Mortality and Morbidity From Exposure to Excessive Natural Heat in Arizona, 2010-2020

ARIZONA DEPARTMENT
OF HEALTH SERVICES

~ Health and Wellness for all Arizonans ~

Douglas A. Ducey, Governor
State of Arizona

Don Herrington, Interim Director
Arizona Department of Health Services

ARIZONA DEPARTMENT OF HEALTH SERVICES
BUREAU OF PUBLIC HEALTH STATISTICS
POPULATION HEALTH AND VITAL STATISTICS SECTION
150 North 18th Avenue, Suite 550
Phoenix, Arizona 85007
Phone: 602-542-7333; FAX: 602-542-2940
http://pub.azdhs.gov/health-stats

This publication can be made available in alternative format.
Please contact the Bureau of Public Health Statistics
at 602-542-7333 (voice) or call 1-800-367-8939 (TDD).

The Arizona Department of Health Services is
an Equal Employment Opportunity Agency.

MORTALITY AND MORBIDITY FROM EXPOSURE TO EXCESSIVE NATURAL HEAT IN ARIZONA, 2010-2020

by
Marguerite L. S. Kemp, Ph.D., ***Arizona Vital Statistician***
Yan Huang, M.S., ***Vital Statistics Health Management Analyst***
Clare Torres, ***Senior Health Data Analyst***

DECEMBER 2021

MORTALITY AND MORBIDITY FROM EXPOSURE TO EXCESSIVE NATURAL HEAT IN ARIZONA, 2010-2020

TABLE OF CONTENTS

FINDINGS, FIGURES AND DATA TABLES

SECTION A: HEAT-RELATED MORTALITY, 2010-2020

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 2010-2020 period, and heat illness cases during 2020 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 2010-2020 period, there were 1,471 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 2010 there were 137 deaths from exposure to excessive natural heat recorded in Arizona, this was followed by a decrease in 2011 (123 deaths) and 2012 (97deaths), then an uptick in 2013 (103 deaths). In 2014, the number of deaths due to exposure to excessive heat fell sharply to 48 deaths in 2014, 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. The largest annual number of deaths of the entire period occurred in 2020, where 313 people died from exposure to excessive natural heat.

√ There were 908 deaths from exposure to excessive natural heat among the residents of Arizona (61.7 percent of the total), or 83 deaths on average per year in 2010-2020.

√ Visitors to Arizona from other U.S. states, Canada or Europe experienced around 105 deaths from exposure to heat due to weather conditions in 2010-2020.

√ The state or country of residence of about 130 decedents in 2010-2020 remains unidentified.

√ Approximately eight out of every ten deaths from exposure to excessive natural heat in 2010-2020 were males, and 34.6 percent were Hispanic or Latino.

√ In 2010-2020, ninety-five percent of all deaths from exposure to heat due to weather conditions occurred during the five months from May through September.

√ In 2010-2020, 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 79.9 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 44.6 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 2010-2020.

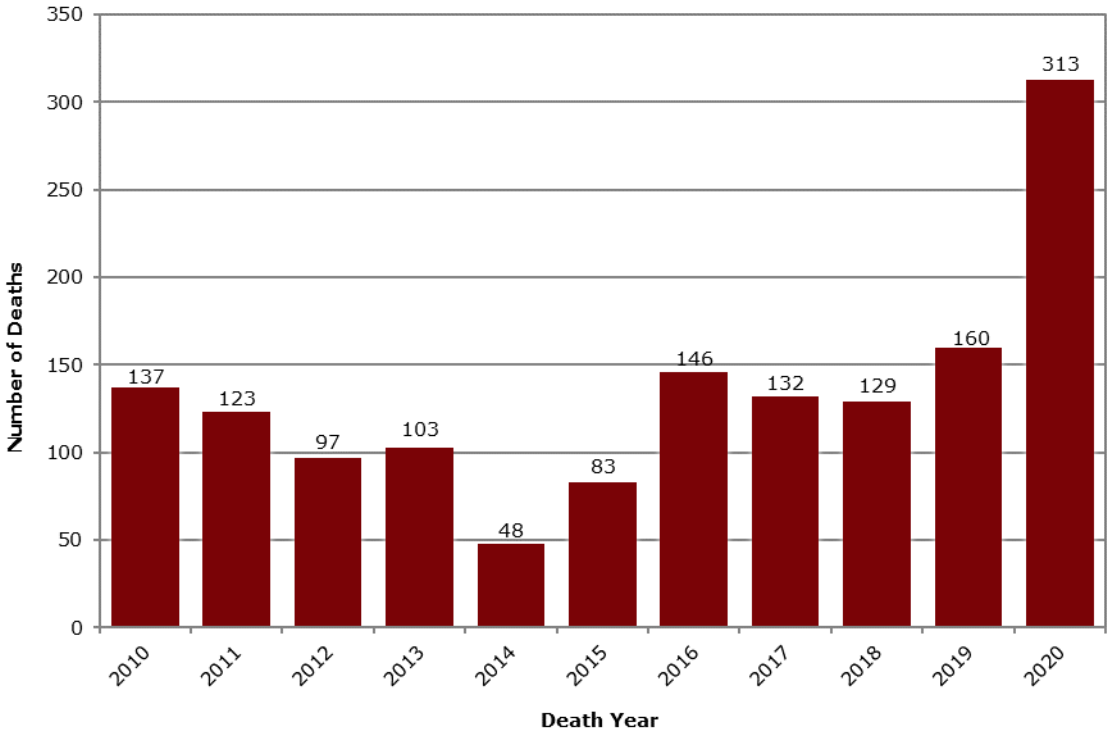
√ In 2010-2020, the four counties along the southern border of Arizona (Cochise, Pima, Santa Cruz, and Yuma) accounted for 36.3 percent of deaths from excessive heat. Individually, Pima county (27.3 percent) and Maricopa county (44.5 percent) accounted for most of the deaths due to exposure to natural heat.

√ Residents from Mexico, Central or South America (56.5 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 (84.4 percent).

√ In 2020, 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, 2010-2020

Figure 1A
Deaths from Exposure to Excessive Natural Heat* occurring in Arizona by Year, 2010-2020



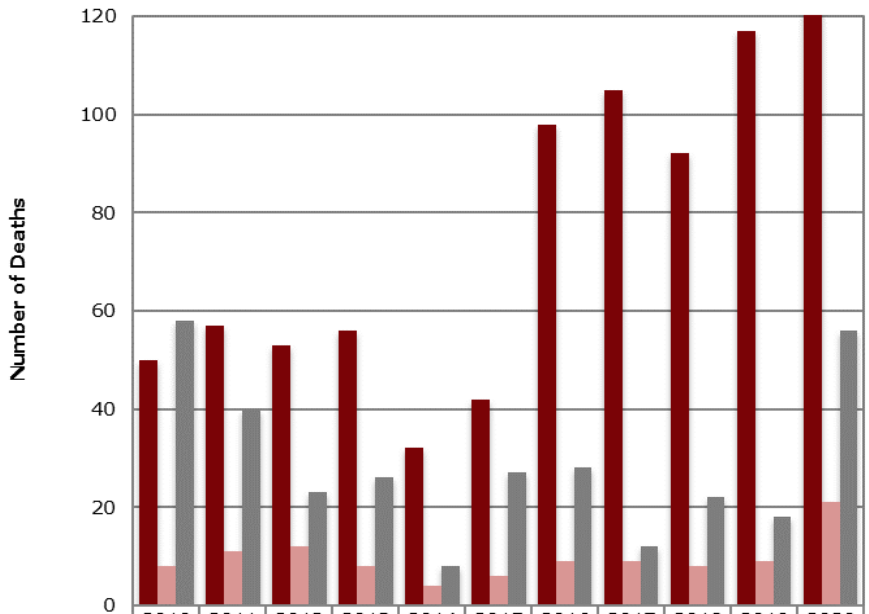
During the 2010-2020 period, 1,471 deaths related to exposure to excessive natural heat occurred in Arizona.

