Mortality and Morbidity From Exposure to Excessive Natural Heat in Arizona, 2012-2022

ARIZONA DEPARTMENT OF HEALTH SERVICES

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MORTALITY AND MORBIDITY FROM EXPOSURE TO EXCESSIVE NATURAL HEAT IN ARIZONA, 2012-2022

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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 2012-2022 period, and heat illness cases during 2022 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 2012-2022 period, there were 1,879 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 2012 there were 97 deaths from exposure to excessive natural heat recorded in Arizona, this was followed by an increase 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. In 2021 there was a minimal decrease to 309 deaths but the largest annual number of deaths of the entire period occurred in 2022, where 359 (19.1 percent) people died from exposure to excessive natural heat.

√ There were 1,232 deaths from exposure to excessive natural heat among the residents of Arizona (65.6 percent of the total), or 112 deaths on average per year in 2012-2022.

√ Visitors to Arizona from other U.S. states, Canada or Europe experienced around 130 deaths from exposure to heat due to weather conditions in 2012-2022.

√ The state or country of residence of about 120 decedents in 2012-2022 remains unidentified.

√ Approximately eight out of every ten deaths from exposure to excessive natural heat in 2012-2022 were males, and 32.6 percent were Hispanic or Latino.

√ In 2012-2022, ninety-five percent of all deaths from exposure to heat due to weather conditions occurred during the five months from May through September.

√ In 2012-2022, 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 80.4 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 48.6 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 2012-2022.

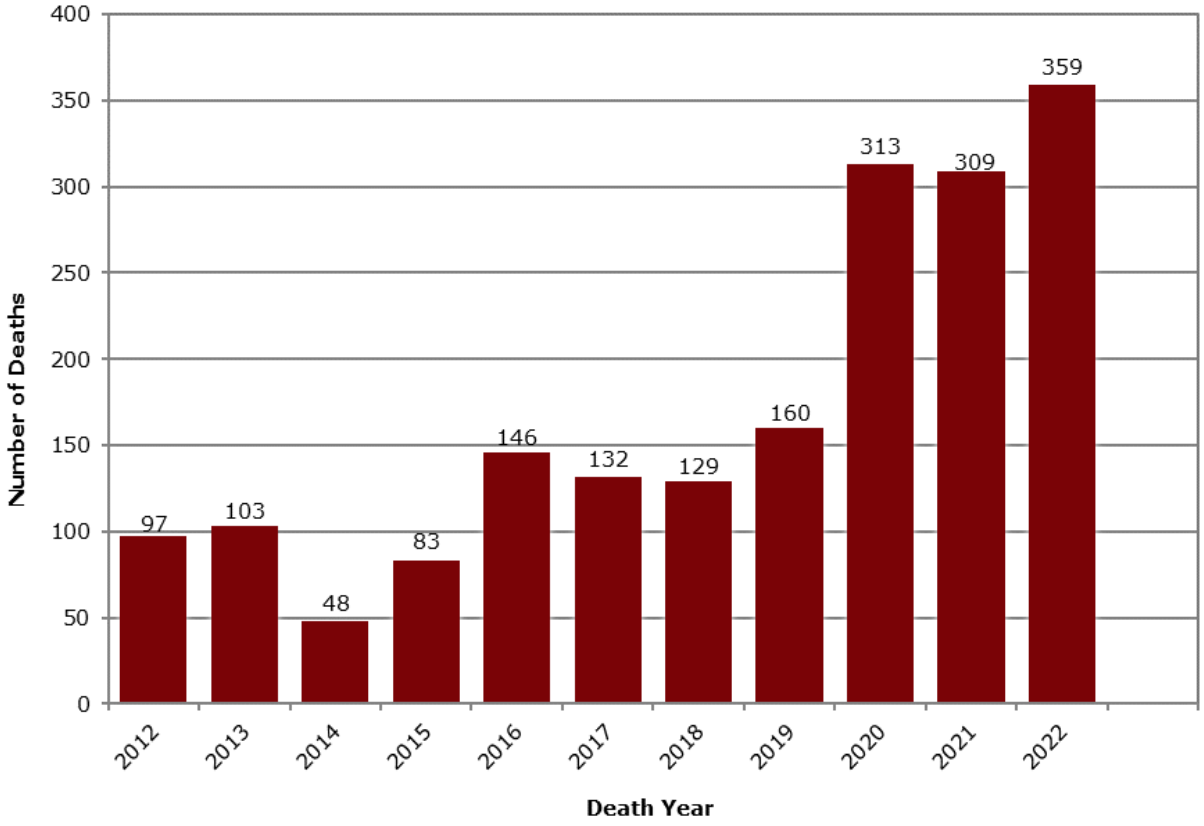
√ In 2012-2022, the four counties along the southern border of Arizona (Cochise, Pima, Santa Cruz, and Yuma) accounted for 33.5 percent of deaths from excessive heat. Individually, Pima county (20.5 percent) and Maricopa county (43.3 percent) accounted for most of the deaths due to exposure to natural heat.

√ In 2022, 97.7 percent of inpatient admissions and 92.3 percent of emergency department visits from exposure to excessive natural heat occurred during the five months from May through September.

√ In 2022, 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, 2012-2022

Figure 1A
Deaths from Exposure to Excessive Natural Heat* occurring in Arizona by Year, 2012-2022



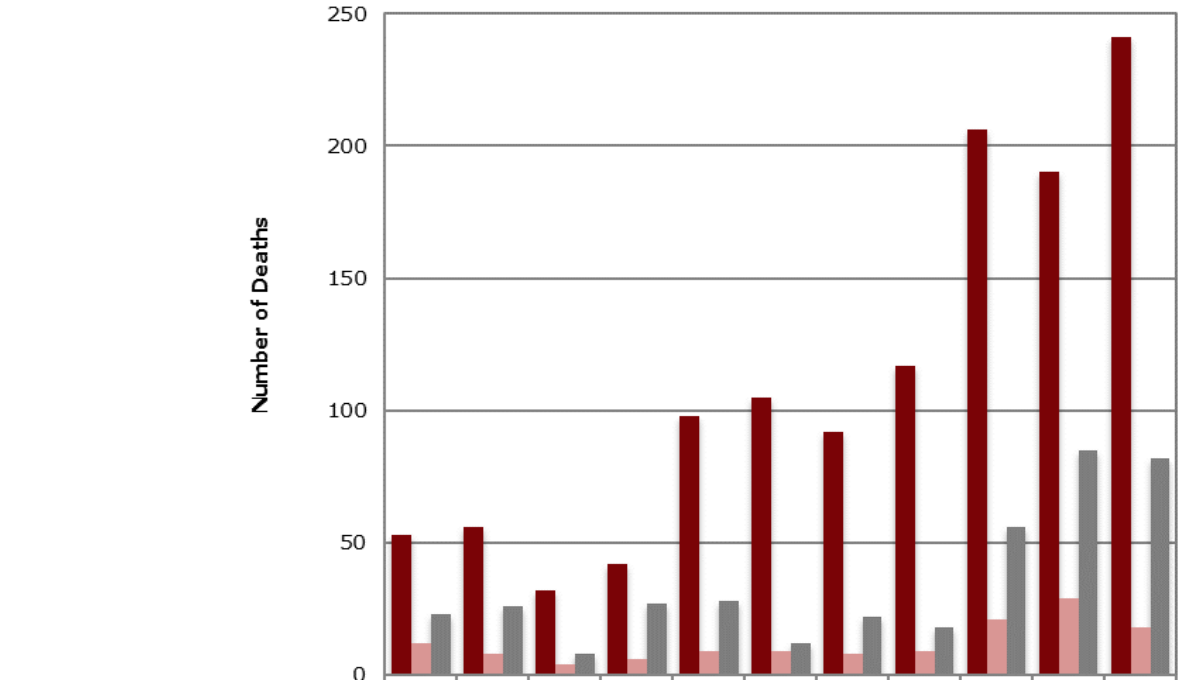
During the 2012-2022 period, 1,879 deaths related to exposure to excessive natural heat occurred in Arizona.

