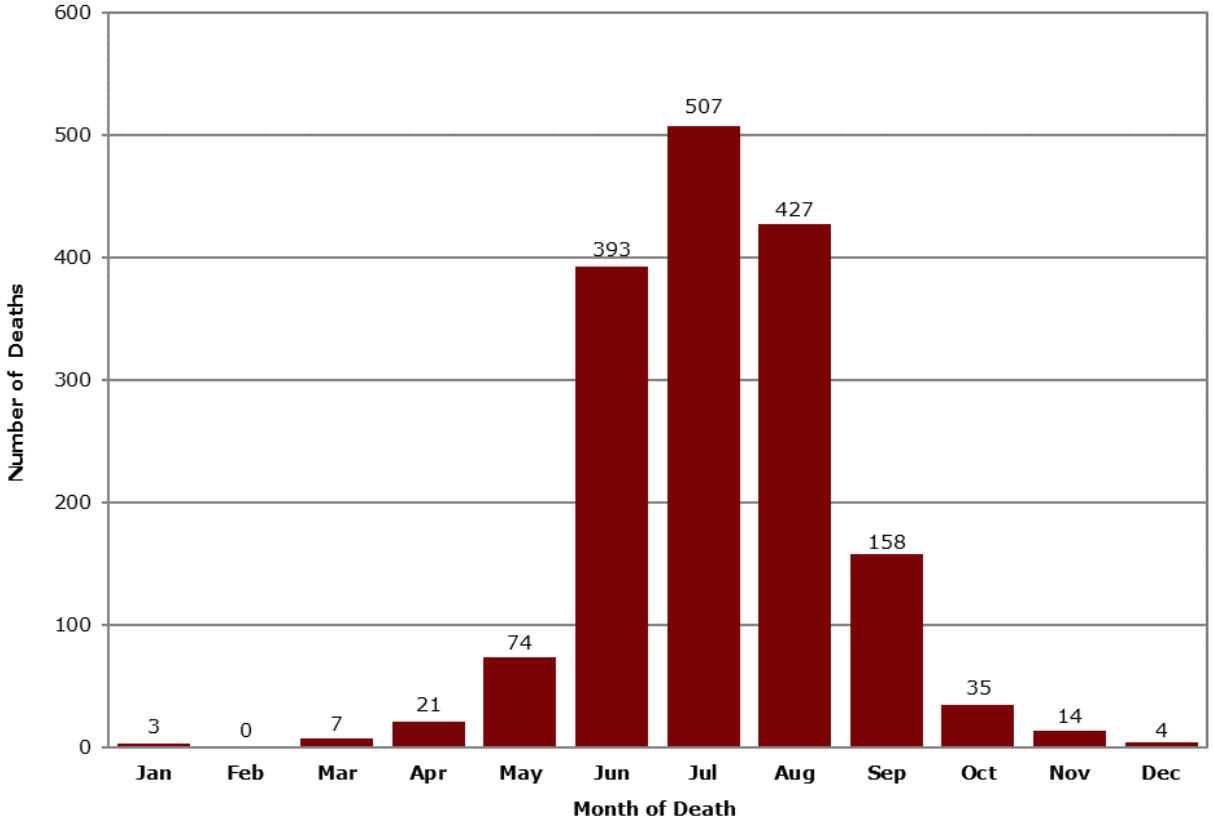
1 http://phoenix.about.com/cs/weather/a/weathertrivia_2.htm

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 (507) in 2011-2021, followed by August (427), then June (393), September (158), and May (74). In 2011-2021, approximately ninety-five percent of all deaths from exposure to heat due to weather conditions occurred during the months of May through September.

Figure 3A
Deaths from Exposure to Excessive Natural Heat* occurring in Arizona by Month, 2011-2021



* 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.

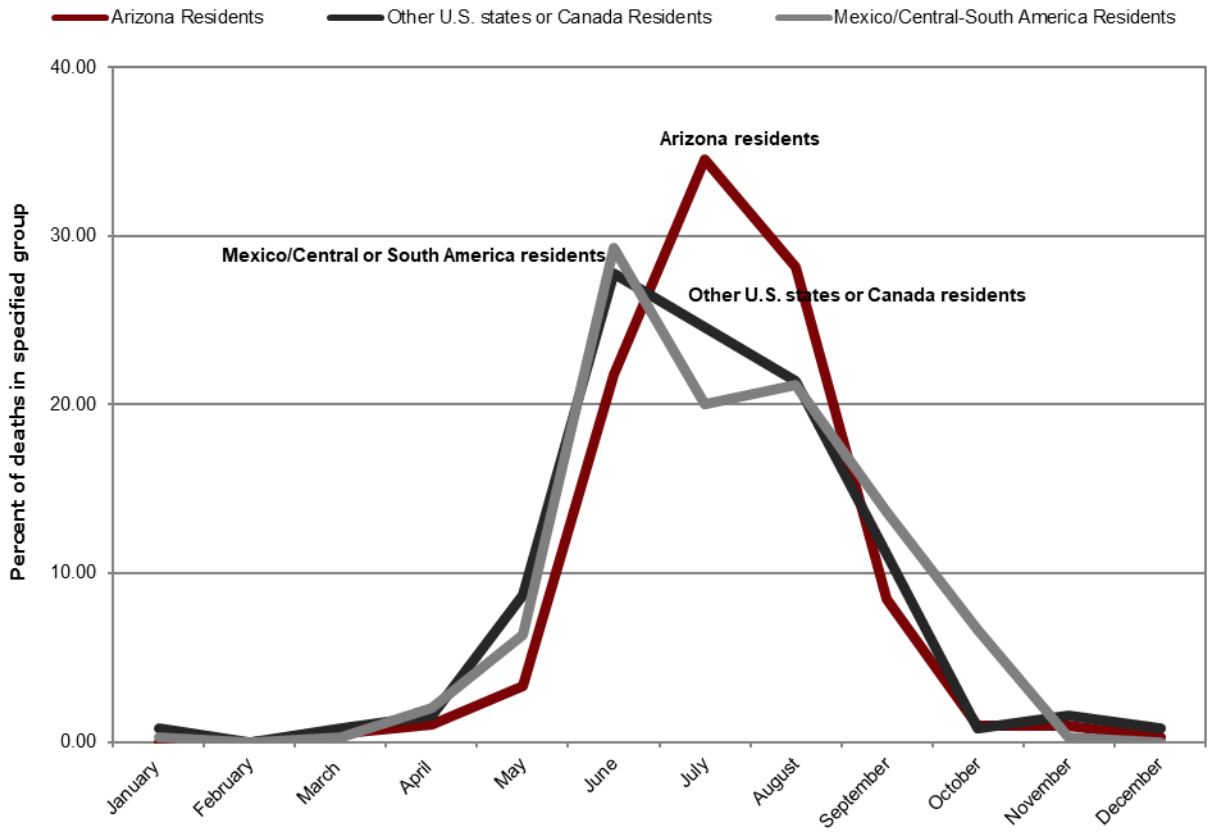
Excluded are deaths due to excessive heat of man-made origin.

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, 2011-2021



* 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.