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, 134 people died every year from a heatstroke or sunstroke between 2010-2020 (**Figure 1A, Table 1A**).

Approximately eight out of every ten deaths from exposure to excessive natural heat in 2010-2020 were males (1,122/1,471 or 76.3 percent, **Table 1A**), and 34.6 percent (509/1,471, **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, 2010-2020



	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Arizona	50	57	53	56	32	42	98	105	92	117	206
Other U.S. states or Canada	8	11	12	8	4	6	9	9	8	9	21
Mexico, Central or South America	58	40	23	26	8	27	28	12	22	18	56

* 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 908 deaths from exposure to excessive natural heat among the residents of Arizona (61.7 percent of the total), or 83 deaths on average per year in 2010-2020.

Migrants from Mexico, Central America or South America accounted for 21.6 percent of the total deaths from exposure to heat due to weather conditions during the 2010 to 2020 period.

Visitors to Arizona from other U.S. states or migrants from Canada experienced 105 deaths from exposure to excessive natural heat during the 2010-2020 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 2020. During the same period, migrants from Mexico, Central American, and South American countries experienced a sustained reduction in mortality due to exposure to excessive natural heat.

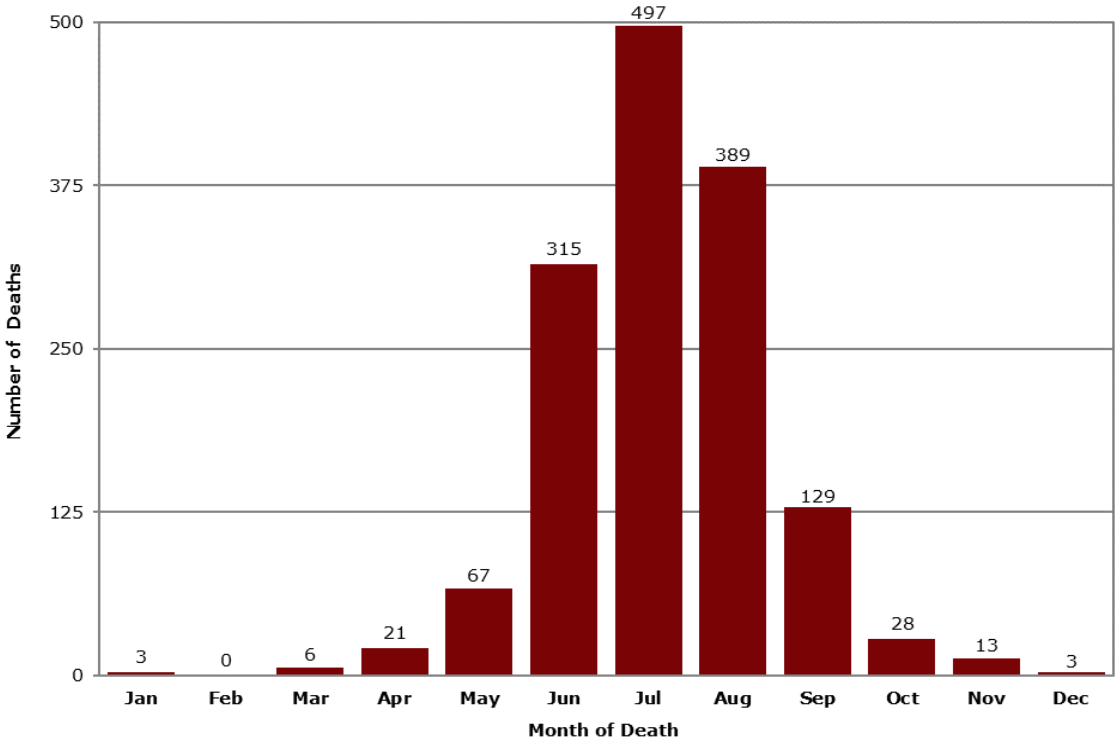
1 http://phoenix.about.com/cs/weather/a/weathertrivia_2.htm

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 (497) in 2010-2020, followed by August (389), then June (315) September (129), and May (67). In 2010-2020, 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, 2010-2020



* 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.

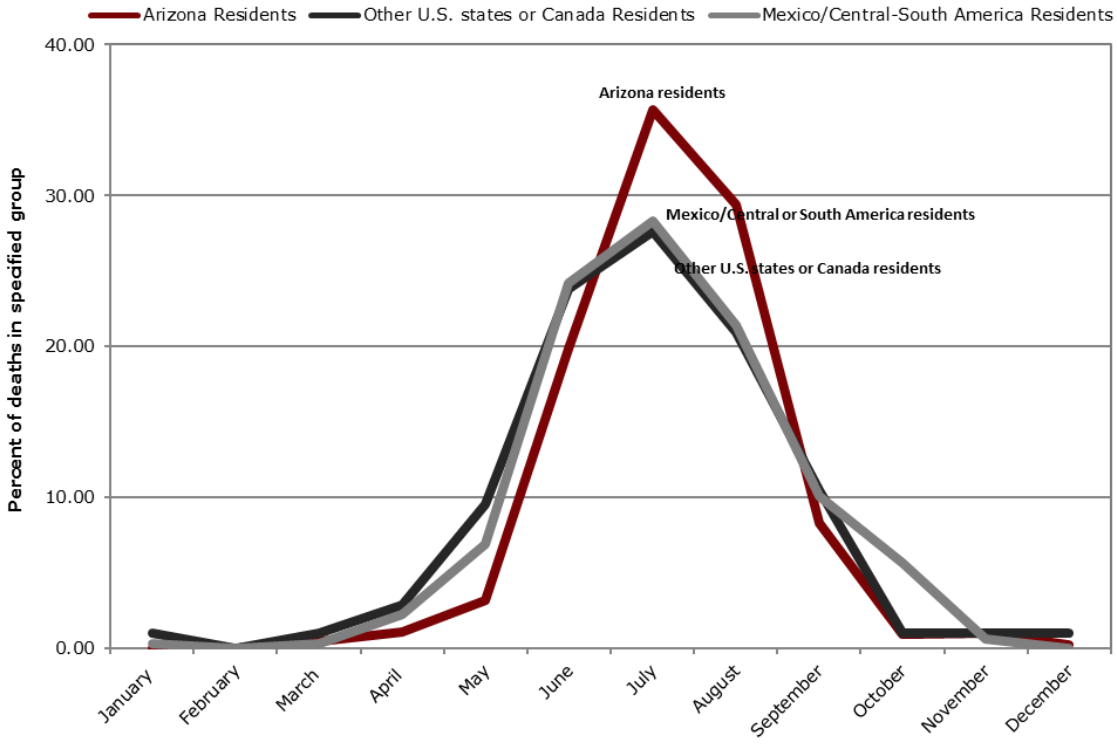
Excluded are deaths due to excessive heat of man-made origin.

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, 2010-2020



* 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.