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 = 359 deaths in 2022. On average, 171 people died every year from a heatstroke or sunstroke between 2012-2022 (**Figure 1A, Table 1A**).

Approximately eight out of every ten deaths from exposure to excessive natural heat in 2012-2022 were males (1,411/1,879 or 75.1 percent, **Table 1A**), and 32.6 percent (612/1,879, **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, 2012-2022



	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Arizona	53	56	32	42	98	105	92	117	206	190	241
Other U.S. states or Canada	12	8	4	6	9	9	8	9	21	29	18
Mexico, Central or South America	23	26	8	27	28	12	22	18	56	85	82

There were 1,232 deaths from exposure to excessive natural heat among the residents of Arizona (65.6 percent of the total), or 112 deaths on average per year in 2012-2022.

Migrants from Mexico, Central America or South America accounted for 20.6 percent of the total deaths from exposure to heat due to weather conditions during the 2012 to 2022 period.

Visitors to Arizona from other U.S. states or migrants from Canada experienced 133 deaths from exposure to excessive natural heat during the 2012-2022 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 2022.

* 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.

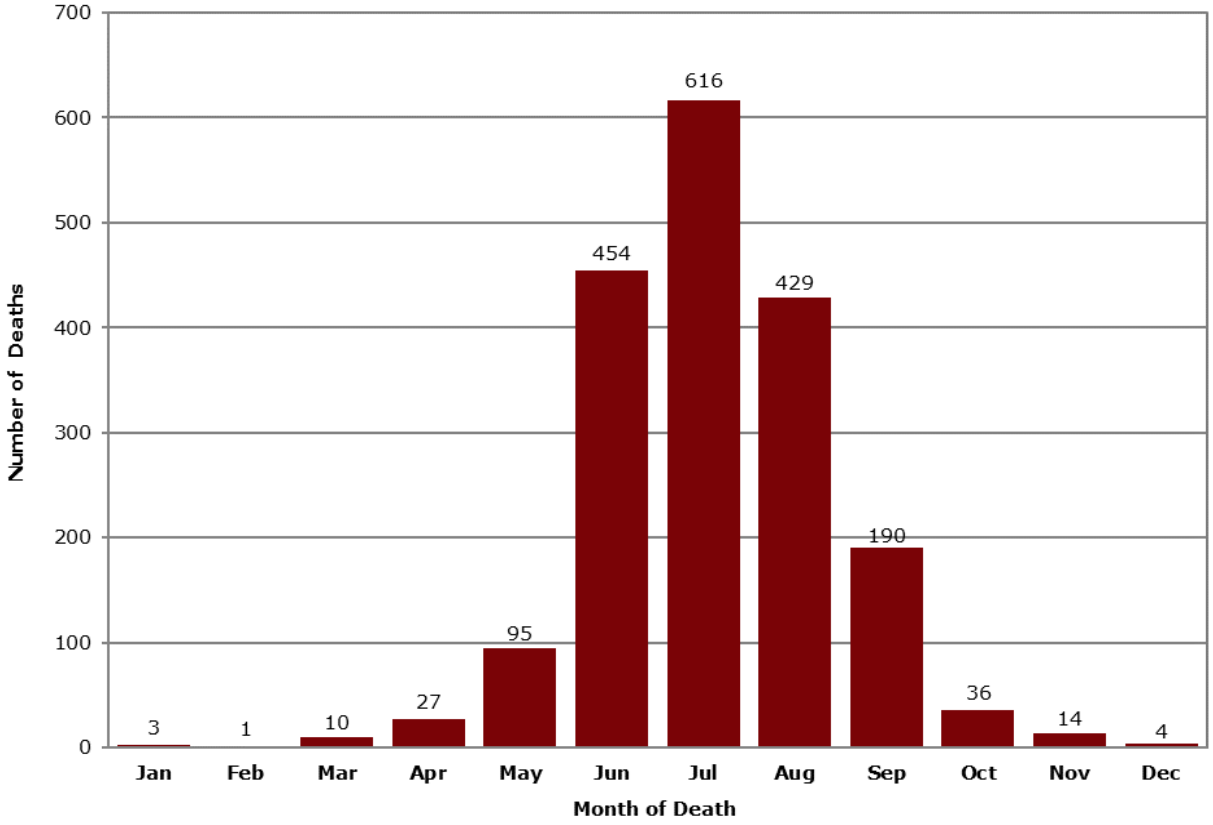
1 http://phoenix.about.com/cs/weather/a/weathertrivia_2.htm

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 (616) in 2012-2022, followed by June (454), then August (429), September (190), and May (95). In 2012-2022, 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, 2012-2022



* 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.

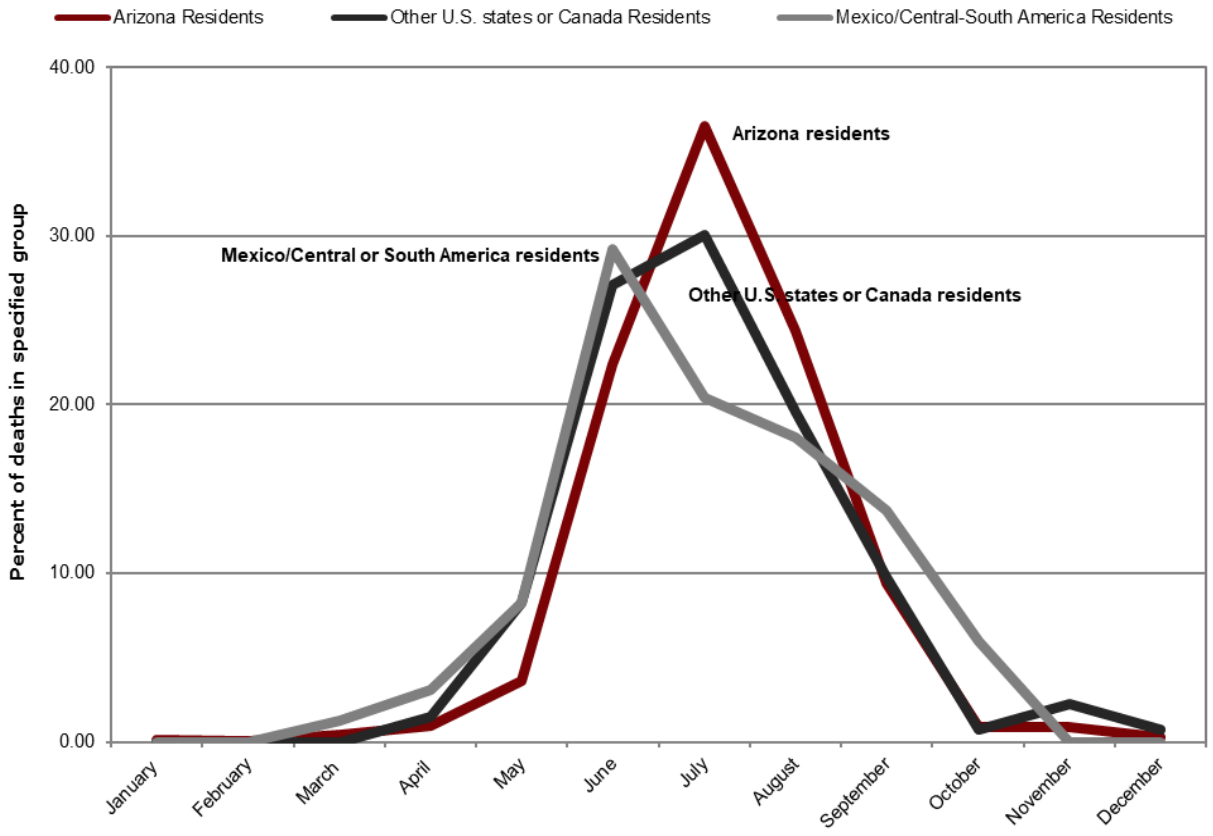
Excluded are deaths due to excessive heat of man-made origin.

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, 2012-2022



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 2012-2022 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.