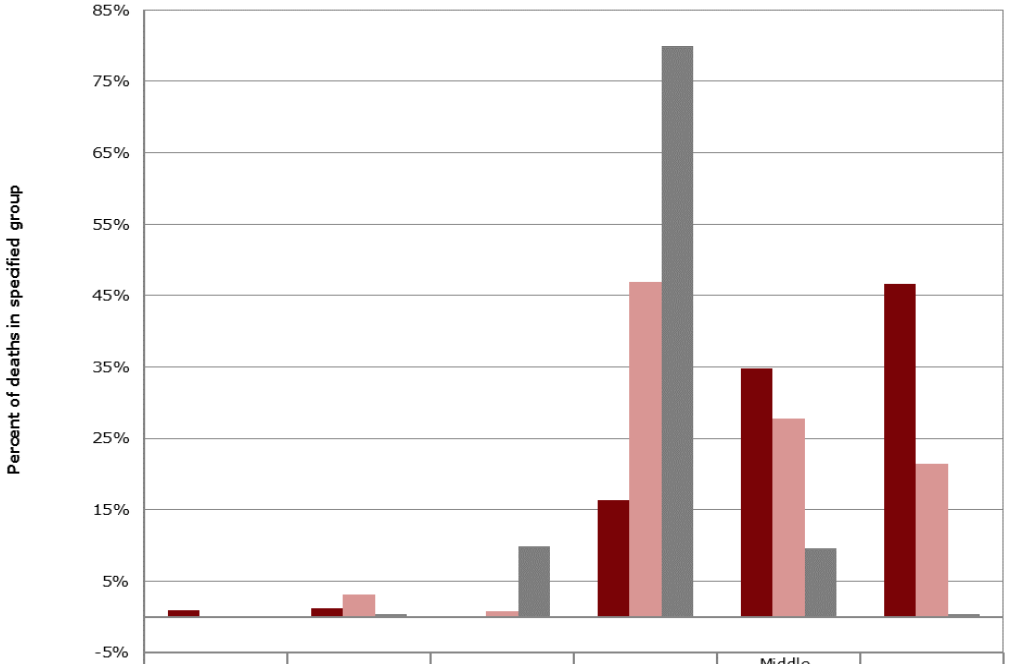
Regardless of the residence status, most deaths from excessive natural heat occurred during the month of July (**Figure 4A, Table 2A**). Compared to the residents of Arizona, the percent distribution of deaths among residents of Mexico, Central America, and South America started rising earlier in the year from March–June before declining during the 2011-2021 period. In contrast, the number of deaths from excessive natural heat among Arizona residents sharply increased in May, and the percent distribution exceeded 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 2011-2021, 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 2011-2021 accounted for 80 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-six percent of fatalities due to exposure to heat occurred among Arizona residents aged 65 years or older. While there was one death recorded among migrants from Mexico and other Central/South American countries of that age group.

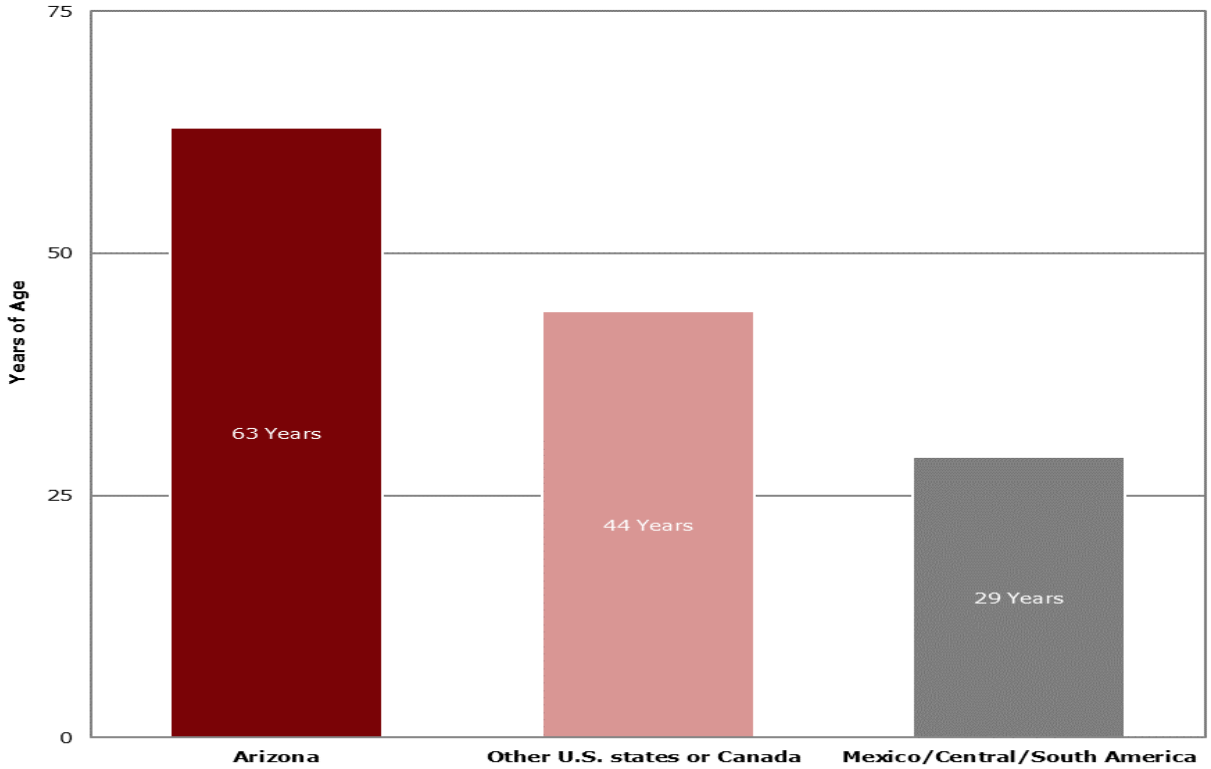
Figure 5A
Percent Distribution of Deaths from Exposure to Excessive Natural Heat* occurring in Arizona by Age Group and Residence Status, 2011-2021



	Infants <1	Children 1 - 14	Adoles-cents 15 - 19	Young Adults 20 - 44	Middle-Aged Adults 45 - 64	Elderly 65+
Arizona	0.86	1.15	0.10	16.32	34.73	46.66
Other U.S. states or Canada	0.00	3.17	0.79	46.83	27.78	21.43
Mexico/Central/South America	0.00	0.29	9.86	80.00	9.57	0.29