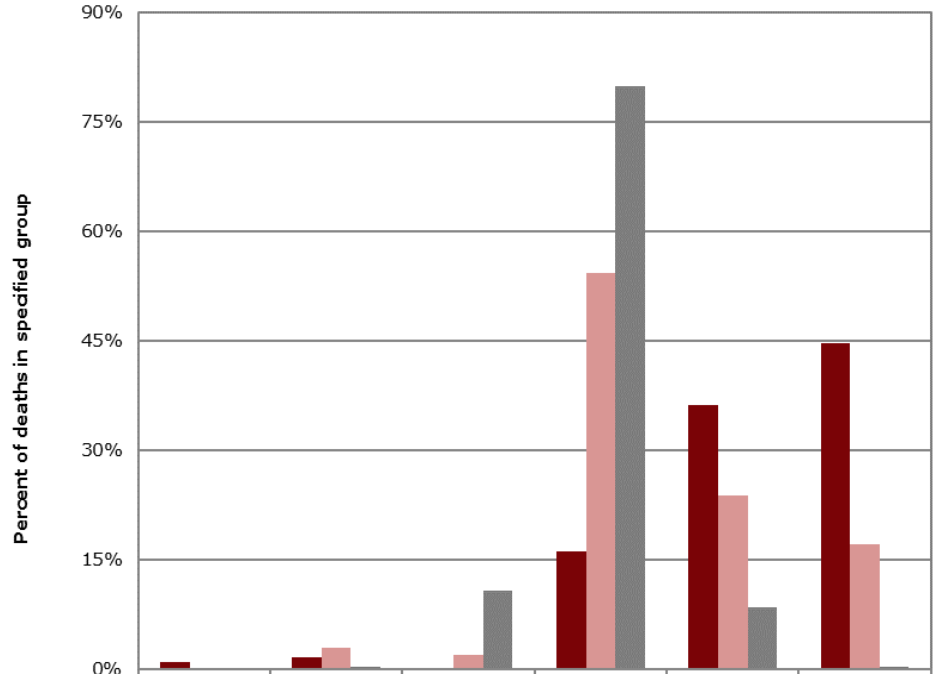
Regardless of the residence status, most deaths from excessive natural heat occurred during the month of July (**Figure 4A, Table 2A**). Compared to the residents of Arizona there were substantially more deaths among residents of Mexico, Central America, and South America from March–June during the 2010-2020 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 2010-2020, 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 2010-2020 accounted for 79.8 percent of deaths from exposure to excessive natural heat among the migrants from Mexico and other Central/South American countries.

In contrast, middle-aged adults and adults 65 years or older have been at the highest risk of heatstroke or sunstroke among the age groups of Arizona residents. Forty-four percent of fatalities due to exposure to heat occurred among Arizona residents aged 65 years or older. While there was one death recorded among migrants from Mexico and other Central/South American countries of that age group.

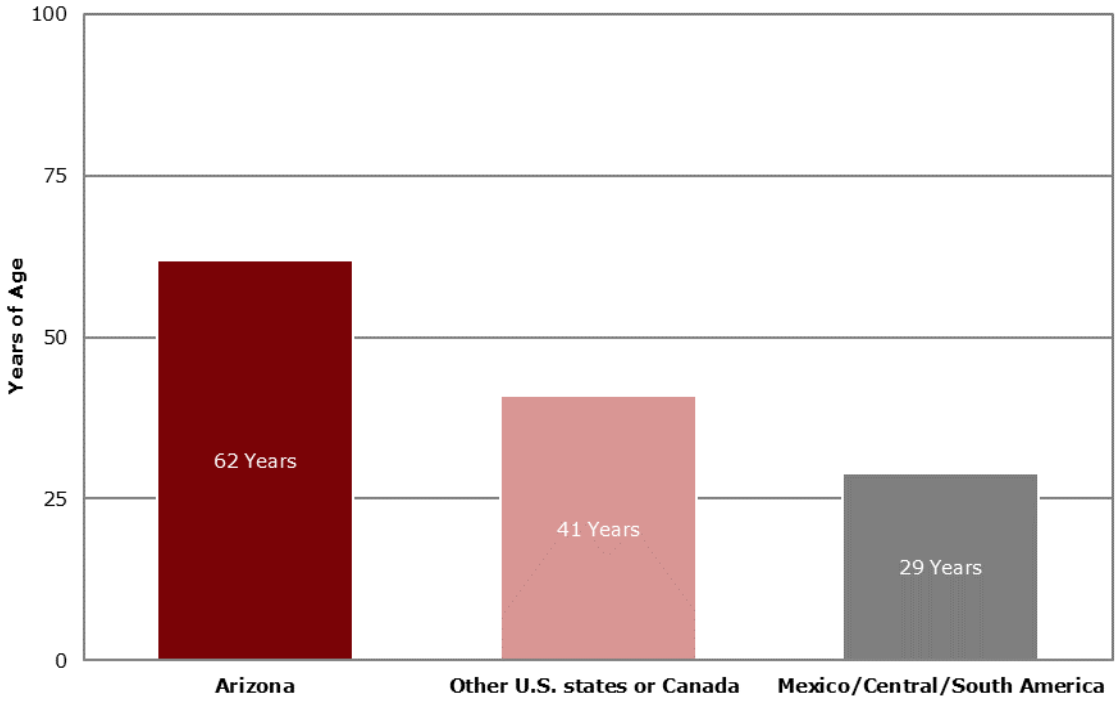
Figure 5A
Percent Distribution of Deaths from Exposure to Excessive Natural Heat* occurring in Arizona by Age Group and Residence Status, 2010-2020



	Infants <1	Children 1 - 14	Adoles-cents 15 - 19	Young Adults 20 - 44	Middle-Aged Adults 45 - 64	Elderly 65+
Arizona	0.99	1.65	0.11	16.19	36.12	44.60
Other U.S. states or Canada	0.00	2.89	1.90	54.29	23.81	17.14
Mexico/Central/South America	0.00	0.31	10.69	79.87	8.49	0.31

* 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, 2010-2020**



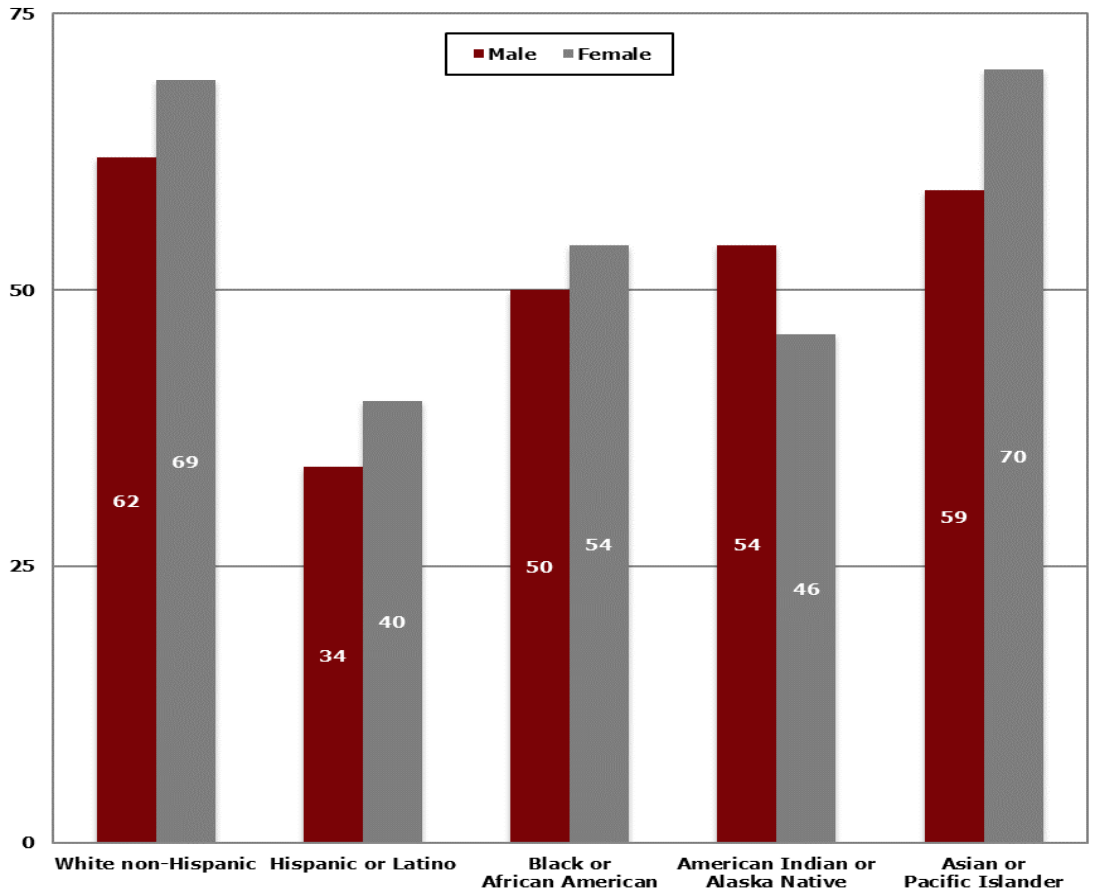
One out of two Arizonans who died from exposure to excessive natural heat in 2010-2020 was older than 62 years of age (**Figure 6A**, **Table 5A**).