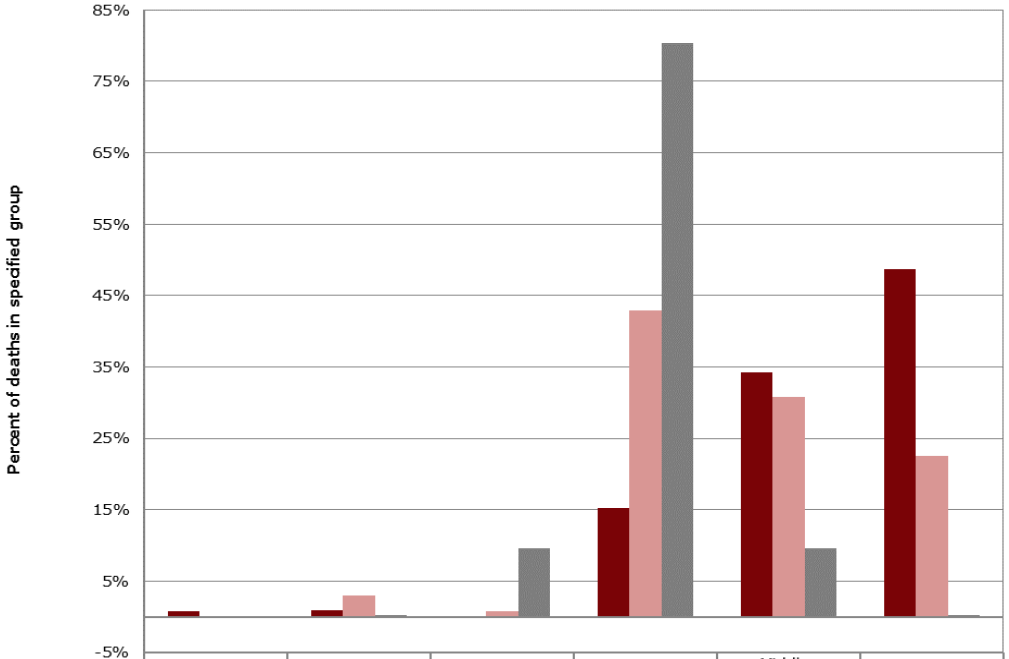
The difference in the seasonal pattern of mortality may mean that fewer migrants entered Arizona in July and August, the two summer months with the highest temperatures (**Table 2A**).

* 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 2012-2022, 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 2012-2022 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-nine 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.

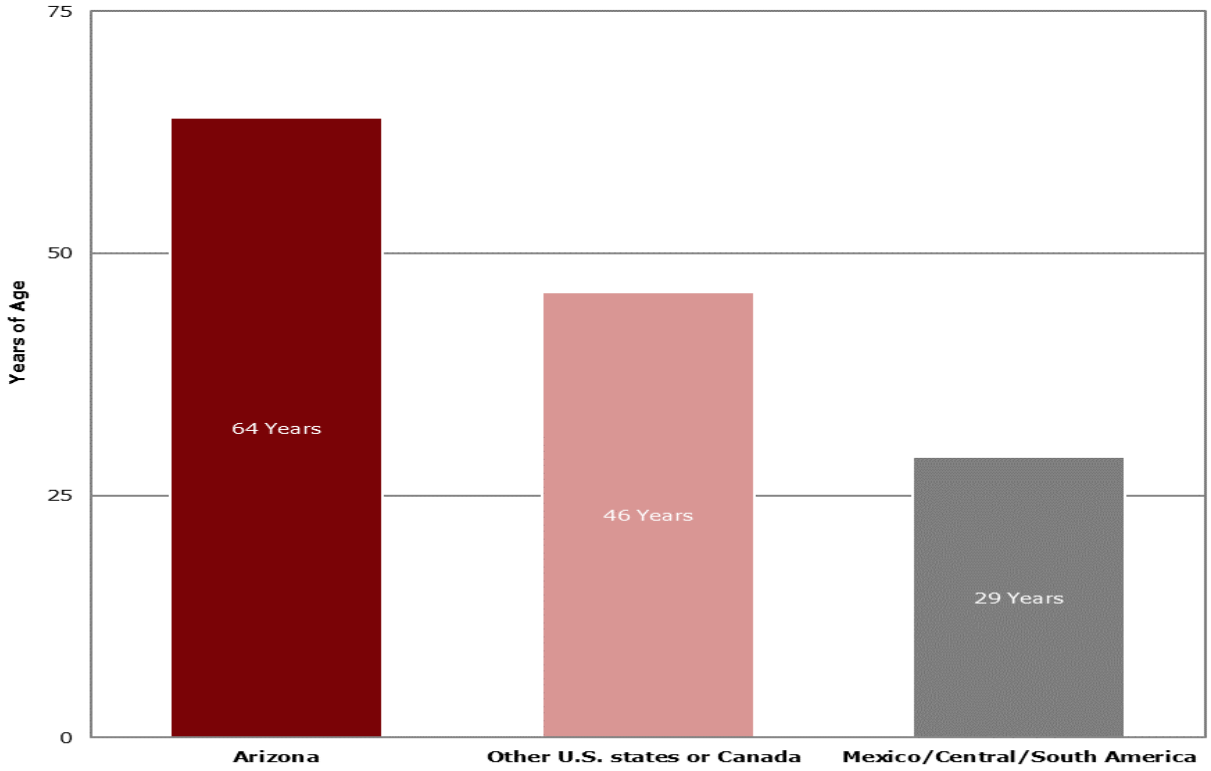
Figure 5A
Percent Distribution of Deaths from Exposure to Excessive Natural Heat* occurring in Arizona by Age Group and Residence Status, 2012-2022



	Infants <1	Children 1 - 14	Adoles-cents 15 - 19	Young Adults 20 - 44	Middle-Aged Adults 45 - 64	Elderly 65+
Arizona	0.73	0.97	0.08	15.18	34.25	48.62
Other U.S. states or Canada	0.00	3.01	0.75	42.86	30.83	22.56
Mexico/Central/South America	0.00	0.26	9.56	80.36	9.56	0.26

* 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, 2012-2022**



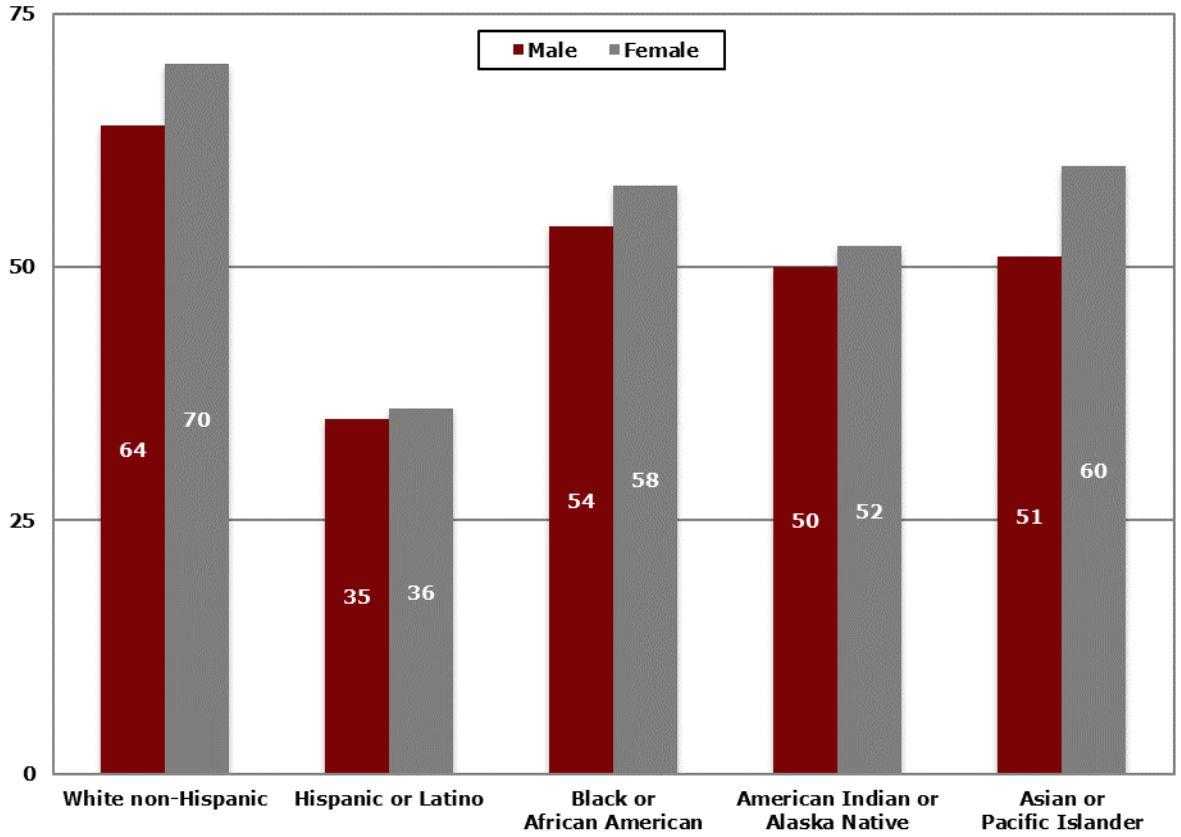
One out of two Arizonans who died from exposure to excessive natural heat in 2012-2022 was older than 64 years of age (**Figure 6A**, **Table 5A**).