* 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, 2011-2021**



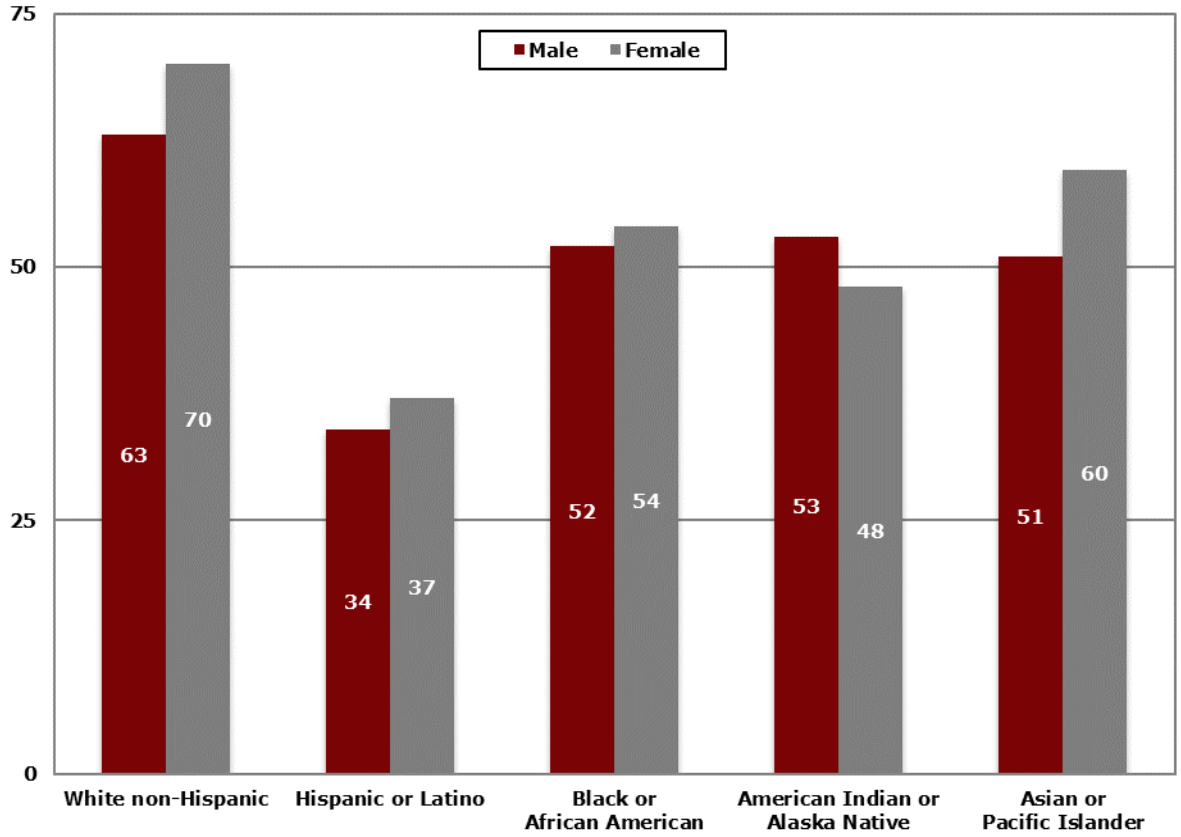
One out of two Arizonans who died from exposure to excessive natural heat in 2011-2021 was older than 63 years of age (**Figure 6A**, **Table 5A**).

In 2011-2021, on average visitors from other states were 19 years younger than the residents of Arizona at the time of death. The median age of residents from Mexico, Central American or South American countries who died from exposure to excessive natural heat was 29 years of age, which was 34 years younger than the median age of deaths of Arizonans.

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

In 2011-2021, White non-Hispanic females ranked highest with median age at death from exposure to excessive natural heat at 70 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 (63 years), and Hispanic males had the lowest (34 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, 2011-2021**



* 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, 2011-2021

		Total	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Total		1,643	123	97	103	48	83	146	132	129	160	313	309
State or Country of Residence	Arizona	1,048	57	53	56	32	42	98	105	92	117	206	190
	Other U.S. states or Canada	130†	11	12	8	*	6	9	9	8	9	21	29
	Mexico, Central or South America	345	40	23	26	8	27	28	12	22	18	56	85
	Other	10†	*	*	*	0	*	*	0	0	0	0	0
	Unknown	120†	14	8	12	*	6	8	6	7	16	30	*
Geographic Region of Occurrence[a]	Central	829	61	55	45	27	39	69	67	76	101	161	128
	Eastern	0	0	0	0	0	0	0	0	0	0	0	0
	Northern	240†	7	0	13	*	*	12	33	19	23	54	68
	Southern	563	55	41	45	18	39	60	32	34	34	95	110
	Western	20†	0	*	0	0	*	*	0	0	*	*	*
County of Occurrence	Apache	10†	*	0	*	0	0	0	0	*	0	0	*
	Cochise	30†	0	0	*	0	*	*	*	*	*	8	9
	Coconino	30†	*	0	*	*	*	0	8	*	*	*	*
	Gila	10†	*	0	*	0	0	*	*	*	*	*	0
	Graham	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	*	*	0	0	*	*	*
	Maricopa	729	54	50	35	21	32	64	59	68	88	143	115
	Mohave	200†	*	0	7	*	*	11	25	15	21	49	60
	Navajo	10†	0	0	0	0	0	*	0	0	0	*	*
	Pima	381	49	35	38	13	28	45	26	25	25	44	53
	Pinal	60†	6	*	*	*	*	*	*	*	12	11	8
	Santa Cruz	30†	*	0	*	*	*	*	0	*	0	7	12
	Yavapai	20†	0	*	*	*	*	*	*	*	0	*	*
	Yuma	130†	*	6	*	*	7	12	*	*	8	36	36
Age Group	0 - 4	20†	0	*	*	*	*	*	*	0	*	*	*
	5 - 9	0†	0	0	0	0	0	0	0	0	*	*	0
	10 - 14	10†	0	0	0	0	*	*	0	*	*	*	*
	15 - 19	40†	*	*	*	*	*	*	*	*	*	7	6
	20 - 24	90†	8	*	13	*	7	8	*	*	7	17	21
	25 - 29	120†	12	7	*	6	8	11	9	7	8	20	26
	30 - 34	100†	14	7	*	0	*	11	10	12	9	11	21
	35 - 39	120†	12	10	7	*	10	11	7	10	6	22	22
	40 - 44	90†	10	8	*	*	*	7	*	6	10	17	19
	45 - 49	100†	9	12	11	0	6	*	7	7	9	23	16
	50 - 54	120†	8	*	8	*	*	10	13	9	8	25	22
	55 - 59	140†	6	7	6	*	9	18	11	7	17	32	18
	60 - 64	130†	10	7	*	*	*	13	8	12	11	29	25
	65 - 69	120†	*	*	*	*	7	7	12	15	11	28	28
	70 - 74	120†	*	7	*	*	7	9	12	17	14	19	25
	75 - 79	120†	6	7	*	*	*	11	13	10	13	30	20
	80 - 84	80†	*	*	6	*	*	*	10	6	11	14	22
	85+	90†	10	*	6	*	*	12	7	*	14	14	16
	Unknown	40†	7	*	12	*	*	*	*	0	*	0	0

Table 1A (continued)

Characteristics of Deaths from Exposure to Excessive Natural Heat Occurring in Arizona by Year, 2011-2021