In 2010-2020, on average visitors from other states were 21 years younger than the residents of Arizona at the time of death. The median age of residents from Mexico, Central American or South American countries who died from exposure to excessive natural heat was 29 years of age, which was 33 years younger than the median age of deaths of Arizonans.

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

In 2010-2020, Asian or Pacific Islander females ranked highest with median age at death from exposure to excessive natural heat at 70 years, exceeding by 30.0 years the median age at death for Hispanic or Latino females (**Figure 7A, Table 6A**). White non-Hispanic males had the highest (62 years), and Hispanic males had the lowest (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, 2010-2020**



* 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, 2010-2020

		Total	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Total		1,471	137	123	97	103	48	83	146	132	129	160	313
State or Country of Residence	Arizona	908	50	57	53	56	32	42	98	105	92	117	206
	Other U.S. states or Canada	110†	8	11	12	8	*	6	9	9	8	9	21
	Mexico, Central or South America	318	58	40	23	26	8	27	28	12	22	18	56
	Other	10†	*	*	*	*	0	*	*	0	0	0	0
	Unknown	130†	19	14	8	12	*	6	8	6	7	16	30
Geographic Region of Occurrence[a]	Central	749	48	61	55	45	27	39	69	67	76	101	161
	Eastern	0	0	0	0	0	0	0	0	0	0	0	0
	Northern	170†	6	7	0	13	*	*	12	33	19	23	54
	Southern	534	81	55	41	45	18	39	60	32	34	34	95
	Western	10†	*	0	*	0	0	*	*	0	0	*	*
County of Occurrence	Apache	0†	0	*	0	*	0	0	0	0	*	0	0
	Cochise	20†	*	0	0	*	0	*	*	*	*	*	8
	Coconino	30†	*	*	0	*	*	*	0	8	*	*	*
	Gila	10†	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	0	*	*
	Maricopa	654	40	54	50	35	21	32	64	59	68	88	143
	Mohave	140†	*	*	0	7	*	*	11	25	15	21	49
	Navajo	0†	0	0	0	0	0	0	*	0	0	0	*
	Pima	402	74	49	35	38	13	28	45	26	25	25	44
	Pinal	60†	6	6	*	*	*	*	*	*	*	12	11
	Santa Cruz	20†	*	*	0	*	*	*	*	0	*	0	7
	Yavapai	20†	*	0	*	*	*	*	*	*	*	0	*
	Yuma	90†	*	*	6	*	*	7	12	*	*	8	36
Age Group	0 - 4	20†	*	0	*	*	*	*	*	*	0	*	*
	5 - 9	2	0	0	0	0	0	0	0	0	0	*	*
	10 - 14	10†	*	0	0	0	0	*	*	0	*	*	*
	15 - 19	40†	7	*	*	*	*	*	*	*	*	*	7
	20 - 24	90†	15	8	*	13	*	7	8	*	*	7	17
	25 - 29	110†	14	12	7	*	6	8	11	9	7	8	20
	30 - 34	90†	8	14	7	*	0	*	11	10	12	9	11
	35 - 39	110†	13	12	10	7	*	10	11	7	10	6	22
	40 - 44	80†	10	10	8	*	*	*	7	*	6	10	17
	45 - 49	100†	10	9	12	11	0	6	*	7	7	9	23
	50 - 54	100†	11	8	*	8	*	*	10	13	9	8	25
	55 - 59	120†	*	6	7	6	*	9	18	11	7	17	32
	60 - 64	100†	*	10	7	*	*	*	13	8	12	11	29
	65 - 69	100†	*	*	*	*	*	7	7	12	15	11	28
	70 - 74	100†	*	*	7	*	*	7	9	12	17	14	19
	75 - 79	110†	6	6	7	*	*	*	11	13	10	13	30
	80 - 84	60†	*	*	*	6	*	*	*	10	6	11	14
	85+	80†	*	10	*	6	*	*	12	7	*	14	14
	Unknown	60†	19	7	*	12	*	*	*	*	0	*	0

Table 1A (continued)

Characteristics of Deaths from Exposure to Excessive Natural Heat Occurring in Arizona by Year, 2010-2020

		Total	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Gender	Male	1,122	111	97	74	83	32	65	103	91	104	123	239
	Female	349	26	26	23	20	16	18	43	41	25	37	74
	Unknown	0	0	0	0	0	0	0	0	0	0	0	0
Race/Ethnicity	White non-Hispanic	732	59	53	46	48	28	44	81	77	70	74	152
	Hispanic or Latino	509	70	59	43	43	16	32	52	28	35	41	90
	Black or African American	60†	6	6	*	6	*	*	*	*	7	9	20
	American Indian or Alaska Native	70†	*	*	*	6	*	*	10	11	6	6	11
	Asian or Pacific Islander	10†	0	0	*	0	0	*	*	*	*	*	*
	Unknown	85	0	0	0	0	0	0	0	12	10	26	37
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	0
	April	20†	*	*	*	*	*	*	*	*	*	*	*
	May	70†	8	*	9	9	*	*	*	*	11	*	9
	June	315	23	27	24	30	12	32	52	49	16	20	30
	July	497	71	30	28	39	17	9	51	34	50	53	115
	August	389	18	39	26	14	7	34	26	22	28	53	122
	September	130†	12	15	6	6	*	*	8	9	20	19	26
	October	30†	*	*	*	*	*	*	*	*	*	*	9
	November	10†	*	*	*	*	*	*	*	*	*	0	0
	December	0†	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	504	19	36	34	27	12	18	37	63	42	62	154
	Yes	967	118	87	63	76	36	65	109	69	87	98	159
	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, 2010-2020

		Total	State or Country of Residence				
			Arizona	Other U.S. states or Canada	Mexico, Central or South America	Other	Unknown
Total		1,471	908	110†	318	10†	130†
	2010	140†	50	8	58	*	19
	2011	120†	57	11	40	*	14
	2012	100†	53	12	23	*	8
	2013	100†	56	8	26	*	12
	2014	50†	32	*	8	0	*
	2015	80†	42	6	27	*	6
	2016	150†	98	9	28	*	8
	2017	132	105	9	12	0	6
	2018	129	92	8	22	0	7
	2019	160	117	9	18	0	16
	2020	313	206	21	56	0	30
Geographic Region of Occurrence[a]	Central	750†	616	36	35	*	58
	Eastern	0	0	0	0	0	0
	Northern	170†	144	27	0	*	*
	Southern	530†	137	39	283	*	71
	Western	10†	11	*	0	0	0
Age Group	0 - 4	17	17	0	0	0	0
	5 - 9	0†	*	*	0	0	0
	10 - 14	10†	6	*	*	0	0
	15 - 19	40†	*	*	34	0	*
	20 - 24	90†	15	*	65	0	*
	25 - 29	110†	29	*	67	*	*
	30 - 34	90†	22	16	46	*	*
	35 - 39	110†	48	15	45	*	*
	40 - 44	81	33	16	31	0	*
	45 - 49	100†	60	6	17	*	14
	50 - 54	100†	83	*	6	*	10
	55 - 59	120†	98	9	*	*	12
	60 - 64	100†	87	6	*	0	10
	65 - 69	100†	82	10	*	0	*
	70 - 74	100†	91	*	0	0	*
	75 - 79	110†	97	*	0	0	*
	80 - 84	60†	57	*	0	*	*
	85+	79	78	0	0	0	*
	Unknown	60†	*	0	*	0	57