In 2012-2022, on average visitors from other states were 18 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 35 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 2012-2022, White non-Hispanic females ranked highest with median age at death from exposure to excessive natural heat at 70 years, exceeding by 34.0 years the median age at death for Hispanic or Latino females (**Figure 7A, Table 6A**). Among males, White non-Hispanic males had the highest (64 years), and Hispanic males had the lowest (35 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, 2012-2022**



* 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, 2012-2022

		Total	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Total		1,879	97	103	48	83	146	132	129	160	313	309	359
State or Country of Residence	Arizona	1,232	53	56	32	42	98	105	92	117	206	190	241
	Other U.S. states or Canada	130†	12	8	*	6	9	9	8	9	21	29	18
	Mexico, Central or South America	387	23	26	8	27	28	12	22	18	56	85	82
	Other	10†	*	*	0	*	*	0	0	0	0	0	*
	Unknown	120†	8	12	*	6	8	6	7	16	30	*	13
Geographic Region of Occurrence[a]	Central	924	55	45	27	39	69	67	76	101	161	128	156
	Eastern	0	0	0	0	0	0	0	0	0	0	0	0
	Northern	300†	0	13	*	*	12	33	19	23	54	68	74
	Southern	629	41	45	18	39	60	32	34	34	95	110	121
	Western	20†	*	0	0	*	*	0	0	*	*	*	8
County of Occurrence	Apache	10†	0	*	0	0	0	0	*	0	0	*	*
	Cochise	40†	0	*	0	*	*	*	*	*	8	9	10
	Coconino	30†	0	*	*	*	0	8	*	*	*	*	*
	Gila	10†	0	*	0	0	*	*	*	*	*	0	*
	Graham	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	*	*	*	8
	Maricopa	814	50	35	21	32	64	59	68	88	143	115	139
	Mohave	260†	0	7	*	*	11	25	15	21	49	60	66
	Navajo	10†	0	0	0	0	*	0	0	0	*	*	*
	Pima	386	35	38	13	28	45	26	25	25	44	53	54
	Pinal	70†	*	*	*	*	*	*	*	12	11	8	12
	Santa Cruz	40†	0	*	*	*	*	0	*	0	7	12	8
	Yavapai	30†	*	*	*	*	*	*	*	0	*	*	*
	Yuma	170†	6	*	*	7	12	*	*	8	36	36	49
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	7
	20 - 24	110†	*	13	*	7	8	*	*	7	17	21	23
	25 - 29	120†	7	*	6	8	11	9	7	8	20	26	10
	30 - 34	110†	7	*	0	*	11	10	12	9	11	21	25
	35 - 39	130†	10	7	*	10	11	7	10	6	22	22	20
	40 - 44	110†	8	*	*	*	7	*	6	10	17	19	27
	45 - 49	110†	12	11	0	6	*	7	7	9	23	16	19
	50 - 54	140†	*	8	*	*	10	13	9	8	25	22	28
	55 - 59	150†	7	6	*	9	18	11	7	17	32	18	22
	60 - 64	150†	7	*	*	*	13	8	12	11	29	25	38
	65 - 69	140†	*	*	*	7	7	12	15	11	28	28	26
	70 - 74	150†	7	*	*	7	9	12	17	14	19	25	32
	75 - 79	150†	7	*	*	*	11	13	10	13	30	20	39
	80 - 84	110†	*	6	*	*	*	10	6	11	14	22	29
	85+	90†	*	6	*	*	12	7	*	14	14	16	13
	Unknown	40†	*	12	*	*	*	*	0	*	0	0	*

Table 1A (continued)

Characteristics of Deaths from Exposure to Excessive Natural Heat Occurring in Arizona by Year, 2012-2022

		Total	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Gender	Male	1,411	74	83	32	65	103	91	104	123	239	232	265
	Female	468	23	20	16	18	43	41	25	37	74	77	94
	Unknown	0	0	0	0	0	0	0	0	0	0	0	0
Race/Ethnicity	White non-Hispanic	951	46	48	28	44	81	77	70	74	152	151	180
	Hispanic or Latino	612	43	43	16	32	52	28	35	41	90	113	119
	Black or African American	100†	*	6	*	*	*	*	7	9	20	21	26
	American Indian or Alaska Native	100†	*	6	*	*	10	11	6	6	11	14	23
	Asian or Pacific Islander	20†	*	0	0	*	*	*	*	*	*	*	*
	Unknown	100	0	0	0	0	0	12	10	26	37	7	8
Month of Death	January	0†	0	0	0	0	0	0	0	*	0	0	*
	February	1	0	0	0	0	0	0	0	0	0	0	*
	March	10†	0	*	0	0	*	*	0	0	0	*	*
	April	30†	*	*	*	*	*	*	*	*	*	*	7
	May	100†	9	9	*	*	*	*	11	*	9	15	25
	June	454	24	30	12	32	52	49	16	20	30	101	88
	July	616	28	39	17	9	51	34	50	53	115	81	139
	August	429	26	14	7	34	26	22	28	53	122	56	41
	September	190†	6	6	*	*	8	9	20	19	26	41	47
	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	782	34	27	12	18	37	63	42	62	154	147	186
	Yes	1,097	63	76	36	65	109	69	87	98	159	162	173
	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, 2012-2022

		Total	State or Country of Residence				
			Arizona	Other U.S. states or Canada	Mexico, Central or South America	Other	Unknown
Total		1,879	1,232	130†	387	10†	120†
	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	*
	2022	360†	241	18	82	*	13
Geographic Region of Occurrence[a]	Central	920†	769	57	30	*	64
	Eastern	0	0	0	0	0	0
	Northern	300†	269	30	0	*	*
	Southern	629	177	41	357	7	47
	Western	20†	17	*	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†	*	*	37	0	*
	20 - 24	110†	16	*	86	*	*
	25 - 29	120†	32	6	75	*	*
	30 - 34	110†	38	16	52	*	*
	35 - 39	130†	58	17	51	*	*
	40 - 44	107	43	15	47	0	*
	45 - 49	110†	68	10	23	*	12
	50 - 54	140†	104	8	9	*	13
	55 - 59	150†	120	13	*	*	13
	60 - 64	150†	130	10	*	*	12
	65 - 69	140†	126	9	*	*	7
	70 - 74	151	139	7	0	0	*
	75 - 79	152	140	8	0	0	*
	80 - 84	110†	102	*	0	0	*
	85+	90†	92	*	0	0	*
	Unknown	40†	*	0	0	0	34

Table 2A (continued)
Characteristics of Arizona Deaths from Exposure to Excessive Natural Heat by Residence Status, 2012-2022