		Total	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Gender	Male	1,243	97	74	83	32	65	103	91	104	123	239	232
	Female	400	26	23	20	16	18	43	41	25	37	74	77
	Unknown	0	0	0	0	0	0	0	0	0	0	0	0
Race/Ethnicity	White non-Hispanic	824	53	46	48	28	44	81	77	70	74	152	151
	Hispanic or Latino	552	59	43	43	16	32	52	28	35	41	90	113
	Black or African American	80†	6	*	6	*	*	*	*	7	9	20	21
	American Indian or Alaska Native	80†	*	*	6	*	*	10	11	6	6	11	14
	Asian or Pacific Islander	20†	0	*	0	0	*	*	*	*	*	*	*
	Unknown	92	0	0	0	0	0	0	12	10	26	37	7
Month of Death	January	0†	*	0	0	0	0	0	0	0	*	0	0
	February	0	0	0	0	0	0	0	0	0	0	0	0
	March	10†	*	0	*	0	0	*	*	0	0	0	*
	April	20†	*	*	*	*	*	*	*	*	*	*	*
	May	70†	*	9	9	*	*	*	*	11	*	9	15
	June	393	27	24	30	12	32	52	49	16	20	30	101
	July	507	30	28	39	17	9	51	34	50	53	115	81
	August	427	39	26	14	7	34	26	22	28	53	122	56
	September	160†	15	6	6	*	*	8	9	20	19	26	41
	October	40†	*	*	*	*	*	*	*	*	*	9	8
	November	10†	*	*	*	*	*	*	*	*	0	0	*
	December	0†	0	0	0	0	0	0	*	0	0	*	*
	Unknown	0	0	0	0	0	0	0	0	0	0	0	0
Autopsy Performed	No	632	36	34	27	12	18	37	63	42	62	154	147
	Yes	1,011	87	63	76	36	65	109	69	87	98	159	162
	Unknown	0	0	0	0	0	0	0	0	0	0	0	0

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

Table 2A

Characteristics of Arizona Deaths from Exposure to Excessive Natural Heat by Residence Status, 2011-2021

		Total	State or Country of Residence				
			Arizona	Other U.S. states or Canada	Mexico, Central or South America	Other	Unknown
Total		1,643	1,048	130†	345	10†	120†
	2011	120†	57	11	40	*	14
	2012	100†	53	12	23	*	8
	2013	100†	56	8	26	*	12
	2014	50†	32	*	8	0	*
	2015	80†	42	6	27	*	6
	2016	150†	98	9	28	*	8
	2017	132	105	9	12	0	6
	2018	129	92	8	22	0	7
	2019	160	117	9	18	0	16
	2020	313	206	21	56	0	30
	2021	309	190	29	85	0	*
Geographic Region of Occurrence[a]	Central	830†	683	51	34	*	58
	Eastern	0	0	0	0	0	0
	Northern	240†	205	28	0	*	*
	Southern	560†	150	43	311	*	55
	Western	20†	10	*	0	0	*
Age Group	0 - 4	15	15	0	0	0	0
	5 - 9	0†	*	*	0	0	0
	10 - 14	10†	*	*	*	0	0
	15 - 19	40†	*	*	34	0	*
	20 - 24	90†	15	*	73	0	*
	25 - 29	120†	34	6	73	*	*
	30 - 34	100†	29	18	49	*	*
	35 - 39	120†	57	15	45	*	*
	40 - 44	90	36	17	36	0	*
	45 - 49	100†	63	8	19	*	13
	50 - 54	120†	88	8	8	*	10
	55 - 59	140†	107	11	*	*	12
	60 - 64	130†	106	8	*	0	11
	65 - 69	120†	104	10	*	0	6
	70 - 74	121	110	7	0	0	*
	75 - 79	120†	110	*	0	0	*
	80 - 84	80†	75	*	0	0	*
	85+	91	90	0	0	0	*
	Unknown	40†	*	0	0	0	40

Table 2A (continued)
Characteristics of Arizona Deaths from Exposure to Excessive Natural Heat by Residence Status, 2011-2021

		Total	State or Country of Residence				
			Arizona	Other U.S. states or Canada	Mexico, Central or South America	Other	Unknown
Gender	Male	1,243	734	92	305	6	106
	Female	400†	314	34	40	*	10
	Unknown	0	0	0	0	0	0
Race/Ethnicity	White non-Hispanic	820†	689	74	*	*	56
	Hispanic or Latino	550†	158	39	342	*	11
	Black or African American	80†	69	6	*	0	*
	American Indian or Alaska Native	80†	78	*	*	0	0
	Asian or Pacific Islander	20†	11	*	0	*	0
	Unknown	90†	43	*	0	0	47
Month of Death	January	0†	0	*	*	0	*
	February	0	0	0	0	0	0
	March	10†	*	*	*	0	0
	April	20†	11	*	7	0	*
	May	70†	35	11	22	*	*
	June	390†	228	35	101	*	25
	July	510†	362	31	69	*	43
	August	427	295	27	73	0	32
	September	160†	89	14	47	*	7
	October	40†	10	*	23	0	*
	November	10†	10	*	*	0	*
	December	0†	*	*	0	0	0
	Unknown	0	0	0	0	0	0
Autopsy Performed	No	630†	523	38	43	*	27
	Yes	1,011	525	88	302	7	89
	Unknown	0	0	0	0	0	0

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

Table 3A

Characteristics of Arizona Deaths from Exposure to Excessive Natural Heat by Region, 2011-2021

		Total	Geographic Region of Occurrence[a]				
			Central	Eastern	Northern	Southern	Western
Total		1,643	829	0	240†	563	20†
	2011	123	61	0	7	55	0
	2012	100†	55	0	0	41	*
	2013	103	45	0	13	45	0
	2014	50†	27	0	*	18	0
	2015	80†	39	0	*	39	*
	2016	150†	69	0	12	60	*
	2017	132	67	0	33	32	0
	2018	129	76	0	19	34	0
	2019	160†	101	0	23	34	*
	2020	310†	161	0	54	95	*
	2021	310†	128	0	68	110	*
State or Country of Residence	Arizona	1,048	683	0	205	150	10
	Other U.S. states or Canada	130†	51	0	28	43	*
	Mexico, Central or South America	345	34	0	0	311	0
	Other	10†	*	0	*	*	0
	Unknown	120†	58	0	*	55	*
County of Occurrence	Apache	10†	0	0	*	0	0
	Cochise	26	0	0	0	26	0
	Coconino	31	0	0	31	0	0
	Gila	11	11	0	0	0	0
	Graham	0†	*	0	0	0	0
	Greenlee	0	0	0	0	0	0
	La Paz	15	0	0	0	0	15
	Maricopa	729	729	0	0	0	0
	Mohave	195	0	0	195	0	0
	Navajo	10†	0	0	*	0	0
	Pima	381	0	0	0	381	0
	Pinal	64	64	0	0	0	0
	Santa Cruz	30	0	0	0	30	0
	Yavapai	22	22	0	0	0	0
	Yuma	126	0	0	0	126	0
Age Group	0 - 4	20†	11	0	*	*	0
	5 - 9	0†	*	0	0	*	0
	10 -14	10†	*	0	*	*	0
	15 - 19	37	6	0	0	31	0
	20 - 24	90†	23	0	*	69	0
	25 - 29	120†	38	0	*	76	*
	30 - 34	100†	38	0	*	58	0
	35 - 39	122	56	0	7	59	0
	40 - 44	90†	41	0	6	41	*
	45 - 49	104	65	0	7	32	0
	50 - 54	120†	76	0	16	22	*
	55 - 59	140†	82	0	27	26	*
	60 - 64	130†	83	0	26	15	*
	65 - 69	120†	64	0	39	17	*
	70 - 74	120†	65	0	36	18	*
	75 - 79	120†	62	0	29	25	*
	80 - 84	80†	42	0	22	16	*
	85+	90†	66	0	10	14	*
	Unknown	40†	*	0	0	37	0

Table 3A (continued)

Characteristics of Arizona Deaths from Exposure to Excessive Natural Heat by Region, 2011-2021