Table 2A (continued)

Characteristics of Arizona Deaths from Exposure to Excessive Natural Heat by Residence Status, 2010-2020

		Total	State or Country of Residence				
			Arizona	Other U.S. states or Canada	Mexico, Central or South America	Other	Unknown
Gender	Male	1,122	633	79	284	8	118
	Female	350†	275	26	34	*	12
	Unknown	0	0	0	0	0	0
Race/Ethnicity	White non-Hispanic	730†	597	57	*	6	71
	Hispanic or Latino	510†	143	38	315	*	11
	Black or African American	60†	51	*	*	0	*
	American Indian or Alaska Native	50†	51	0	*	0	0
	Asian or Pacific Islander	10†	8	*	0	0	0
	Unknown	110†	58	*	0	*	47
Month of Death	January	0†	0	*	*	0	*
	February	0	0	0	0	0	0
	March	10†	*	*	*	0	0
	April	20†	10	*	7	0	*
	May	70†	29	10	22	*	*
	June	320†	180	25	77	*	29
	July	500†	324	29	90	*	51
	August	389	267	22	68	0	32
	September	130†	75	11	32	*	9
	October	30†	8	*	18	0	*
	November	10†	9	*	*	0	*
	December	0†	*	*	0	0	0
	Unknown	0	0	0	0	0	0
Autopsy Performed	No	500†	424	30	25	*	24
	Yes	967	484	75	293	9	106
	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, 2010-2020

		Total	Geographic Region of Occurrence[a]			
			Central	Northern	Southern	Western
Total		1,471	749	170†	534	10†
	2010	140†	48	6	81	*
	2011	123	61	7	55	0
	2012	100†	55	0	41	*
	2013	103	45	13	45	0
	2014	50†	27	*	18	0
	2015	80†	39	*	39	*
	2016	150†	69	12	60	*
	2017	132	67	33	32	0
	2018	129	76	19	34	0
	2019	160†	101	23	34	*
	2020	310†	161	54	95	*
State or Country of Residence	Arizona	908	616	144	137	11
	Other U.S. states or Canada	110†	36	27	39	*
	Mexico, Central or South America	318	35	0	283	0
	Other	10†	*	*	*	0
	Unknown	130†	58	*	71	0
County of Occurrence	Apache	0†	0	*	0	0
	Cochise	19	0	0	19	0
	Coconino	28	0	28	0	0
	Gila	11	11	0	0	0
	Graham	0†	*	0	0	0
	Greenlee	0	0	0	0	0
	La Paz	14	0	0	0	14
	Maricopa	654	654	0	0	0
	Mohave	140	0	140	0	0
	Navajo	0†	0	*	0	0
	Pima	402	0	0	402	0
	Pinal	62	62	0	0	0
	Santa Cruz	22	0	0	22	0
	Yavapai	20	20	0	0	0
	Yuma	91	0	0	91	0
Age Group	0 - 4	20†	12	*	*	0
	5 - 9	0†	*	0	*	0
	10 -14	10†	*	*	*	0
	15 - 19	38	8	0	30	0
	20 - 24	90†	20	*	64	0
	25 - 29	110†	32	*	70	*
	30 - 34	90†	30	*	53	0
	35 - 39	113	46	7	60	0
	40 - 44	80†	38	*	37	*
	45 - 49	100†	65	*	28	0
	50 - 54	100†	75	11	17	*
	55 - 59	120†	76	22	23	*
	60 - 64	100†	73	14	16	*
	65 - 69	98	57	27	14	0
	70 - 74	100†	57	26	14	*
	75 - 79	110†	57	21	23	*
	80 - 84	60†	32	15	12	*
	85+	80†	58	8	12	*
	Unknown	61	7	0	54	0

Table 3A (continued)
Characteristics of Arizona Deaths from Exposure to Excessive Natural Heat by Region, 2010-2020

		Total	Geographic Region of Occurrence			
			Central	Northern	Southern	Western
Gender	Male	1,122	553	114	445	10
	Female	350†	196	60	89	*
	Unknown	0	0	0	0	0
Race/Ethnicity	White non-Hispanic	732	433	128	161	10
	Hispanic or Latino	509	147	14	348	0
	Black or African American	60†	55	0	*	*
	American Indian or Alaska Native	52	25	20	7	0
	Asian or Pacific Islander	10†	8	*	*	0
	Unknown	110†	81	10	15	*
Month of Death	January	0†	*	0	*	0
	February	0	0	0	0	0
	March	10†	*	0	*	0
	April	20†	8	*	9	0
	May	70†	22	7	37	*
	June	320†	145	33	135	*
	July	500†	272	66	156	*
	August	390†	207	45	132	*
	September	130†	66	16	44	*
	October	28	14	0	14	0
	November	10†	7	*	*	0
	December	0†	*	*	0	0
	Unknown	0	0	0	0	0
Autopsy Performed	No	504	232	143	119	10
	Yes	970†	517	31	415	*
	Unknown	0	0	0	0	0

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

Table 4A
Deaths from Exposure to Excessive Natural Heat by Geographic Region of Occurrence in Arizona, and Residence Status, 2010-2020

		Total	Geographic Region of Occurrence[a]			
			Central	Northern	Southern	Western
State or Country of Residence	Arizona	908	616	144	137	11
	Other U.S. states or Canada	110†	36	27	39	*
	Mexico, Central or South America	318	35	0	283	0
	Other	10†	*	*	*	0
	Unknown	130†	58	*	71	0
Total		1,471	750†	170†	530†	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, 2010-2020

		Geographic Region of Occurrence[a]			
		Central	**Northern**	**Southern**	**Western**
State or Country of Residence	Arizona	59	68	65	70
	Other U.S. states or Canada	41	50	36	63
	Mexico, Central or South America	29	0	29	0
	Other	48	38	34	0

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

Table 6A
Median Age at Death from Exposure to Excessive Natural Heat by Race/Ethnicity and Gender, 2010-2020

Race/Ethnicity	Gender	Median Age at Death
White non-Hispanic	Male	62
	Female	69
	Total	**65**
Hispanic or Latino	Male	34
	Female	40
	Total	**35**
Black or African American	Male	50
	Female	54
	Total	**52**
American Indian or Alaska Native	Male	54
	Female	46
	Total	**50**
Asian or Pacific Islander	Male	59
	Female	70
	Total	**67**
Unknown	Male	60
	Female	60
	Total	**60**