		Total	State or Country of Residence				
			Arizona	Other U.S. states or Canada	Mexico, Central or South America	Other	Unknown
Gender	Male	1,411	865	97	336	7	106
	Female	470†	367	36	51	*	9
	Unknown	0	0	0	0	0	0
Race/Ethnicity	White non-Hispanic	950†	819	77	*	*	50
	Hispanic or Latino	610†	176	37	383	*	11
	Black or African American	100†	84	8	*	0	*
	American Indian or Alaska Native	100†	92	*	*	0	*
	Asian or Pacific Islander	20†	12	*	0	*	0
	Unknown	100†	49	*	*	0	48
Month of Death	January	0†	*	0	0	0	*
	February	0†	*	0	0	0	0
	March	10†	*	0	*	0	0
	April	30†	12	*	12	0	*
	May	100†	45	11	32	*	*
	June	450†	276	36	113	*	25
	July	620†	450	40	79	*	45
	August	430†	300	26	70	*	32
	September	190†	116	13	53	*	6
	October	40†	11	*	23	0	*
	November	10†	11	*	0	0	0
	December	0†	*	*	0	0	0
	Unknown	0	0	0	0	0	0
Autopsy Performed	No	780†	627	42	81	*	28
	Yes	1,097	605	91	306	8	87
	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, 2012-2022

		Total	Geographic Region of Occurrence[a]				
			Central	Eastern	Northern	Southern	Western
Total		1,879	924	0	300†	629	20†
	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	*
	2022	359	156	0	74	121	8
State or Country of Residence	Arizona	1,232	769	0	269	177	17
	Other U.S. states or Canada	130†	57	0	30	41	*
	Mexico, Central or South America	387	30	0	0	357	0
	Other	10†	*	0	*	7	0
	Unknown	120†	64	0	*	47	*
County of Occurrence	Apache	7	0	0	7	0	0
	Cochise	36	0	0	0	36	0
	Coconino	30	0	0	30	0	0
	Gila	11	11	0	0	0	0
	Graham	0†	*	0	0	0	0
	Greenlee	0	0	0	0	0	0
	La Paz	23	0	0	0	0	23
	Maricopa	814	814	0	0	0	0
	Mohave	258	0	0	258	0	0
	Navajo	8	0	0	8	0	0
	Pima	386	0	0	0	386	0
	Pinal	70	70	0	0	0	0
	Santa Cruz	37	0	0	0	37	0
	Yavapai	25	25	0	0	0	0
	Yuma	170	0	0	0	170	0
Age Group	0 - 4	20†	11	0	*	*	0
	5 - 9	0†	*	0	0	*	0
	10 -14	10†	*	0	*	*	0
	15 - 19	40	7	0	0	33	0
	20 - 24	110†	25	0	*	82	0
	25 - 29	120†	36	0	*	76	*
	30 - 34	110†	44	0	*	62	0
	35 - 39	130	58	0	6	66	0
	40 - 44	110†	45	0	7	53	*
	45 - 49	110†	66	0	10	37	*
	50 - 54	140†	87	0	20	27	*
	55 - 59	150†	88	0	35	28	*
	60 - 64	150†	97	0	37	17	*
	65 - 69	140†	75	0	49	18	*
	70 - 74	150†	80	0	47	21	*
	75 - 79	152	78	0	41	27	6
	80 - 84	110†	54	0	28	25	*
	85+	90†	62	0	11	19	*
	Unknown	40†	*	0	0	31	0

Table 3A (continued)

Characteristics of Arizona Deaths from Exposure to Excessive Natural Heat by Region, 2012-2022

		Total	Geographic Region of Occurrence				
			Central	Eastern	Northern	Southern	Western
Gender	Male	1,411	668	0	216	509	18
	Female	470†	256	0	87	120	*
	Unknown	0	0	0	0	0	0
Race/Ethnicity	White non-Hispanic	951	542	0	225	168	16
	Hispanic or Latino	610†	158	0	22	431	*
	Black or African American	100†	87	0	*	*	*
	American Indian or Alaska Native	100†	56	0	32	7	*
	Asian or Pacific Islander	20†	16	0	*	*	0
	Unknown	100†	65	0	16	17	*
Month of Death	January	0†	0	0	*	*	0
	February	0†	0	0	*	0	0
	March	10†	*	0	*	*	0
	April	30†	7	0	*	15	*
	May	100†	34	0	7	53	*
	June	450†	187	0	76	187	*
	July	616	350	0	114	144	8
	August	429	221	0	65	136	7
	September	190†	92	0	28	68	*
	October	40†	16	0	*	19	0
	November	10†	9	0	*	*	0
	December	0†	*	0	*	0	0
	Unknown	0	0	0	0	0	0
Autopsy Performed	No	782	283	0	266	218	15
	Yes	1,097	641	0	37	411	8
	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, 2012-2022

		Total	Geographic Region of Occurrence[a]				
			Central	Eastern	Northern	Southern	Western
State or Country of Residence	Arizona	1232	769	0	269	177	17
	Other U.S. states or Canada	130†	57	0	30	41	*
	Mexico, Central or South America	387	30	0	0	357	0
	Other	10†	*	0	*	7	0
	Unknown	120†	64	0	*	47	*
Total		1,879	920†	0	300†	629	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, 2012-2022

		Geographic Region of Occurrence[a]				
		Central	**Eastern**	**Northern**	**Southern**	**Western**
State or Country of Residence	Arizona	61	0	68	69	74
	Other U.S. states or Canada	49	0	56	37	63
	Mexico, Central or South America	24	0	0	30	0
	Other	48	0	36	35	0
	Unknown	58	0	62	0	65

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, 2012-2022

Race/Ethnicity	Gender	Median Age at Death
White non-Hispanic	Male	64
	Female	70
	Total	**66**
Hispanic or Latino	Male	35
	Female	36
	Total	**35**
Black or African American	Male	54
	Female	58
	Total	**55**
American Indian or Alaska Native	Male	50
	Female	52
	Total	**51**
Asian or Pacific Islander	Male	51
	Female	60
	Total	**51**
Unknown	Male	64
	Female	63
	Total	**64**