		Total	Geographic Region of Occurrence				
			Central	Eastern	Northern	Southern	Western
Gender	Male	1,243	603	0	163	466	11
	Female	400†	226	0	73	97	*
	Unknown	0	0	0	0	0	0
Race/Ethnicity	White non-Hispanic	824	483	0	174	157	10
	Hispanic or Latino	552	155	0	17	380	0
	Black or African American	80†	73	0	*	*	*
	American Indian or Alaska Native	80†	41	0	28	8	*
	Asian or Pacific Islander	20†	13	0	*	*	0
	Unknown	90†	64	0	13	14	*
Month of Death	January	0†	*	0	0	*	0
	February	0	0	0	0	0	0
	March	10†	*	0	*	*	0
	April	20†	8	0	*	9	0
	May	70†	28	0	8	37	*
	June	390†	167	0	59	164	*
	July	510†	284	0	88	131	*
	August	430†	226	0	56	140	*
	September	160†	82	0	16	58	*
	October	40†	16	0	*	18	0
	November	10†	9	0	*	*	0
	December	0†	*	0	*	0	0
	Unknown	0	0	0	0	0	0
Autopsy Performed	No	632	261	0	203	159	9
	Yes	1,011	568	0	33	404	6
	Unknown	0	0	0	0	0	0

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

Table 4A
Deaths from Exposure to Excessive Natural Heat by Geographic Region of Occurrence in Arizona, and Residence Status, 2011-2021

		Total	Geographic Region of Occurrence[a]				
			Central	Eastern	Northern	Southern	Western
State or Country of Residence	Arizona	1048	683	0	205	150	10
	Other U.S. states or Canada	130†	51	0	28	43	*
	Mexico, Central or South America	345	34	0	0	311	0
	Other	10†	*	0	*	*	0
	Unknown	120†	58	0	*	55	*
Total		1,643	830†	0	240†	560†	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, 2011-2021

		Geographic Region of Occurrence[a]				
		Central	**Eastern**	**Northern**	**Southern**	**Western**
State or Country of Residence	Arizona	60	0	68	66	74
	Other U.S. states or Canada	45	0	55	37	62
	Mexico, Central or South America	28	0	0	29	0
	Other	45	0	36	34	0

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

Table 6A
Median Age at Death from Exposure to Excessive Natural Heat by Race/Ethnicity and Gender, 2011-2021

Race/Ethnicity	Gender	Median Age at Death
White non-Hispanic	Male	63
	Female	70
	Total	**65**
Hispanic or Latino	Male	34
	Female	37
	Total	**35**
Black or African American	Male	52
	Female	54
	Total	**54**
American Indian or Alaska Native	Male	53
	Female	48
	Total	**52**
Asian or Pacific Islander	Male	51
	Female	60
	Total	**51**
Unknown	Male	64
	Female	61
	Total	**64**

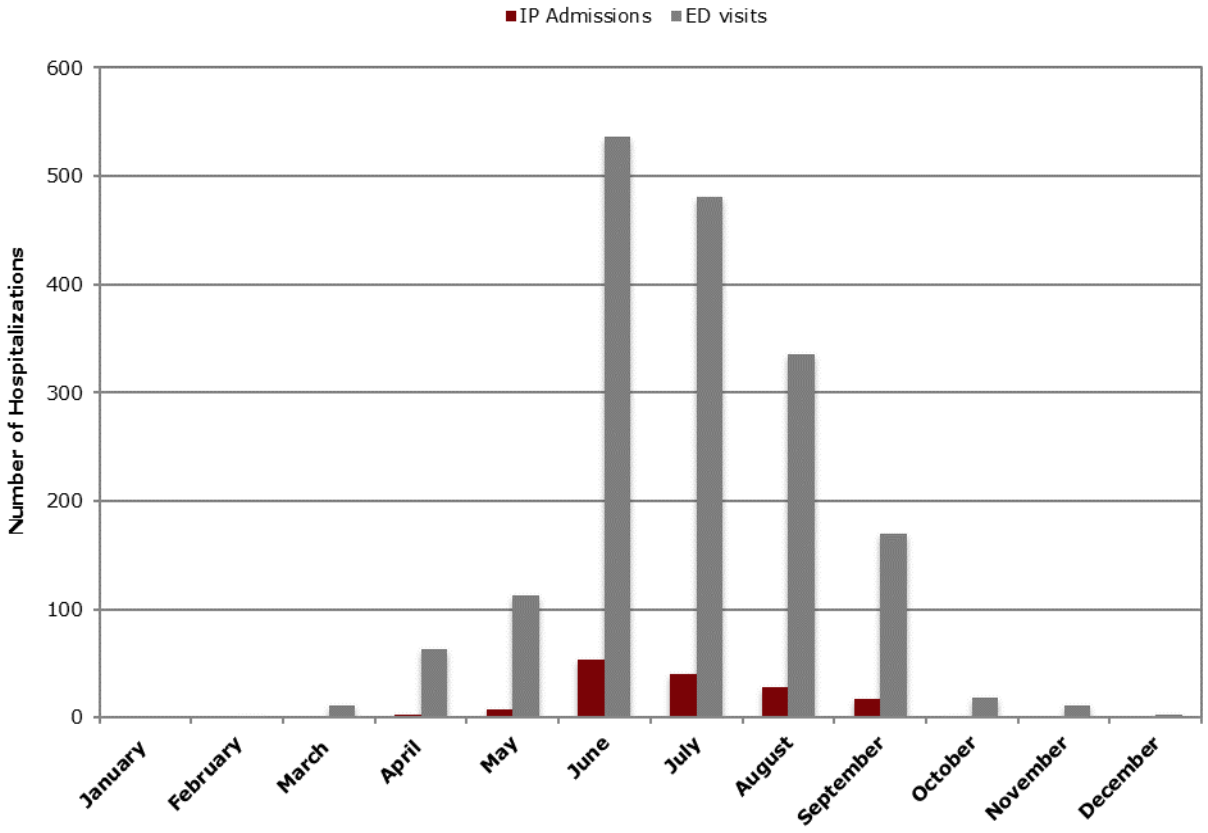
Section B: Heat-Related Morbidity, 2021

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 May, June, July, August, and September.