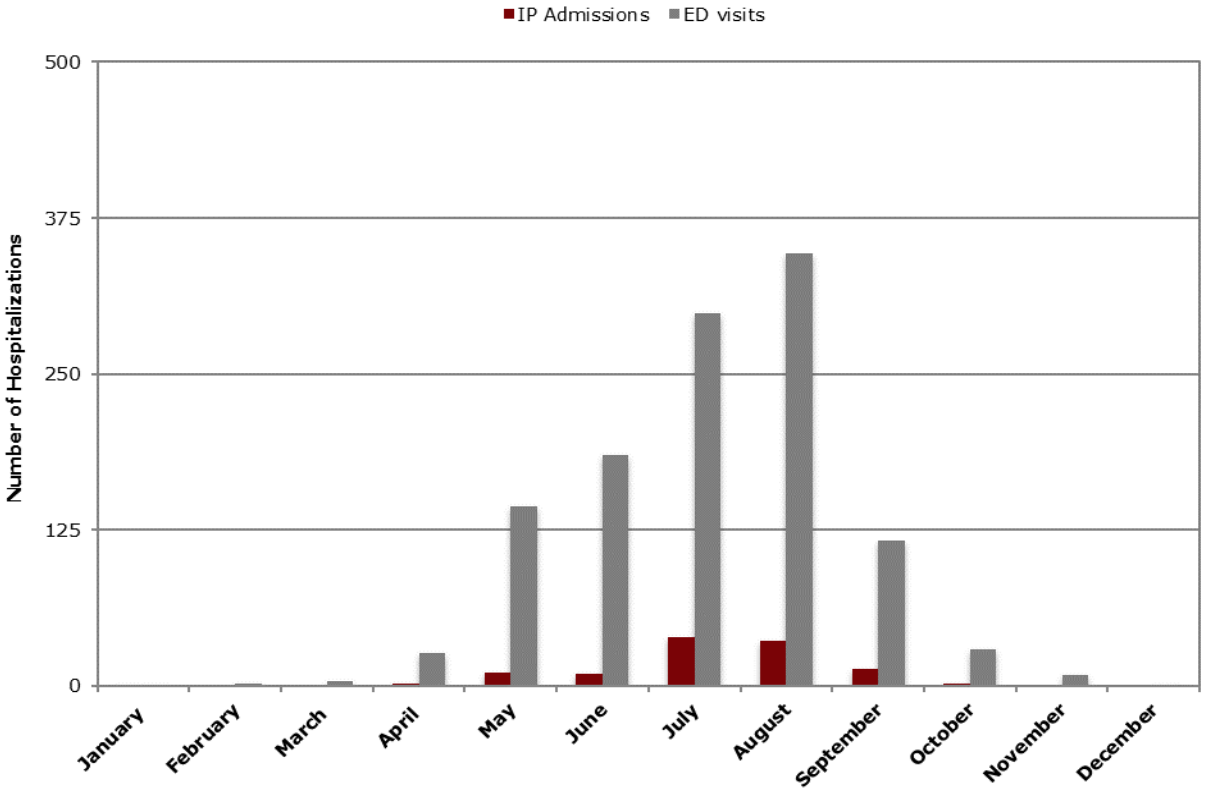
Section B: Heat-Related Morbidity, 2020

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.

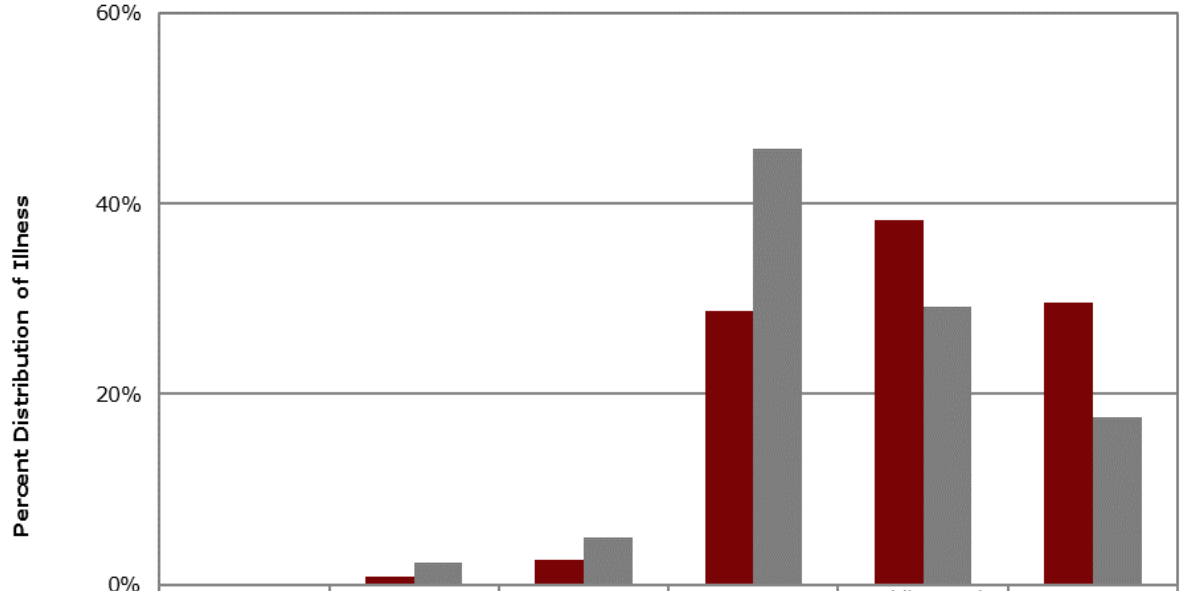
The warm season between May and September accounts for 95.7 percent of hospitalizations and 93.7 percent of the total ED visits from exposure to excessive natural heat.

Figure 1B
Hospitalizations from Exposure to Excessive Natural Heat occuring in Arizona by Month, 2020



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, 2020



	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	2.6	28.7	38.3	29.6
ED visits	0.1	2.3	5.0	45.8	29.2	17.6

In 2020, 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 28.7 percent of IP admissions and 45.8 percent of heat illness ED visits. On the other hand, middle aged and elderly Arizona residents accounted for only 46.8 percent of heat illness ED visits for exposure to excessive natural heat, but represent 67.8 percent of IP admissions (**Figure 2B**).

Approximately 2.3 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 2020 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 8 years lower than the female median age at illness, but 18 years lower at time of admission for inpatient care. In 2020, 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, 2020