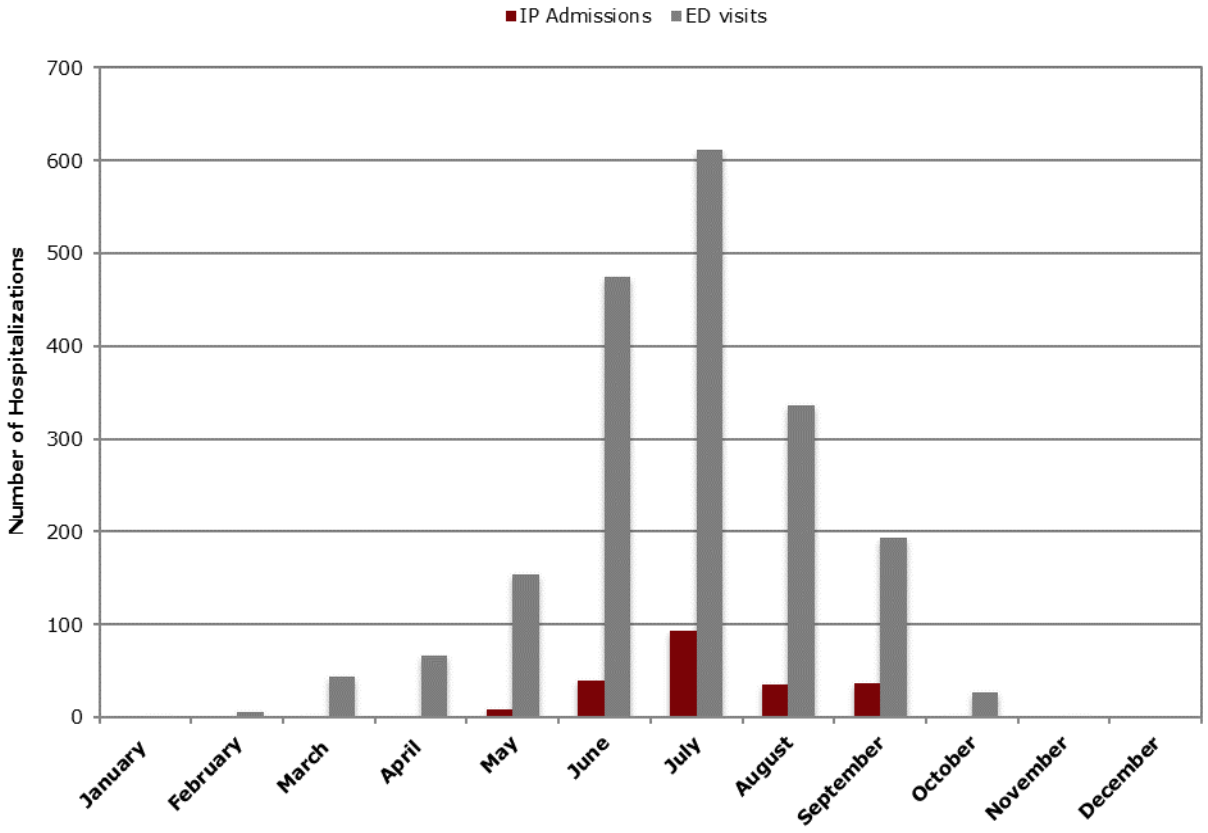
Section B: Heat-Related Morbidity, 2022

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.

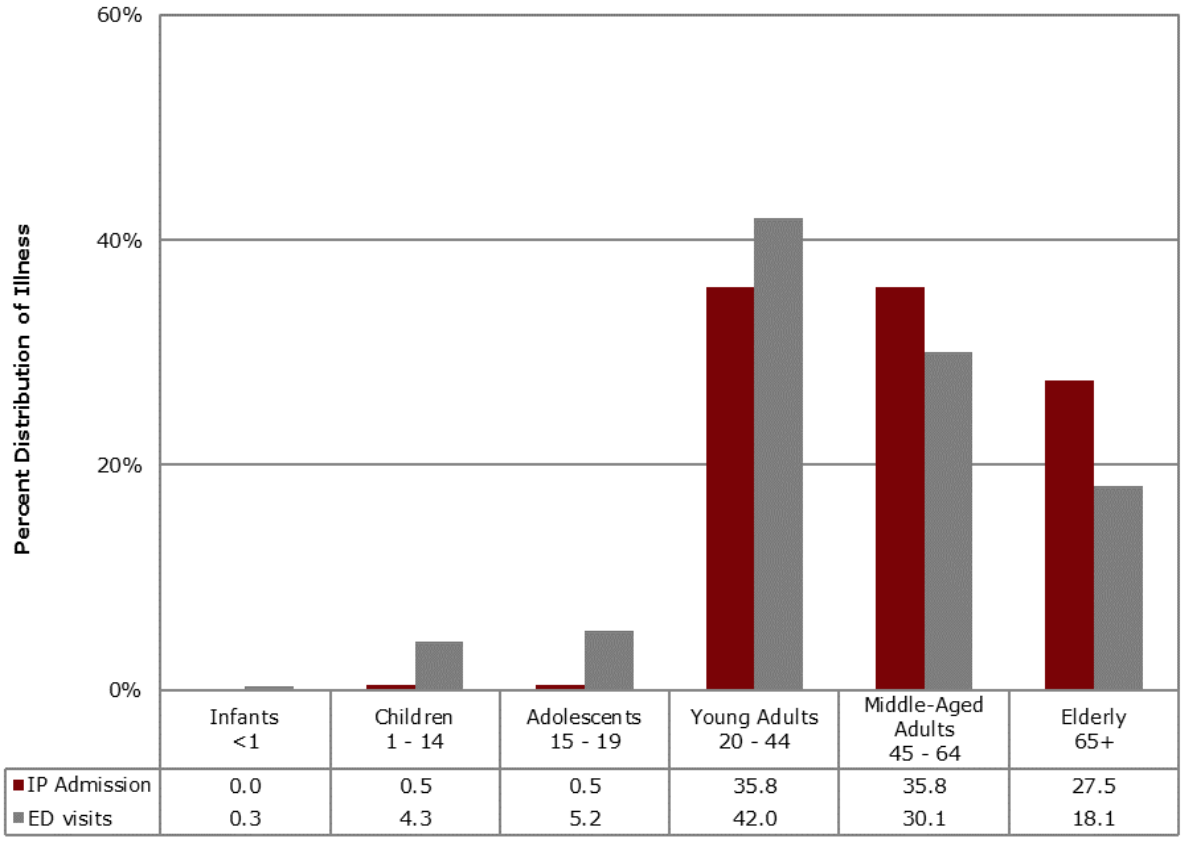
In 2022, the warm season between May and September accounted for 97.7 percent of hospitalizations and 92.3 percent of the total ED visits from exposure to excessive natural heat.

Figure 1B
Hospitalizations from Exposure to Excessive Natural Heat occuring in Arizona by Month, 2022



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, 2022



	Infants <1	Children 1 - 14	Adolescents 15 - 19	Young Adults 20 - 44	Middle-Aged Adults 45 - 64	Elderly 65+
IP Admission	0.0	0.5	0.5	35.8	35.8	27.5
ED visits	0.3	4.3	5.2	42.0	30.1	18.1

In 2022, 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 20-44 years old accounted for 35.8 percent of IP admissions and 42.0 percent of heat illness ED visits. On the other hand, middle aged and elderly accounted for only 48.2 percent of heat illness ED visits for exposure to excessive natural heat, but represent 63.3 percent of IP admissions (**Figure 2B**).

Approximately 4.3 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 5.2 percent of the total.

The median age at illness form exposure to excessive natural heat in 2022 was consistently higher among females for both IP admissions and ED visits. Gender differences with respect to age at illness tend to be larger for IP admissions compared to ED visits (**Figure 3B**). The median age of males visiting the emergency department for a heat illness was 6 years lower than the female median age at illness, but 23 years lower at time of admission for inpatient care. In 2022, 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, 2022