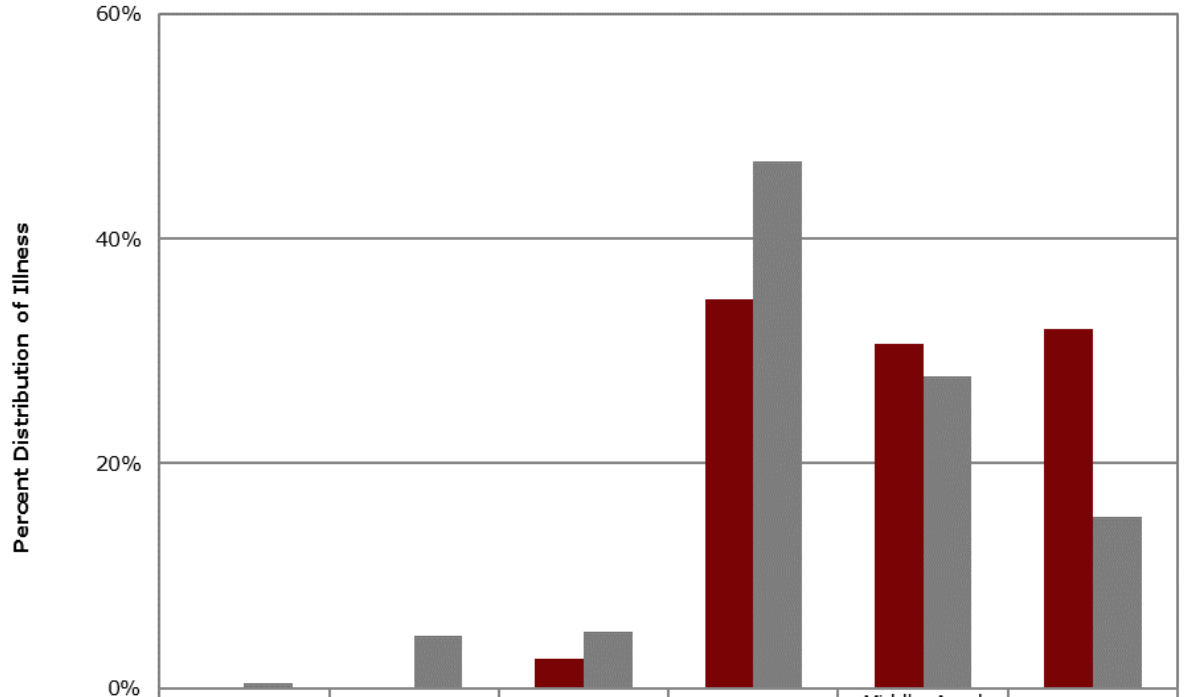
The warm season between May and September accounts for 97.3 percent of hospitalizations and 93.9 percent of the total ED visits from exposure to excessive natural heat.

Figure 1B
Hospitalizations from Exposure to Excessive Natural Heat occuring in Arizona by Month, 2021



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, 2021



	Infants <1	Children 1 - 14	Adolescents 15 - 19	Young Adults 20 - 44	Middle-Aged Adults 45 - 64	Elderly 65+
IP Admission	0.0	0.0	2.7	34.7	30.7	32.0
ED visits	0.4	4.7	5.0	46.8	27.8	15.2

In 2021, IP admissions due exposure to excessive natural heat affected all age groups. This is true for ED visits, but with the exception of infants (<1year old). Young adult residents of Arizona 20-44 years old accounted for 34.7 percent of IP admissions and 46.8 percent of heat illness ED visits. On the other hand, middle aged and elderly Arizona residents accounted for only 43.0 percent of heat illness ED visits for exposure to excessive natural heat, but represent 62.7 percent of IP admissions (**Figure 2B**).

Approximately 5.1 percent of heat illness emergency department visits were from Arizona resident children ages 1-14 years old, but Arizona resident adolescents 15-19 years old accounted for 5.0 percent of the total.

The median age at illness form exposure to excessive natural heat in 2021 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 14 years lower at time of admission for inpatient care. In 2021, the median age due to exposure to excessive natural heat was generally higher for IP admissions compared to ED visits.

Figure 3B
Median Age at Illness from Exposure to Excessive Natural Heat by Gender, 2021

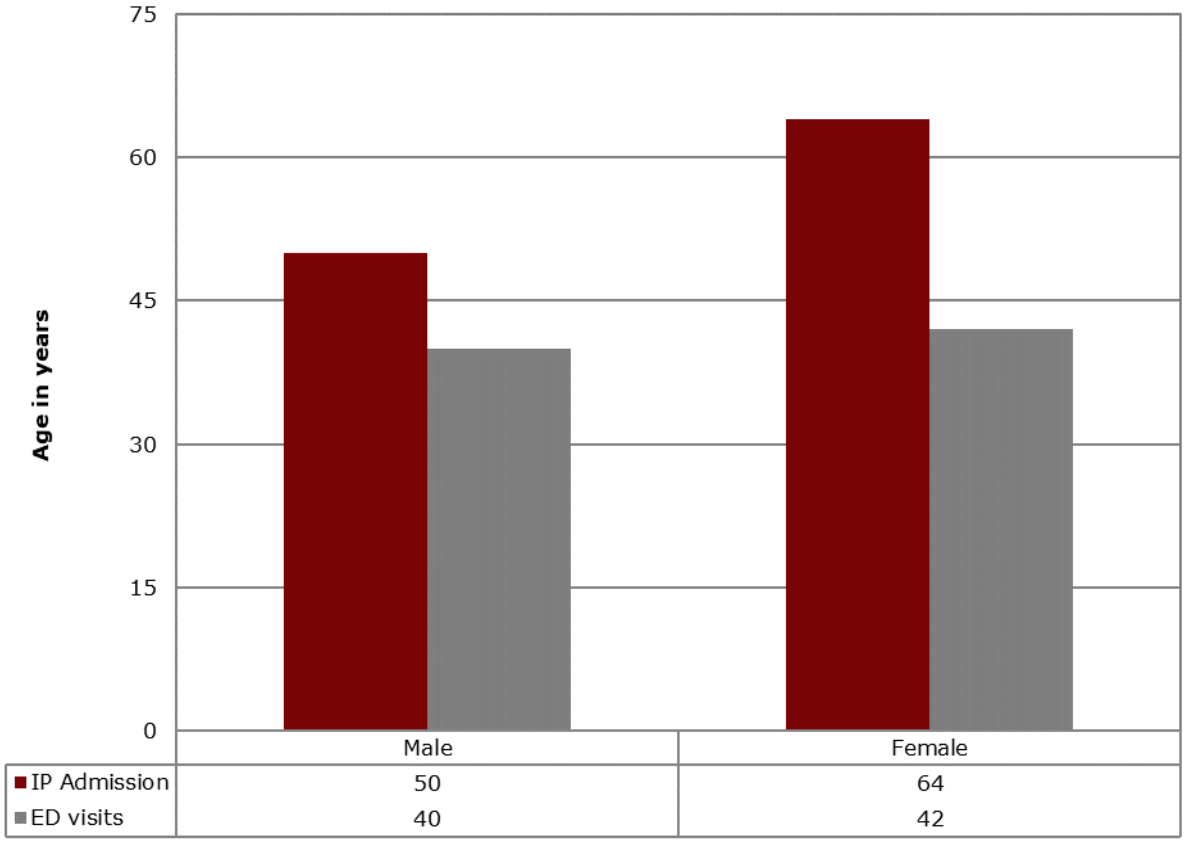
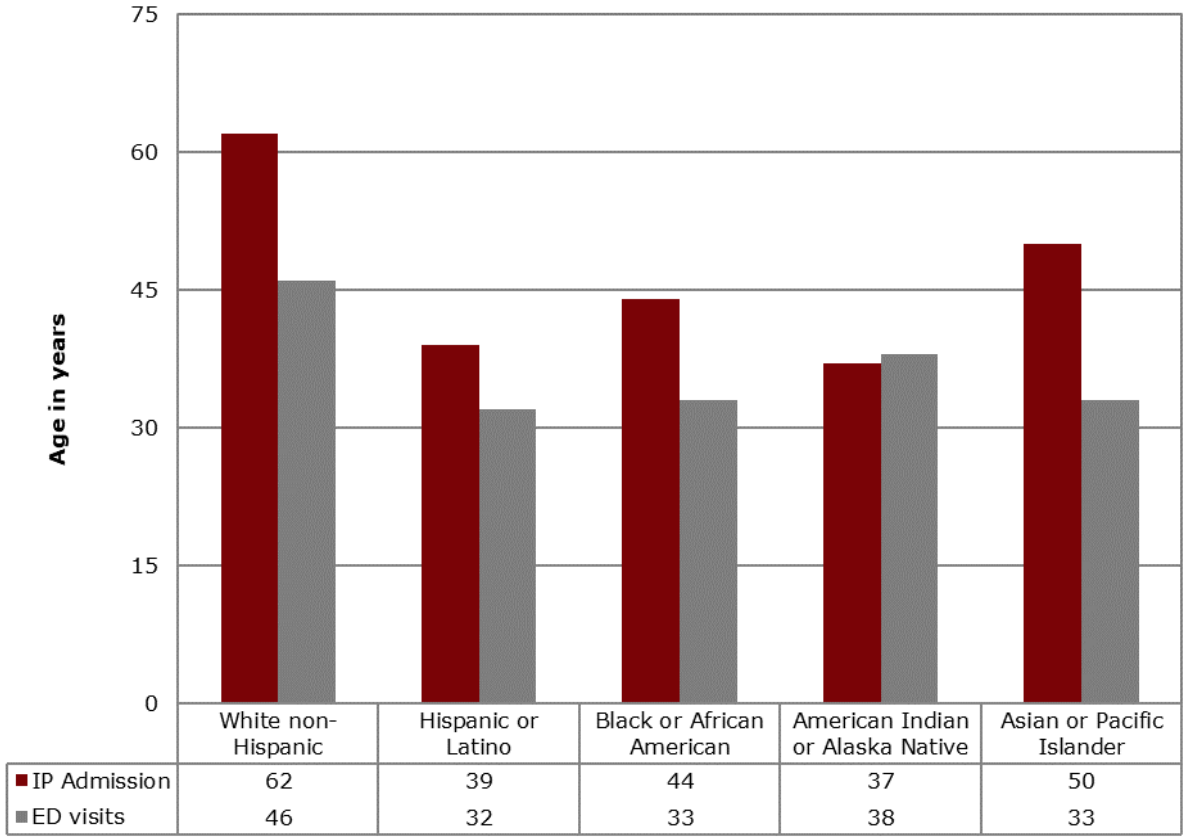