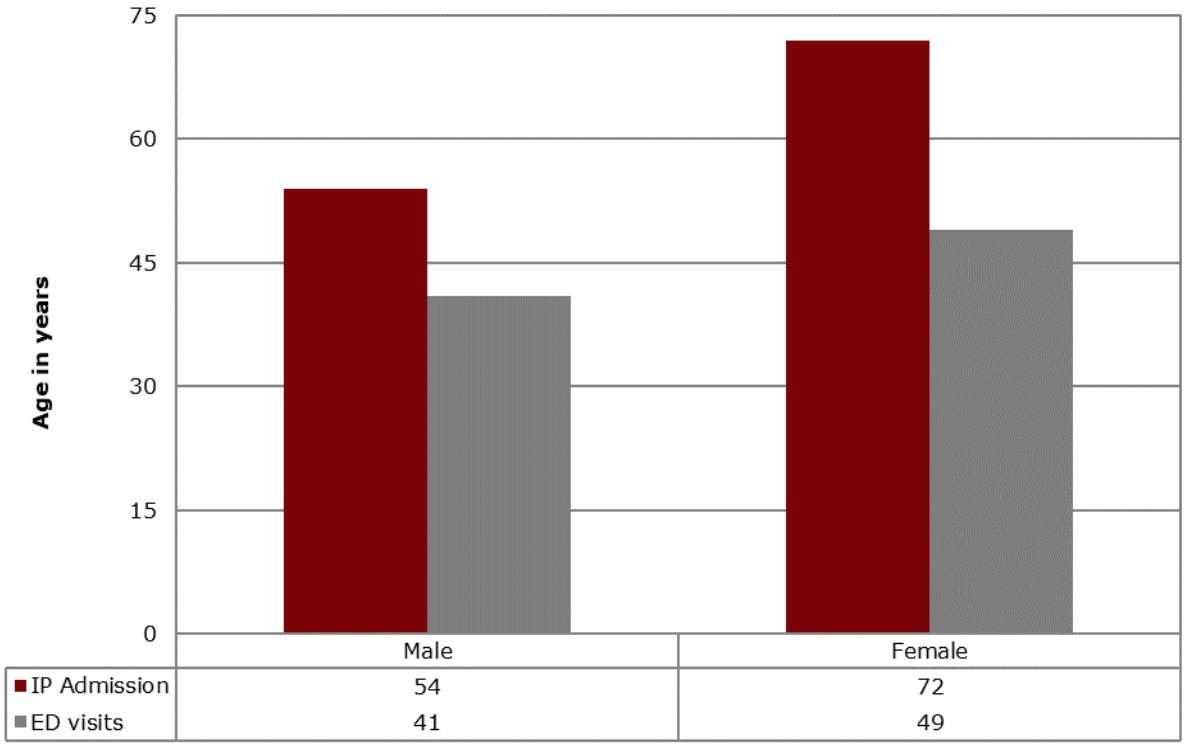
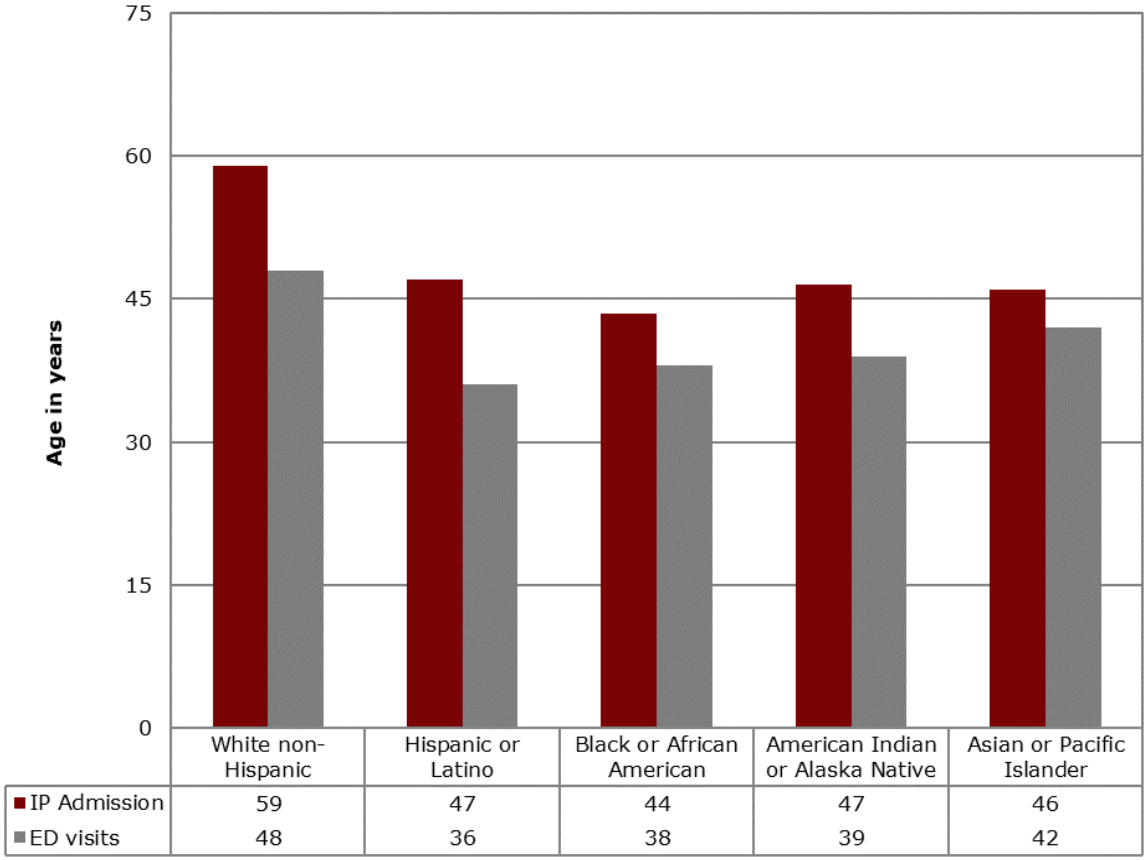


Figure 4B
Median Age at Illness from Exposure to Excessive Natural Heat by Race/Ethnic Group, 2020



	White non-Hispanic	Hispanic or Latino	Black or African American	American Indian or Alaska Native	Asian or Pacific Islander
IP Admission	59	47	44	47	46
ED visits	48	36	38	39	42

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 Black or African American had the youngest age at illness. The median age of White non-Hispanics visiting the emergency department for a heat illness was 48 years of age, the highest among all race/ethnic groups, the lowest being recorded among Hispanic or Latinos (36), and Black or African American (38), American Indian or Alaska Natives (39), followed by Asian or Pacific Islanders (42 years).

Table 1B

Inpatient stays and ED visits from Exposure to Excessive Natural Heat by Region and Demographic Characteristics, 2020

		Total	IP Admissions	ED Visits
Total		1,280	120†	1,165
Geographic Region of Occurrence[a]	Central	854	84	770
	Eastern	0	0	0
	Northern	120†	*	118
	Southern	242	25	217
	Western	16	0	16
	Unknown	50†	*	44
County of Occurrence	Apache	0†	0	*
	Cochise	16	0	16
	Coconino	11	0	11
	Gila	9	0	9
	Graham	10†	0	*
	Greenlee	0	0	0
	La Paz	16	0	16
	Maricopa	726	81	645
	Mohave	100†	*	94
	Navajo	12	0	12
	Pima	98	7	91
	Pinal	90†	*	85
	Santa Cruz	0†	0	*
	Yavapai	30†	*	26
	Yuma	126	18	108
	Unknown	50†	*	44
Age Group	0 - 4	8	0	8
	5 - 9	0†	0	*
	10 - 14	20†	*	16
	15 - 19	60†	*	58
	20 - 24	100†	*	94
	25 - 29	103	8	95
	30 - 34	128	9	119
	35 - 39	134	6	128
	40 - 44	105	8	97
	45 - 49	102	11	91
	50 - 54	91	10	81
	55 - 59	102	12	90
	60 - 64	89	11	78
	65 - 69	71	6	65
	70 - 74	73	12	61
	75 - 79	46	7	39
	80 - 84	28	6	22
	85+	20†	*	18
	Unknown	0†	0	*

Table 1B (continued)

Inpatient stays and ED visits from Exposure to Excessive Natural Heat by Region and Demographic Characteristics, 2020

		Total	IP Admissions	ED Visits
Gender	Male	935	92	843
	Female	345	23	322
Race/Ethnicity	White non-Hispanic	771	79	692
	Hispanic or Latino	340	17	323
	Black or African American	90	12	78
	American Indian or Alaska Native	55	6	49
	Asian or Pacific Islander	10†	*	13
	Unknown	10	0	10
Month of Occurrence	January	0†	*	*
	February	0†	0	*
	March	0†	0	*
	April	30†	*	27
	May	155	11	144
	June	195	10	185
	July	338	39	299
	August	383	36	347
	September	131	14	117
	October	30†	*	29
	November	9	0	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, 2020