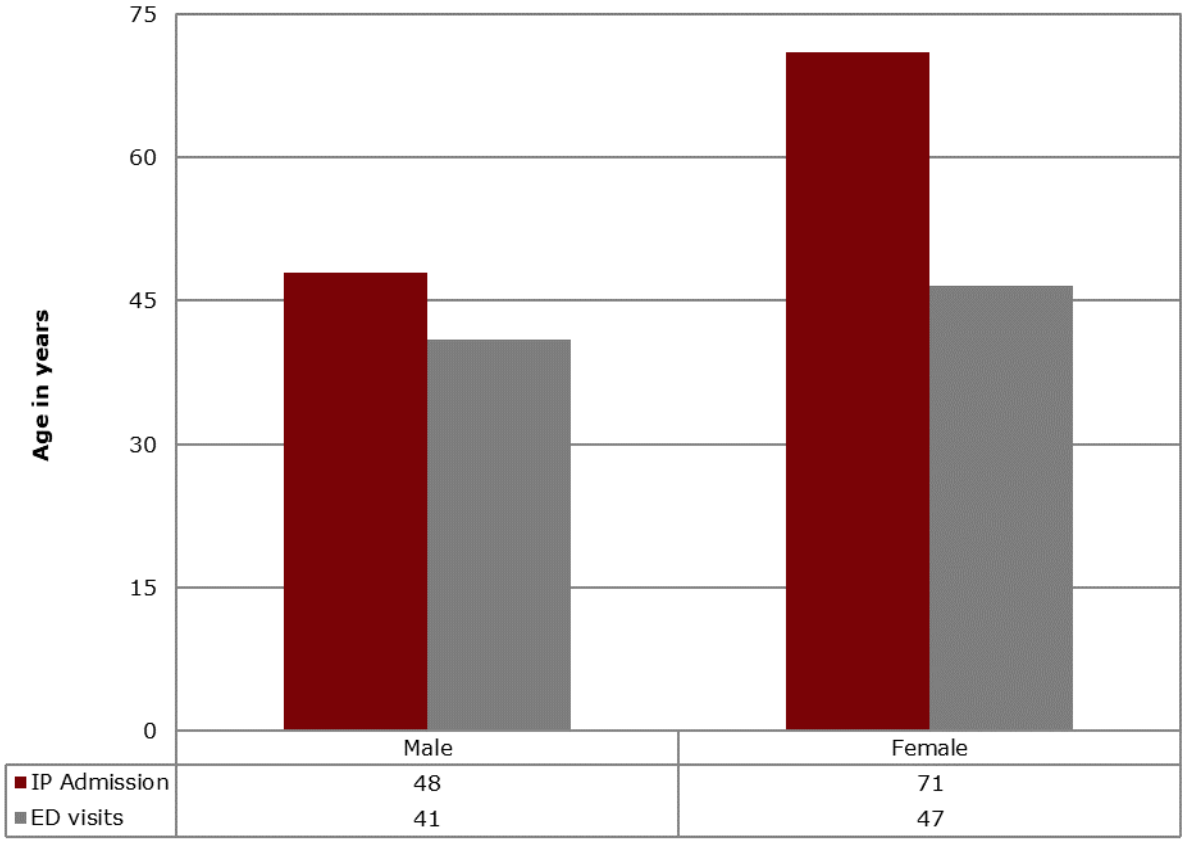
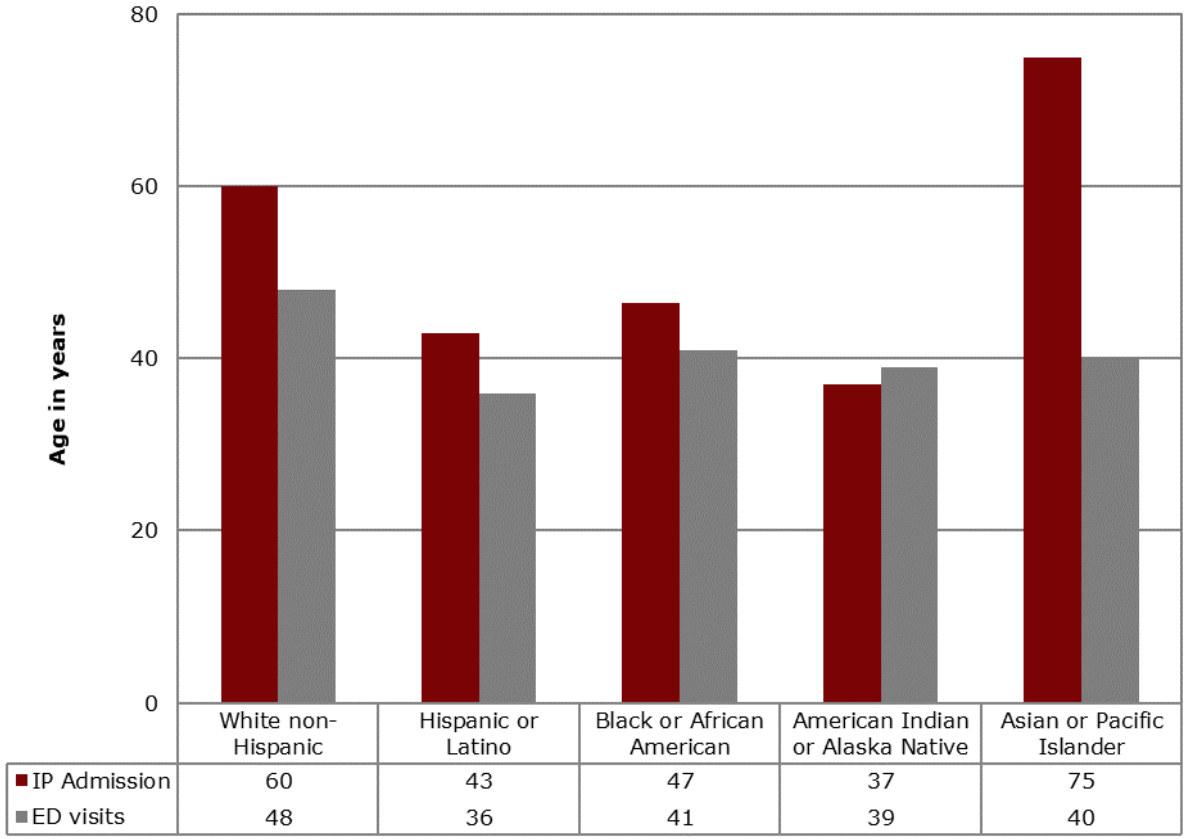


Figure 4B
Median Age at Illness from Exposure to Excessive Natural Heat by Race/Ethnic Group, 2022



	White non-Hispanic	Hispanic or Latino	Black or African American	American Indian or Alaska Native	Asian or Pacific Islander
IP Admission	60	43	47	37	75
ED visits	48	36	41	39	40

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 Islander, 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 48 years of age, the highest among all race/ethnic groups and the lowest being recorded among Hispanic or Latinos (36).

Table 1B

Inpatient stays and ED visits from Exposure to Excessive Natural Heat by Region and Demographic Characteristics, 2022

		Total	IP Admissions	ED Visits
Total		2,134	218	1,916
Geographic Region of Occurrence[a]	Central	1,394	147	1,247
	Eastern	0	0	0
	Northern	178	13	165
	Southern	344	50	294
	Western	29	0	29
	Unknown	189	8	181
County of Occurrence	Apache	0	0	0
	Cochise	30†	*	25
	Coconino	30†	*	26
	Gila	15	0	15
	Graham	6	0	6
	Greenlee	0	0	0
	La Paz	29	0	29
	Maricopa	1,183	139	1,044
	Mohave	139	12	127
	Navajo	12	0	12
	Pima	126	11	115
	Pinal	132	7	125
	Santa Cruz	0†	0	*
	Yavapai	60†	*	57
	Yuma	191	38	153
	Unknown	189	8	181
Age Group	0 - 4	20†	*	16
	5 - 9	30	0	30
	10 - 14	43	0	43
	15 - 19	100†	*	100
	20 - 24	174	12	162
	25 - 29	194	17	177
	30 - 34	185	22	163
	35 - 39	174	17	157
	40 - 44	155	10	145
	45 - 49	166	17	149
	50 - 54	166	16	150
	55 - 59	161	20	141
	60 - 64	161	25	136
	65 - 69	108	9	99
	70 - 74	103	23	80
	75 - 79	76	10	66
	80 - 84	55	8	47
	85+	65	10	55
	Unknown	0	0	0

Table 1B (continued)

Inpatient stays and ED visits from Exposure to Excessive Natural Heat by Region and Demographic Characteristics, 2022

		Total	IP Admissions	ED Visits
Gender	Male	1,461	161	1,300
	Female	673	57	616
Race/Ethnicity	White non-Hispanic	1,274	131	1,143
	Hispanic or Latino	523	59	464
	Black or African American	196	16	180
	American Indian or Alaska Native	96	9	87
	Asian or Pacific Islander	30†	*	28
	Unknown	14	0	14
Month of Occurrence	January	0†	0	*
	February	6	0	6
	March	50†	*	44
	April	70†	*	67
	May	162	8	154
	June	514	40	474
	July	704	93	611
	August	371	35	336
	September	231	37	194
	October	30†	*	27
	November	0†	0	*
	December	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 2B

Inpatient stays and ED visits from Exposure to Excessive Natural Heat by Region (Expanded) and Demographic Characteristics, 2022