Figure 4B
Median Age at Illness from Exposure to Excessive Natural Heat by Race/Ethnic Group, 2021



	White non-Hispanic	Hispanic or Latino	Black or African American	American Indian or Alaska Native	Asian or Pacific Islander
IP Admission	62	39	44	37	50
ED visits	46	32	33	38	33

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-Hispanic, was substantially the greatest while American Indian or Alaska Native had the youngest age at illness. The median age of White non-Hispanics visiting the emergency department for a heat illness was 46 years of age, the highest among all race/ethnic groups and the lowest being recorded among Hispanic or Latinos (32).

Table 1B

Inpatient stays and ED visits from Exposure to Excessive Natural Heat by Region and Demographic Characteristics, 2021

		Total	IP Admissions	ED Visits
Total		1,894	150†	1,744
Geographic Region of Occurrence[a]	Central	1,226	110	1,116
	Eastern	0	0	0
	Northern	197	11	186
	Southern	308	23	285
	Western	30†	*	28
	Unknown	130†	*	129
County of Occurrence	Apache	0†	0	*
	Cochise	23	0	23
	Coconino	27	0	27
	Gila	11	0	11
	Graham	0†	0	*
	Greenlee	0	0	0
	La Paz	30†	*	28
	Maricopa	1,092	105	987
	Mohave	152	11	141
	Navajo	15	0	15
	Pima	116	10	106
	Pinal	80†	*	74
	Santa Cruz	0†	0	*
	Yavapai	40†	*	40
	Yuma	166	13	153
	Unknown	130†	*	129
Age Group	0 - 4	21	0	21
	5 - 9	29	0	29
	10 - 14	39	0	39
	15 - 19	90†	*	88
	20 - 24	150†	*	146
	25 - 29	186	8	178
	30 - 34	206	16	190
	35 - 39	167	12	155
	40 - 44	159	11	148
	45 - 49	136	8	128
	50 - 54	136	13	123
	55 - 59	132	8	124
	60 - 64	127	17	110
	65 - 69	88	11	77
	70 - 74	92	11	81
	75 - 79	59	12	47
	80 - 84	41	7	34
	85+	33	7	26
	Unknown	0	0	0

Table 1B (continued)

Inpatient stays and ED visits from Exposure to Excessive Natural Heat by Region and Demographic Characteristics, 2021

		Total	IP Admissions	ED Visits
Gender	Male	1,324	119	1,205
	Female	570	31	539
Race/Ethnicity	White non-Hispanic	1,148	97	1,051
	Hispanic or Latino	460	33	427
	Black or African American	157	11	146
	American Indian or Alaska Native	86	7	79
	Asian or Pacific Islander	20†	*	15
	Unknown	30†	*	26
Month of Occurrence	January	0	0	0
	February	0†	0	*
	March	11	0	11
	April	70†	*	63
	May	121	8	113
	June	590	53	537
	July	521	40	481
	August	364	28	336
	September	187	17	170
	October	20†	*	18
	November	11	0	11
	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 (Expanded) and Demographic Characteristics, 2021

		Total	Geographic Region of Occurrence[a]											
			IP Admissions						ED Visits					
			Central	Eastern	Northern	Southern	Western	Un-known	Central	Eastern	Northern	Southern	Western	Un-known
Total		1,894	110†	0	11	23	0†	4	1,120†	0	190†	290†	28	129
County of Occurrence	Apache	0†	0	0	0	0	0	0	0	0	*	0	0	0
	Cochise	23	0	0	0	0	0	0	0	0	0	23	0	0
	Coconino	27	0	0	0	0	0	0	0	0	27	0	0	0
	Gila	11	0	0	0	0	0	0	11	0	0	0	0	0
	Graham	0†	0	0	0	0	0	0	*	0	0	0	0	0
	Greenlee	0	0	0	0	0	0	0	0	0	0	0	0	0
	La Paz	30†	0	0	0	0	*	0	0	0	0	0	28	0
	Maricopa	1,092	105	0	0	0	0	0	987	0	0	0	0	0
	Mohave	152	0	0	11	0	0	0	0	0	141	0	0	0
	Navajo	15	0	0	0	0	0	0	0	0	15	0	0	0
	Pima	116	0	0	0	10	0	0	0	0	0	106	0	0
	Pinal	80†	*	0	0	0	0	0	74	0	0	0	0	0
	Santa Cruz	0†	0	0	0	0	0	0	0	0	0	*	0	0
	Yavapai	40†	*	0	0	0	0	0	40	0	0	0	0	0
	Yuma	166	0	0	0	13	0	0	0	0	0	153	0	0
	Unknown	133	0	0	0	0	0	*	0	0	0	0	0	129
Age Group	0 - 4	20†	0	0	0	0	0	0	8	0	*	7	*	0
	5 - 9	30†	0	0	0	0	0	0	13	0	*	9	*	*
	10 - 14	40†	0	0	0	0	0	0	28	0	*	*	*	*
	15 - 19	90†	*	0	0	*	0	0	51	0	12	15	*	7
	20 - 24	150†	*	0	0	*	0	*	92	0	10	23	*	19
	25 - 29	190†	6	0	0	*	0	0	116	0	16	26	*	17
	30 - 34	210†	11	0	*	*	0	*	131	0	19	27	*	12
	35 - 39	170†	9	0	*	*	0	0	103	0	15	22	*	12
	40 - 44	160†	*	0	*	*	*	*	97	0	18	20	*	12
	45 - 49	140†	8	0	0	0	0	0	85	0	13	17	*	10
	50 - 54	140†	11	0	0	*	0	*	79	0	13	23	*	7
	55 - 59	130†	6	0	*	*	0	0	86	0	11	19	*	6
	60 - 64	130†	12	0	*	*	0	0	72	0	12	21	0	*
	65 - 69	90†	8	0	0	*	*	0	47	0	11	12	*	6
	70 - 74	90†	9	0	*	0	0	0	43	0	10	23	*	*
	75 - 79	60†	8	0	*	*	0	0	26	0	8	11	*	*
	80 - 84	40†	6	0	0	*	0	0	21	0	7	*	*	*
	85+	30†	*	0	0	*	0	0	18	0	*	*	0	*
	Unknown	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 2B (continued)