		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		1,280	80†	0	10†	25	0	1	770†	0	120†	220†	16	44
County of Occurrence	Apache	0†	0	0	0	0	0	0	0	0	*	0	0	0
	Cochise	16	0	0	0	0	0	0	0	0	0	16	0	0
	Coconino	11	0	0	0	0	0	0	0	0	11	0	0	0
	Gila	9	0	0	0	0	0	0	9	0	0	0	0	0
	Graham	10†	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	16	0	0	0	0	0	0	0	0	0	0	16	0
	Maricopa	726	81	0	0	0	0	0	645	0	0	0	0	0
	Mohave	100†	0	0	*	0	0	0	0	0	94	0	0	0
	Navajo	12	0	0	0	0	0	0	0	0	12	0	0	0
	Pima	98	0	0	0	7	0	0	0	0	0	91	0	0
	Pinal	90†	*	0	0	0	0	0	85	0	0	0	0	0
	Santa Cruz	0†	0	0	0	0	0	0	0	0	0	*	0	0
	Yavapai	30†	*	0	0	0	0	0	26	0	0	0	0	0
	Yuma	126	0	0	0	18	0	0	0	0	0	108	0	0
	Unknown	45	0	0	0	0	0	*	0	0	0	0	0	44
Age Group	0 - 4	10†	0	0	0	0	0	0	7	0	*	0	0	0
	5 - 9	0†	0	0	0	0	0	0	*	0	0	0	0	0
	10 - 14	20†	*	0	0	0	0	0	9	0	*	*	0	*
	15 - 19	60†	*	0	0	0	0	0	34	0	7	15	0	*
	20 - 24	100†	0	0	0	*	0	0	62	0	*	22	0	6
	25 - 29	100†	*	0	0	*	0	0	61	0	6	22	*	*
	30 - 34	130†	8	0	0	*	0	0	85	0	8	18	*	6
	35 - 39	130†	*	0	*	*	0	0	93	0	13	18	*	*
	40 - 44	110†	6	0	0	*	0	0	71	0	8	16	0	*
	45 - 49	100†	7	0	0	*	0	*	66	0	8	14	0	*
	50 - 54	90†	10	0	0	0	0	0	56	0	9	13	*	*
	55 - 59	100†	7	0	*	*	0	0	59	0	14	13	*	*
	60 - 64	90†	10	0	0	*	0	0	41	0	11	19	*	*
	65 - 69	70†	*	0	0	*	0	0	41	0	10	11	*	*
	70 - 74	70†	7	0	*	*	0	0	32	0	9	15	*	*
	75 - 79	50†	*	0	0	*	0	0	24	0	*	11	0	*
	80 - 84	30†	6	0	0	0	0	0	14	0	*	*	*	*
	85+	20†	*	0	0	0	0	0	10	0	*	*	*	0
	Unknown	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 and Demographic Characteristics, 2020

		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	940†	68	0	*	19	0	*	559	0	73	169	31	0
	Female	350†	16	0	*	6	0	0	211	0	45	48	13	0
Race/ Ethnicity	White non-Hispanic	770†	60	0	*	14	0	*	427	0	98	124	29	0
	Hispanic or Latino	340†	10	0	*	6	0	0	226	0	10	77	10	0
	Black or African American	90†	8	0	0	*	0	0	63	0	*	11	*	0
	American Indian or Alaska Native	60†	*	0	0	*	0	0	38	0	8	*	0	0
	Asian or Pacific Islander	10†	*	0	0	0	0	0	9	0	0	*	*	0
	Unknown	10†	0	0	0	0	0	0	7	0	*	*	*	0
Month of Illness	January	0†	*	0	0	0	0	0	*	0	0	0	0	0
	February	0†	0	0	0	0	0	0	*	0	0	0	0	0
	March	0†	0	0	0	0	0	0	*	0	0	*	0	0
	April	30†	*	0	0	0	0	0	15	0	*	8	0	0
	May	160†	8	0	*	*	0	0	85	0	15	38	*	0
	June	200†	7	0	*	*	0	0	127	0	18	31	7	0
	July	340†	32	0	*	6	0	0	204	0	32	40	14	0
	August	380†	24	0	*	11	0	0	242	0	27	67	10	0
	September	130†	9	0	*	*	0	0	68	0	18	23	6	0
	October	30†	*	0	0	0	0	*	15	0	*	8	*	0
	November	10†	0	0	0	0	0	0	7	0	0	*	*	0
	December	0†	0	0	0	0	0	0	*	0	0	0	0	0

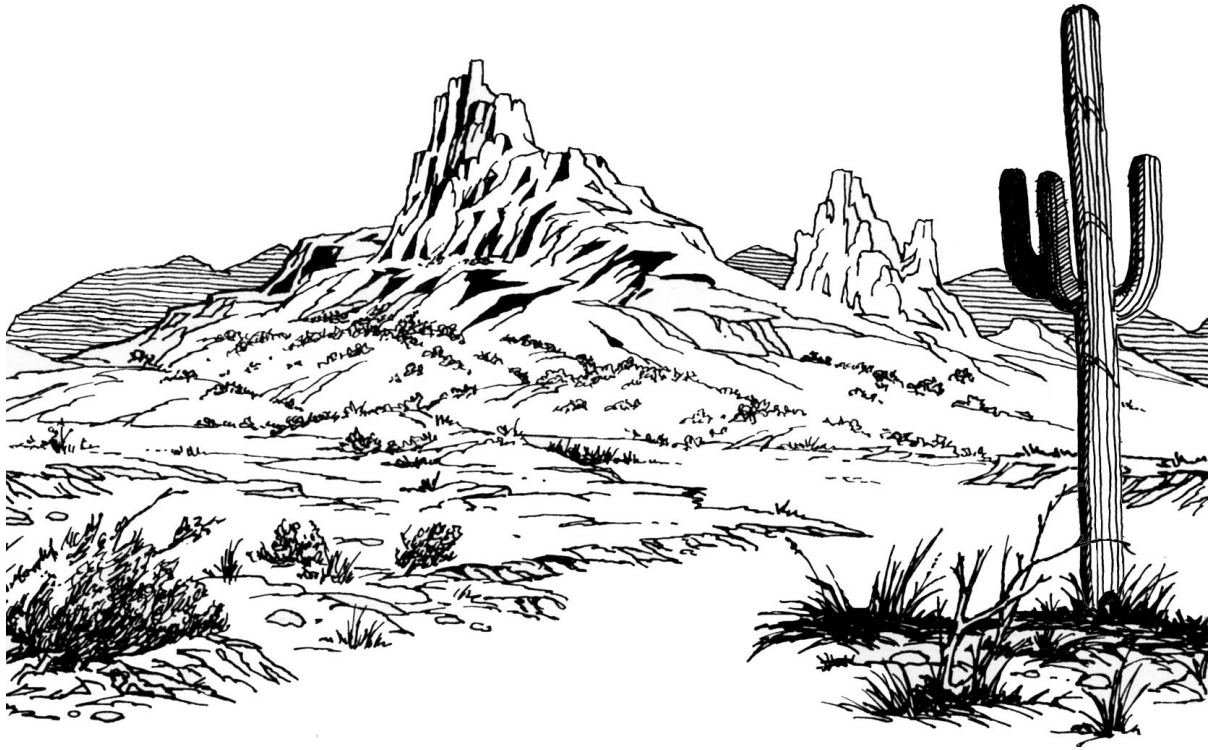
Notes: * Cell suppressed due to non-zero count less than 6; † Sum rounded to nearest tens unit due to non-zero addend less than 6; [a] Classification of geographic regions: Central = Gila, Graham, Maricopa, Pinal, and Yavapai; Eastern = Greenlee; Northern = Apache, Coconino, Mohave, and Navajo; Southern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

Table 3B

Median Age at Illness from Exposure to Excessive Natural Heat by Race/Ethnicity and Gender, 2020

Race/Ethnicity	Gender	Median Age at Death	
		IP Admissions	ED Visits
White non-Hispanic	Male	53	47
	Female	70	52
	Total	**57**	**49**
Hispanic or Latino	Male	46	38
	Female	38	39
	Total	**44**	**38**
Black or African American	Male	44	40
	Female	0	44
	Total	**44**	**40**
American Indian or Alaska Native	Male	50	40
	Female	0	41
	Total	**50**	**40**
Asian or Pacific Islander	Male	0	39
	Female	46	73
	Total	**46**	**45**
Refused/Unknown	Male	0	44
	Female	0	46
	Total	**0**	**45**

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