		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		2,134	150†	0	10†	50†	0	8	1,247	0	165	290†	29	181
County of Occurrence	Apache	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cochise	30†	0	0	0	*	0	0	0	0	0	25	0	0
	Coconino	30†	0	0	*	0	0	0	0	0	26	0	0	0
	Gila	15	0	0	0	0	0	0	15	0	0	0	0	0
	Graham	6	0	0	0	0	0	0	6	0	0	0	0	0
	Greenlee	0	0	0	0	0	0	0	0	0	0	0	0	0
	La Paz	29	0	0	0	0	0	0	0	0	0	0	29	0
	Maricopa	1,183	139	0	0	0	0	0	1,044	0	0	0	0	0
	Mohave	139	0	0	12	0	0	0	0	0	127	0	0	0
	Navajo	12	0	0	0	0	0	0	0	0	12	0	0	0
	Pima	126	0	0	0	11	0	0	0	0	0	115	0	0
	Pinal	132	7	0	0	0	0	0	125	0	0	0	0	0
	Santa Cruz	0†	0	0	0	0	0	0	0	0	0	*	0	0
	Yavapai	60†	*	0	0	0	0	0	57	0	0	0	0	0
	Yuma	191	0	0	0	38	0	0	0	0	0	153	0	0
	Unknown	189	0	0	0	0	0	8	0	0	0	0	0	181
Age Group	0 - 4	20†	*	0	0	0	0	0	10	0	0	*	0	*
	5 - 9	30†	0	0	0	0	0	0	19	0	*	*	0	6
	10 - 14	40†	0	0	0	0	0	0	22	0	*	10	0	7
	15 - 19	100†	0	0	0	*	0	0	59	0	9	17	*	13
	20 - 24	170†	6	0	0	6	0	0	97	0	15	23	*	24
	25 - 29	190†	11	0	0	*	0	*	121	0	7	27	*	21
	30 - 34	190†	16	0	*	*	0	*	105	0	11	30	*	15
	35 - 39	170†	9	0	0	6	0	*	110	0	12	22	*	12
	40 - 44	160†	8	0	0	*	0	0	100	0	7	20	*	16
	45 - 49	170†	15	0	*	*	0	0	97	0	9	30	*	11
	50 - 54	170†	8	0	*	6	0	*	98	0	13	21	6	12
	55 - 59	160†	15	0	0	*	0	0	94	0	13	24	*	9
	60 - 64	160†	20	0	*	*	0	*	87	0	16	21	*	9
	65 - 69	110†	8	0	*	0	0	0	70	0	9	9	*	8
	70 - 74	100†	15	0	*	6	0	0	49	0	14	10	0	7
	75 - 79	80†	7	0	*	*	0	0	42	0	9	10	*	*
	80 - 84	60†	*	0	*	*	0	0	31	0	9	*	*	*
	85+	70†	*	0	*	*	0	*	36	0	*	12	*	*
	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, 2022

		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	1,461	111	0	8	34	0	8	857	0	103	196	24	120
	Female	670†	36	0	*	16	0	0	390	0	62	98	*	61
Race/ Ethnicity	White non-Hispanic	1,274	91	0	12	22	0	6	747	0	121	141	21	113
	Hispanic or Latino	520†	37	0	*	20	0	*	285	0	17	116	7	39
	Black or African American	200†	13	0	0	*	0	0	140	0	*	19	0	17
	American Indian or Alaska Native	100†	*	0	0	*	0	*	51	0	20	6	*	9
	Asian or Pacific Islander	30†	*	0	0	*	0	0	15	0	*	8	0	*
	Unknown	10†	0	0	0	0	0	0	9	0	0	*	0	*
Month of Illness	January	0†	0	0	0	0	0	0	0	0	0	*	0	0
	February	10†	0	0	0	0	0	0	*	0	0	0	*	*
	March	50†	*	0	0	0	0	0	30	0	*	7	0	*
	April	70†	*	0	0	0	0	0	45	0	*	12	*	*
	May	160†	*	0	*	*	0	*	87	0	16	36	*	14
	June	510†	29	0	*	8	0	*	300	0	49	79	*	43
	July	700†	65	0	*	20	0	*	421	0	44	69	9	68
	August	370†	19	0	*	15	0	0	221	0	33	48	8	26
	September	230†	26	0	6	*	0	0	121	0	14	36	*	18
	October	30†	0	0	0	*	0	*	16	0	*	6	*	*
	November	0†	0	0	0	0	0	0	*	0	0	0	0	0
	December	0	0	0	0	0	0	0	0	0	0	0	0	0

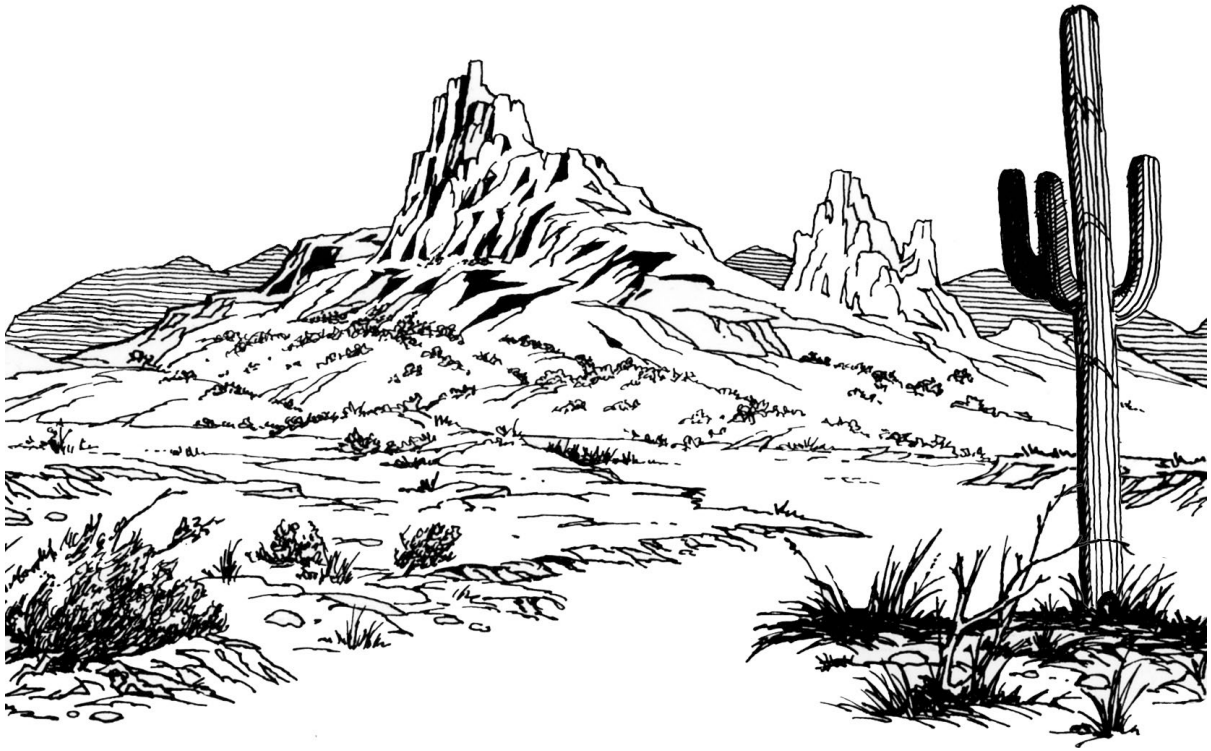
Notes: * Cell suppressed due to non-zero count less than 6; † Sum rounded to nearest tens unit due to non-zero addend less than 6; [a] Classification of geographic regions: Central = Gila, Graham, Maricopa, Pinal, and Yavapai; Eastern = Greenlee; Northern = Apache, Coconino, Mohave, and Navajo; Southern = 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, 2022

Race/Ethnicity	Gender	Median Age	
		IP Admissions	ED Visits
White non-Hispanic	Male	55	47
	Female	72	51
	Total	**60**	**48**
Hispanic or Latino	Male	41	36
	Female	58	37
	Total	**43**	**36**
Black or African American	Male	44	41
	Female	64	44
	Total	**47**	**41**
American Indian or Alaska Native	Male	36	39
	Female	38	38
	Total	**37**	**39**
Asian or Pacific Islander	Male	0	38
	Female	75	42
	Total	**75**	**40**
Refused/Unknown	Male	0	36
	Female	0	58
	Total	**0**	**36**

Note: Zero in a stratification means no case count to run median age.

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.



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