Inpatient stays and ED visits from Exposure to Excessive Natural Heat by Region (Expanded) and Demographic Characteristics, 2021

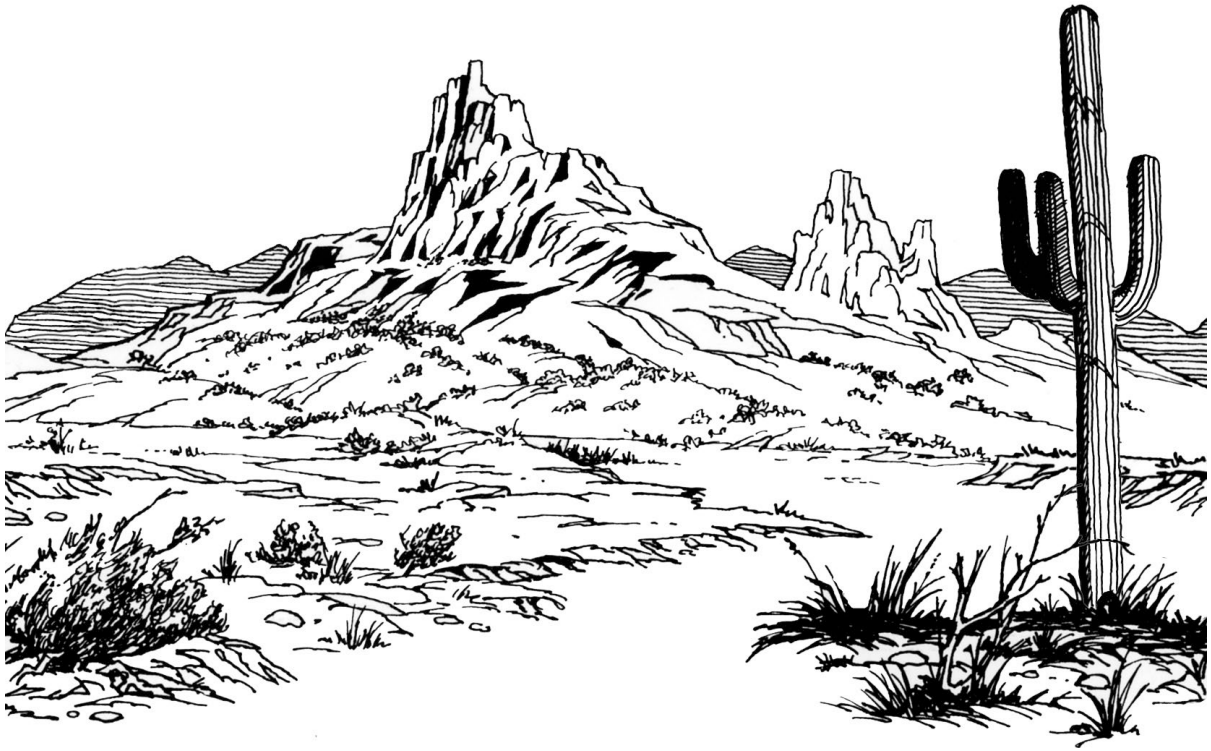
		Total	Geographic Region of Occurrence[a]											
			IP Admissions						ED Visits					
			Central	Eastern	Northern	Southern	Western	Un-known	Central	Eastern	Northern	Southern	Western	Un-known
Gender	Male	1,320†	88	0	7	19	*	*	770	0	125	189	15	106
	Female	570†	22	0	*	*	0	*	346	0	61	96	13	23
Race/ Ethnicity	White non-Hispanic	1,150†	71	0	8	15	*	*	656	0	142	148	19	86
	Hispanic or Latino	460†	22	0	*	6	0	*	269	0	20	104	6	28
	Black or African American	160†	9	0	*	*	0	0	106	0	8	20	0	12
	American Indian or Alaska Native	90†	6	0	0	*	0	0	51	0	13	9	*	*
	Asian or Pacific Islander	20†	*	0	0	0	0	0	15	0	0	0	0	0
	Unknown	30†	*	0	0	0	0	0	19	0	*	*	0	0
Month of Illness	January	0	0	0	0	0	0	0	0	0	0	0	0	0
	February	0†	0	0	0	0	0	0	0	0	0	*	0	0
	March	10†	0	0	0	0	0	0	7	0	*	*	0	0
	April	70†	*	0	*	*	0	0	42	0	*	10	*	*
	May	120†	6	0	*	*	0	0	67	0	11	24	*	7
	June	590†	39	0	*	8	0	*	330	0	62	96	14	35
	July	520†	31	0	0	7	*	*	329	0	55	61	*	35
	August	360†	16	0	*	6	0	*	203	0	42	57	*	29
	September	190†	16	0	0	0	*	0	118	0	7	29	*	14
	October	20†	*	0	0	0	0	0	11	0	*	*	0	*
	November	10†	0	0	0	0	0	0	8	0	0	*	0	*
	December	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, 2021

Race/Ethnicity	Gender	Median Age at Death	
		IP Admissions	ED Visits
White non-Hispanic	Male	61	45
	Female	68	48
	Total	**62**	**46**
Hispanic or Latino	Male	36	32
	Female	59	32
	Total	**39**	**32**
Black or African American	Male	39	33
	Female	45	34
	Total	**44**	**33**
American Indian or Alaska Native	Male	37	38
	Female	50	37
	Total	**37**	**38**
Asian or Pacific Islander	Male	50	39
	Female	0	30
	Total	**50**	**33**
Refused/Unknown	Male	77	49
	Female	0	59
	Total	**77**	**52**

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 (all injury, accidents, suicides, homicides, legal intervention, undetermined, 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, alcohol abuse, asthma, diabetes, substance abuse, falls, influenza and pneumonia, injury, and mental disorders), Abortions in Arizona, Community Vital Statistics, Teenage Pregnancy, Differences in Health Status Among Racial/Ethnic Groups, Health Status Profile of American Indians in Arizona, Mortality from Alzheimer's Disease, Heart Disease vs. Cancer: An Epidemiologic Transition in Mortality Risks, and Deaths from Exposure to Excessive Natural Heat Occurring in Arizona.



ARIZONA DEPARTMENT OF HEALTH SERVICES
Business Intelligence Office
Vital Statistics Program